博士論文

Co-creative university partnerships for urban transformations towards sustainability:

Beyond the third mission through technology transfer

（サステイナビリティに向けた都市の転換のための

大学の共創的パートナーシップ：

技術移転を通じた第三のミッションを超えて）

トレンチャー　グレゴリー　パトリック

Gregory Patrick Trencher

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Abstract

Worsening sustainability challenges such as climate change, food, water and resource security, pollution, environmental degradation and interlinked socio-economic concerns are symptomatic of systematic failures. Unlike most historical market failures merely requiring ‘tinkering’ or ‘re-adjustment’, modern sustainability ailments require fundamental reconfiguration and transformations of societal systems. With humanity predominantly concentrated in urban centres, progress towards sustainability must begin here. Yet doing so requires collaboration across various societal sectors. The university is well placed to play a decisive role in cross-sector partnerships for this task. This is due to a capacity to generate technological and social innovation, link vast areas of societal expertise and activity, amass research funds and donations, in addition to a high level of societal trust from a non-profit status and commitment to the public good, and extensive portfolios of real estate assets in urban areas.

This potential to initiate, fund and direct cross-sector attempts to co-create urban sustainability is reflected by a worldwide flourishing of partnerships. However, despite this emerging co-creative capacity, emphasis on economic contributions through technology transfer to industry continues to dominate expectations on desirable forms of societal contribution for the university. A key ‘marketing’ instrument for propagating the technology transfer model is the idea of a ‘third mission’, alongside existing responsibilities of education and research. Although this model has proven successful in a handful of ‘entrepreneurial’ universities, its ability to drive societal transformations towards greater sustainability is yet to be demonstrated.

Although studies exist on both university partnerships for sustainability and conventional technology transfer practices, none so far have bridged and cross-examined these two forms of stakeholder collaboration. This is the first gap addressed by this study. The second is the absence of systematic comparisons across cases and a lack of robust analytical frameworks for understanding key characteristics and mechanisms of sustainability partnerships.

This study therefore aimed to examine the distinguishing features and mechanisms of co-creative university partnerships for urban transformations towards sustainability with special regard to the conventional technology transfer model. Specific objectives were to consider a large sample pool and generate global-level knowledge on defining features, in addition to commonly encountered drivers, barriers and potential impacts. In parallel, the study sought to generate a detailed understanding of the processes, mechanisms, impacts and challenges encountered by pioneering cases from contrasting institutions and socio-economic conditions. The scope of this study is on *university*-driven cross-sector partnerships for sustainability (either complete or ongoing) in urban or sub-urban areas within industrialised Europe, Asia and North America.

The research approach is empirical, employing both qualitative and quantitative methods. It includes a *macro*-dimension (global survey and statistical analysis) and a *micro*-dimension (two case studies). The macro-level analysis involved identifying 70 cases from around the world, together with collecting and integrating qualitative secondary data into an Excel database. Three analytical tools were created: 1) a framework for identifying key attributes such as sub-systems targeted, actors involved, geographic scope, triggers and mechanisms; 2) a second framework for identifying drivers, barriers and appraising impacts; and 3) a typology of partnership types.

These were then applied to the sample using primary data from quantitative and qualitative surveys, in addition to secondary evidence. The macro-level analysis consisted of a twin case study: the *2000 Watt Society Basel Pilot Region* by the ETH domain (Swiss Federal Institutes of Technology) and the *Oberlin Project* by Oberlin College in the US. These were conducted via document analysis and primary data obtained through fieldtrips and semi-structured interviews.

Macro-level research results indicate a global pre-occupation with the built environment and energy. However, partnerships typically seek to simultaneously transform multiple urban sub-systems, usually at the local or city scale. Common partners for co-creative university partnerships for sustainability are local government, together with strong contributions from civil society. This study shed light on mechanisms used to drive societal transformations towards urban sustainability; the most common being activities related to knowledge management and governance and planning. Overall, a bias towards techno-centric approaches was identified (especially in Asia) with a reluctance to pursue social innovation avenues. Results show that surveyed cases are demonstrating positive impacts in regards to environmental, social and sustainability dimensions, with significantly less confidence regarding economic aspects. Lastly, frequently cited barriers were human rather than technical and mostly related to internal partnership dynamics such as time restraints, lack of unity and harmony, and communication difficulties. Other key hampering factors related to funding availability, academic incentive structures and norms, and lastly, potential tensions between differing ‘worldviews’, priorities and timespans influencing operating cultures in local government and academia.

Micro-level case study results demonstrated the potential of the emerging co-creative model to cater for highly contrasting institutional characteristics, motivations, socio-economic conditions and societal needs. The 2000 Watt Society Basel Pilot Region illustrated a case unfolding in thriving socio-economic circumstances, led by a research-intense institution. This partnership aimed to implement the scientific vision of a ‘2000-watt society’ and trial emerging technologies for long-term sustainability targets in mobility and the built environment. It was driven principally by research and a technical approach, with key partners from local government and large industry. On the other hand, the Oberlin Project illustrated a case emerging in circumstances of severe socio-economic decline, from a liberal arts institution desiring to improve social and environmental conditions to ensure long-term competitiveness and resiliency towards climate change and sustainability challenges. Ambitions of spurring post-carbon economic regeneration required civil society engagement and a social innovation approach with real estate development.

A key finding in the cases was that socio-economic conditions and institutional motivations and characteristics strongly influence the model of co-creation. Two distinctive models of co-creation for urban sustainability were thus defined—one for *innovation* and the other for *regeneration.*

Co-creation for innovation would be expected to emerge from prosperous socio-economic conditions and research-intense universities strong in engineering. Objectives would be to drive urban sustainability through technical innovation, demonstrations and implementation projects with scientific value. Core partners would be industry and local government. Macro (and micro-level) research suggests that potential impacts of this model could include: integration of scientific knowledge into real-world implementation projects and long-term government planning; verification of both technical and social aspects of emerging technologies in ‘urban laboratories’;

and the creation and export of technical tools such as new technologies, decision making instruments and socio-technical systems for driving wider societal transformations. Other outcomes could include changes in industry practice via science-backed reform of governance frameworks, and the transfer of innovation to industry and local government—with or without patenting. Case study results suggest that strengths of this model would include the use of scientific research to measure sustainability, shape public policy and influence industry behaviour. Potential limitations could arise from incapacity to tackle lifestyles due to overwhelmingly technical approaches and absence of civil society actors. Other difficulties could include tensions when aligning long-term scientific research agendas with local government priorities on short-term implementation projects. This highlights the need for strategies to co-design projects in 'middle ground' to generate value for both academic and government actors.

On the other hand, co-creation for regeneration could be expected in declining socio-economic and built-environment settings. It could emerge from less research-intense institutions with priorities in improving social and environmental conditions and developing real estate assets in the neighbouring community. Objectives would be to drive socio-economic regeneration via sustainable development, with chiefly social innovation approaches and less emphasis on scientific research. Core partners would be diverse actors from civil society, together with local government. Case study (and micro-level) analyses suggest that potential impacts would encompass: advancement of human dimensions of sustainable development such as community engagement, capacity building and fostering of social entrepreneurship; the institutionalisation of sustainability into government policy; societal transformations or prototypes of new configurations of energy, transport, carbon finance and food systems and so on; with potential economic regeneration achieved via increased economic activity, reduced leakage (i.e. expenditures on imported energy, goods and services) and new low-carbon businesses and employment. Strengths of this model would include potential to generate widespread social engagement around sustainability due to a high civil sector involvement. Challenges would be encountered however in seeking to drive economic growth due to the complexity and time required for this task in a contracting economy.

The empirically demonstrated capacity to serve differing university profiles and motivations—whilst addressing highly distinctive societal needs and socio-economic circumstances—suggests vast potential applications for the emerging co-creative model. Further, with its ability to provide a framework to integrate and enhance various university functions such as research, education, outreach, technology transfer and real estate development, benefits of co-creative partnerships for both stakeholders and the university appear significant. This spectrum of possibility hence justifies the call for a re-interpretation of the third mission away from narrow conceptions of economic growth achieved predominantly through technology transfer. A reform of government policies regarding university appraisal systems and research funding selection is needed to foster the co-creative potential of the university to pursue a much broader form of societal development—one more aligned to the complex sustainability needs of human settlements in this century.

Contributions of this study are triple. Firstly, through a statistical analysis of 70 cases it has laid out theoretical and empirical foundations and the first 'bird's eye view' of an emerging global phenomenon that, until now, was examined case by case. New theoretical concepts were then elaborated via two case studies demonstrating the characteristics and potential impacts of emerging forms of co-creative collaboration with society. Secondly, by linking two separate bodies of literature, it has demonstrated the limitations of the dominating model of technology transfer vis-à-vis the challenge of urban sustainability. Conversely, it has empirically illustrated how the emerging co-creative model can address these limitations and function as a collaborative innovation platform for creating socio-economic, technological, environmental and political transformations towards sustainability. Lastly and most importantly, it has laid out a powerful way for diverse university actors to respond to the sustainability crisis and mounting pressures from governmental, international and scientific organisations to tie university functions to the needs of surrounding communities and regions.

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Although there is only one author behind this dissertation, it is in fact the product of innumerable, brilliant minds with which I have been fortunate enough to be surrounded with during my time at the University of Tokyo. To each and every one of you who has guided me in some way—whether by encouragement, advice or sharp criticism—know that I am extremely grateful. I will never forget this incredible academic and professional journey that I have been so fortunate to undertake under the guidance of you all.

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Dedication

To my precious wife Natsumi. Without your unbounded love, encouragement, faith and comfort, I could never have achieved this feat. You are by far the greatest gift and source of power that any researcher could have at their side.

I also dedicate this dissertation to the Earth—to Gaia. May ‘sustainability’ grow from an academic concept and buzz word to a new organising principle for humanity. May it become a means of reconciling the violent rift that has occurred between the spirit of creation, the Earth and the human enterprise.

If you want to go fast, go alone. If you want to go far, go together.
(African proverb)

We have to go far, quickly.
(Gore, 2009)

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List of Abbreviations

CPDP	(Clinton Foundation) Climate Positive Development Programme
ETH	Swiss Federal Institutes of Technology
GHG	Green House Gas (emissions)
FHNW	University of Applied Sciences and Arts Northwestern Switzerland
IPRs	Intellectual Property Rights
MIT	Massachusetts Institute of Technology
OECD	Organisation for Economic Co-operation and Development
US	United States of America

Chapter 1
Introduction

1.1 Background and problem statement

The core theme of 'co-creative partnerships for urban transformations towards sustainability' implies a merging of, what is for many, three separate social phenomena and areas of academic enquiry. That is, university partnerships with society, urban sustainability problems and university-industry collaboration through technology transfer. The relationship between these three tenets, along with the problem description that has motivated the production of this dissertation, is set out briefly below.

The global transition to a sustainable society will ultimately be the sum of a decentralised transformation process carried out by countless individual communities and regions across the planet. With human society predominantly concentrated in urban centres, the main arena for this transformation will be cities and towns. Sustainability ailments of the modern age have been described as uncertain, wicked, chronic, complex and messy (Brown et al., 2008; Rotmans and Loorbach, 2008, 2010; Yarime et al., 2012). That the grand sustainability challenges of our time—such as climate change, food, water and resource security, pollution, environmental degradation and the various related socio-economic concerns—are symptomatic of systematic failures. Most historical market failures concerned local regions and/or small groups of entities and thereby merely required 'tinkering' or 're-adjustment'. Addressing modern sustainability ailments, however, requires a fundamental re-configuration of that system, and therefore societal transformations. With the majority of humanity concentrated in urban centres, societal transformations toward sustainability must begin here. Yet the roots of sustainability problems cut across multiple areas of the complex and interwoven social, economic, political, environmental and technological fabric surrounding us. The solving of such problems therefore surpasses the resources or expertise of a single societal player or organisation. By default, addressing sustainability problems requires collaboration between various societal sectors (i.e. across academia, government, industry and civil society). Also, because of the uncertain, wicked, chronic, complex, messy—and above all *place-specific* nature—of sustainability problems, there are no universal and ready-to-go solutions. A core focus of cross-sector collaborations set up to tackle sustainability problems must be on initiating experimental approaches to new ways of organising interconnected social, economic, political, environmental and technological systems. In short, a key strategy for advancing the sustainably of urban settlements and associated sub-systems is the assemblage of multi-stakeholder partnerships. The purpose of such alliances is to combine knowledge and resources to experiment with emerging and novel approaches to societal challenges such as producing energy, reducing greenhouse gas emissions and increasing energy efficiency, stimulating post-carbon economic growth, reducing pollution, improving living conditions, the built environment and transport systems, and also, enhancing the capacity of urban centres to withstand 'shocks' such as extreme weather events or interruption to resource flows.

As a powerful generator of both technological and social innovation, along with an innate ability to bring together vast areas of expertise and activities across society, the university[1] could potentially play a central role in the type of cross-sector partnerships just described. As well as being pointed out by many scholars (Bardaglio, 2009; Evans and Karvonen, 2011; Konig, 2013; Molnar et al., 2011; Stephens et al., 2008, 2009; Whitmer et al. 2010; Yarime et al., 2012; Zilahy and Huisingh, 2009), this point may also be confirmed empirically. The growing faith in the power of partnerships to tackle place-based sustainability problems is testified by a flourishing around the world in recent years of university actor initiated partnerships assembled in the goal of co-creating societal, technological and environmental transformations in pursuit of materialising sustainable development in specific locations, regions or societal sub-sectors. Such partnerships (referred to as 'co-creative' in this dissertation) are usually characterised by broad collaborations of diverse actors (both expert and non-expert) from local or regional government, industry and civil society. They are also marked often by cross-discipline collaboration and the participation of non-academic actors in the university. Such alliances will often experiment with the merging of established and emerging societal engagement paradigms such as transdisciplinarity, participatory research, neighbourhood improvement through real estate development and economic development, living laboratories and service learning. Such partnerships are also characterised by an explicit commitment to sustainability values and often highly ambitious objectives. Such goals seem to be also influenced by the priorities and strengths of the institution concerned, and the socio-economic conditions and needs of the surrounding society. For this reason, in areas of post-industrial decline in Europe and the US several co-creative university partnerships have emerged in an attempt to combat deteriorating socio-economic conditions and increase environmental sustainability. Conversely, in other urban regions characterised by more prosperous socio-economic conditions, many partnerships have emerged in the goal of using the city as a 'laboratory' and experimenting with emerging low-carbon technologies. Asides from signalling a hopeful and even exciting development in the many functions of the modern university, the newness of this emerging phenomenon is also problematic. Such partnerships are not yet well understood by the literature, and they are in general not appreciated or encouraged by the more established and powerful nexus of forces that predominantly sees the co-creative potential of the university as a potential 'engine of economic growth' in an increasingly knowledge-driven global economy.

The more established model of societal collaboration through technology transfer to industry and government is an occurrence to have emerged from the US, greatly accelerating since the 1980 introduction of the Bayh-Dole Act. This model involves the assertion of intellectual property rights (IPRs) via patenting on academic inventions demonstrating prospects for commercial development. With such practices mainly taking place in the fields of biomedicine, pharmaceutics, biotechnology, IT and some fields of applied engineering, the targets of privatisation in this manner typically consist of early stage prototypes of drugs, medical devices, software packages and industrial materials. The 'transfer' of these potential market goods then takes place through collaborative R&D efforts between a narrow set of university researchers and experts from corporate or government research facilities. Most often, this will entail a relationship built upon the eventual licencing (in return for royalties) of the invention in question to that

[1] In this dissertation, the term 'university' is taken to indicate any certified bachelor awarding higher education institution, a term thereby encompassing many US colleges. That said, there is a distinct focus on the research university in this study.

enterprise, or alternatively, the creation of new company—a university 'spin-off' firm. Fuelled by ideologies of market-logic and success stories of 'entrepreneurial' institutions such as MIT and Stanford, the model of technology transfer has since been propagated around the globe through government and academic discourse.

If viewed as one of numerous avenues for the university to interact with society, the worldwide propagation of the above-described model of technology transfer does not appear particularly problematic. After all, both contributing to economic development and maximising the societal impact of fruits ensuing publicly financed research is an important function for the university. However, a two-fold problem has accompanied the rise of the technology transfer model in academia, especially in the US where technology transfer activities are most prevalent.

The first concerns impacts on university behaviour and traditional scientific conduct. It is argued by some scholars that the prospect of income is inciting some technology transfer programmes to seek higher-paying exclusive licence deals with a single player instead of licencing cheaply and widely in order to ensure maximal societal impact (Mowery, 2007; Mowery et al., 2004; Nelson, 2004; Rai and Eisenberg, 2002; Washburn, 2006). Other scholars have observed a breakdown of traditional scientific norms such as free sharing of data results and open collaboration (Heller and Eisenberg, 1998; Nelson, 2004). The changing of these norms, it is argued, has negative impacts on the economic logic and efficiency of the scientific system to contribute to the 'knowledge commons' upon which so much commercial and non-commercial scientific conduct depends. Concerns such as these have even prompted reactions from prestigious scientific institutions such as the Royal Society in the UK. In a report entitled *Keeping science open: the effects of intellectual property policy on the conduct of science* (Royal Society Working Group on Intellectual Property, 2003) an international team of industry and academic representatives demand freer access to scientific databases and journals and implored universities to "refrain from aggressively seeking so many patents" (Couzine, 2003). In the same year, another team of international scientists (many of whom were Nobel Prize laureates) wrote to the WIPO and cited open-innovation modes such as open-source software and Internet standards as proof that "one can achieve a high level of innovation in some areas of the modern economy without intellectual property protection" (Butler, 2003, p. 118). Such views continue to exist today, with rapid advances in smart phones and software innovation bringing to light many problems of the patent-based innovation model. For example, 2007 Nobel laureate in economics Eric Maskin argued in a recent letter to the editor in the New York Times in regards to software patenting that, "in an industry with highly sequential innovation, it may be better for society to scrap patents altogether than try to tighten them" (Maskin, 2012). On top of this, industry contempt for rising entrepreneurial behaviour and profit seeking from academic research results has also been observed by Mowery (2007), who argues that many US corporations are finding that the dominating model of intellectual property-based technology transfer can, contrary to expectations, *impede* and not facilitate collaboration and innovation.

The above summary of potential problems associated with the more established model of technology transfer presents but one side of the problem. The other comes into light when considering the complex nature of societal sustainability problems and the type of approaches required to address them. Global and local manifestations of diverse sustainability challenges such as climate change, food, water and energy security, ecological decline and decaying socio-economic conditions are threating the relevancy of pursuing economic development alone. The needs of human settlements in this century are situated at the intersection of social, environmental and economic interests. The required response to this sustainability crisis is a type of stakeholder collaboration that differs significantly from the dominating model of university-industry collaboration through technology transfer. As advocated by international scientific communities such as the field of sustainability science and the Future Earth initiative[2] (Future Earth, 2013), the academic response to the global sustainability crisis must involve 'co-design' and 'co-production' of scientific knowledge with external actors—inclusive of civil society and so-called 'non-experts'—it must be interdisciplinary, and above all, solutions and place-focused (Clark and Dickson, 2003; Komiyama and Takeuchi, 2006; Matson, 2009; Miller 2012; NRC, 1999; Spangenberg, 2011; Yarime et al., 2012).

More importantly, the adequate tackling of sustainability issues requires a holistic and value-laden paradigm fundamentally different to that driving the spread of entrepreneurial behaviour in academia. In such a context, the utility of corporate logic and the prevailing technology transfer model to serve as a *leitmotif* or guiding force for collaboratively achieving sustainable human development in the 21st century appears doubtful. The need for an alternative mission and 'social contract' (Gibbons, 1999) between academic science and society has never been greater. For a university seeking to apply its expertise and creative powers to the goal of creating societal transformations in view of advancing the sustainability of a specific community, city, region or societal sub-sector, clearly an alternative model of engagement with society is required. It is time to consider emerging patterns of stakeholder collaboration for sustainability moving beyond the dominating paradigm of university-collaboration through technology transfer.

[2] See section 7.4.6 for more details on the Future Earth initiative.

1.2 Research objectives

The uniqueness and originality of this research lies in its resolve to address multiple social occurrences and bodies of academic literature that, until now, have been largely treated by scholars in separation. The first is that of *technology transfer,* which is widely promoted in academia as a 'third mission' for the university (i.e. university-industry collaborations seeking to generate income and drive economic development through the identification and commercialisation of intellectual property arising from scientific research results). The second *sustainable urban transformations* (i.e. transformations of interlinked social, economic, environmental, technological and political systems to address complex sustainability problems such as, to mention but a few; climate change, resource security, degradation of the built and natural environmental, socio-economic decline and so on), with the final being *university partnerships with society*. The topic that builds a bridge across these areas of enquiry is the core subject of this dissertation: *co-creative university partnerships for urban transformations toward sustainability*.

This study is founded upon several assumptions that deserve pointing out in advance. These are:

- Co-creative university partnerships harbour the potential to significantly advance the sustainable transformation of a particular urban location, region or societal sub-sector.
- The dominating model of technology transfer (and its framing through the third mission) is largely unsuited for the type of collaborations required to drive societal transformations towards sustainability.
- The emerging co-creative sustainability model differs significantly to conventional technology transfer practices.
- Existing theoretical knowledge and frameworks are largely insufficient to grasp the characteristics, mechanisms and implications of the emerging university function of co-creation for sustainability.

These above assumptions are connected to two core motivations behind this study. The first is to lay the theoretical and empirical foundations for what appears to be an emerging area of academic study and societal attention. Specifically, theoretical areas of interest for the author included knowledge on the characteristics of co-creative university partnerships and the mechanisms by which they can contribute to societal transformations towards greater sustainability. Other desired areas of understanding were how the emerging co-creative sustainability model can address the limitations and problems in the dominating model of technology transfer. The second motivation was therefore a wish to propose a model of stakeholder collaboration and societal engagement that would be relevant to both the complex and interlinked environmental, social and economic (i.e. *sustainability*) challenges of humanity[3], in addition to the needs of the university. These motivations have in turn shaped the principal objective of this research, which is to:

[3] It should be pointed out that this study is predominantly concerned with the sustainability needs and university stakeholder collaboration models of industrialised nations in Europe, Asia and North America. However it is hoped that the implications of this model would be global.

Main objective: Examine the distinguishing features and mechanisms of co-creative university partnerships for urban transformations towards sustainability with special regard to the conventional technology transfer model.

From this principle goal stems three specific sub-objectives:

> **Sub-objective 1:** To determine from a global perspective key attributes, commonalities and differences characterising co-creative university partnerships for urban transformations towards sustainability.
>
> **Sub-objective 2:** To determine from a global perspective commonly encountered drivers and barriers, assessing overall effectiveness and impacts.
>
> **Sub-objective 3:** To build an in-depth, qualitative understanding on contrasting types of co-creative partnerships initiated by frontrunner institutions with a special regard to: motivating factors, stakeholder type and roles, partnership mechanisms, sustainability impacts attained, drivers and barriers encountered, and lastly, strengths and weakness of the approach.

In order to respond to these objectives and generate knowledge on co-creative partnerships for urban sustainability transformations in the most robust and rigorous fashion possible, this study exploits both quantitative (statistical analyses) and qualitative (descriptive case study) methods.

Based upon the personal motivations and research objectives outlined above, the ultimate goal of this study is to paint a way forward for the university to respond to changing societal needs and expectations. By the same token it is to ensure this institution's continued relevancy in a century where complex and rapidly worsening sustainability challenges are threatening the long-term wellbeing of humanity—and therefore the university itself.

1.3 Research questions

The core research objective and corresponding set of sub-objectives outlined in the previous section have given birth to the following set of specific research questions. The formulation of these has been driven by the gaps and limitations in the existing literature on university sustainability partnerships, which are covered briefly at the end of this section (and explored in detail in the literature review).

Sub-objective 1: To determine from a global perspective key attributes, commonalities and differences characterising co-creative university partnerships for urban transformations towards sustainability.

Specific research questions:

1.1 To what extent have co-creative partnerships for urban sustainability transformations emerged across academia?

1.2 From an overall global perspective, what are the most and least common:
- urban sub-systems targeted?
- geographical scales of target areas?
- internal and external partners and stakeholders involved?
- factors motivating the formation of partnerships?
- mechanisms used to achieve sustainable urban transformations?

1.3 What different types of co-creative partnerships for urban sustainability may be found around the world?

Sub-objective 2: To determine from a global perspective commonly encountered drivers and barriers, assessing overall effectiveness and impacts.

Specific research questions:

2.1 What are the most significant driving factors influencing co-creative partnerships for sustainability around the world?

2.2 What are the most commonly encountered barriers hampering co-creative partnerships for sustainability around the world?

2.2 From an overall global perspective, how effective are co-creative sustainability partnerships at achieving their objectives and contributing to economic, environmental, social and sustainable development?

Sub-objective 3: To build an in-depth, qualitative understanding on contrasting types of co-creative partnerships initiated by frontrunner institutions with a special regard to: motivating factors, stakeholder type and roles, partnership mechanisms, sustainability impacts attained, drivers and barriers encountered, and lastly, strengths and weakness of the approach.

Specific research questions:

3.1 What sort of socio-economic factors and institutional motivations influence the type of co-creation performed?

3.2 What are the processes by which the partnership emerged and developed?

3.3 What are the defining characteristics and mechanisms driving the partnership?

3.4 What sort of outcomes and progress towards urban sustainability transformations have been attained and how were these achieved?

3.5 What range of factors has contributed to successful development of the partnership and implementation of various projects?

3.6 What obstacles have been met and what measures were taken to overcome these?

3.7 What are the overall strengths and limitations of the approach of the partnership?

By conducting research to respond to the above questions, this study would hence address an array of limitations and gaps in the literature to date. For example, research questions connected to sub-objective one and two would address the overwhelming tendency of the literature (as pointed out by Karatzoglou 2011, 2013) to focus upon individual or small-*n* sets of university partnerships for sustainability, and hence miss the overall bigger picture of the global emergence of the co-creative sustainability model. By seeking to generate global-level theory based upon a large-*n* sample, this objective would also aim to address the existing scholarship's bias towards descriptive case studies, an inclination also identified by Stephens et al. (2009). By doing so, this study would thus create, to the best of the author's knowledge, the first large-*n* global sample and empirical analysis of specifically *university*-driven sustainability partnerships. This would therefore constitute one of the key contributions of this study.

The decision of sub-objective three (and related research questions) to focus on highly pioneering cases where the goal of bringing about the sustainable transformation of a particular area, city, region or societal sub-sector has been elevated to an institutional mission would address another set of deficiencies in the literature. That is, a failure to account for still emerging and highly novel and ambitious cases (which in this study will be represented by a twin case study on the *Oberlin Project* by Oberlin College and 2000 Watt Society Basel Pilot Region by the ETH domain) and also, illustrate the so far unexplored idea that forming partnerships to tackle place-based sustainability challenges and create societal transformations can actually constitute an institutional *mission*.

1.4 Overview of research methods

To address the above research objectives and questions, this study adopts an empirical approach employing both qualitative and quantitative methods. It consists of a *macro*-dimension (a statistical analysis of a 70-case global sample) in addition to a *micro*-dimension (two dual case studies). Consequently, this study has both a global and local scope. Methods employed by this dissertation are discussed in detail in Chapter 3. Yet a brief overview is as follows:

The macro-level analysis aims to build global level knowledge on the emerging phenomenon of co-creative university partnerships for urban transformations towards sustainability. With a specific focus on industrialised nations in Europe, Asia and North America, this is conducted firstly via the identification of 70 suitable cases and the collection of qualitative data. This has mostly been secondary and in the form of Internet and press documents, university and academic publications. Yet primary data was also collected from several cases through semi-structured interviews (details listed in Appendix 2). Data for each of these samples has been summarised in an Excel database (for which an abbreviated version can be found in Appendix 1). Secondly, a series of analytical tools was developed to aid the task of identifying key attributes, structures, mechanisms, in addition to assessing drivers barriers and performance of the 70 cases. These analytical tools were then applied to the sample using data sourced from two separate questionnaires (see Appendix 3 and Appendix 4). The macro-dimension of this study is thus completed via a statistical analysis of this survey data.

The macro-level dimension of this study consists of a twin case study. The aim of this is to compliment the micro-level and examine two contrasting models of co-creation for sustainability, thereby generating detailed, descriptive data. The two cases chosen to achieve this task are the *2000 Watt Society Basel Pilot Region* by the ETH domain (the Swiss Institutes of Technology) and the *Oberlin Project* by Oberlin College in the USA. The case analyses were conducted chiefly via analysis of secondary documents and the production of primary data collected during onsite visits and semi-structured interviews with various project leaders and key stakeholders.

By adopting simultaneously both a *macro*- and *micro*-level analysis with both quantitative and qualitative techniques, this study therefore aims to triangulate research results. This is to ensure more robust findings than could be generated from one perspective or method alone.

1.5 Societal relevance and contribution of this research

The societal relevance of this research is assured by its attempt to sketch a concrete solution to a growing problem plaguing human settlements in both industrialised and non-industrialised settings around the world. That is: *How can individual towns and cities be diverted from unsustainable development trajectories and transformed to a more environmentally, economically and socially desirable state?* As will become apparent throughout this dissertation, the author's answer to this question is cross-sector coalitions formed in the goal of combining knowledge and resources to experiment with emerging types of technical and social innovation and co-create societal transformations towards greater urban sustainability. By tackling such a socially cross-cutting theme, this study by consequence has relevance for the university just as much as it does for other societal sectors such industry, government and civil society.

This societal significance of this dissertation, however, is particularly salient for the university—and in particular the modern research university. This institution has been the target of sharp critiques from scholars all around the world in recent years with many calling for a new model of university and academic scholarship more aligned to the societal needs of this century. In particular, global level developments such as climate change and broader sustainability challenges have provided much ammunition to critics of the ivory tower. Despite its imperfections, as a single institution the academy boasts an almost 1000-year history. Yet many of the harshest criticisms concern attributes inherited from this long history. These include this institution's long-continuing commitment to stand alone academic disciplines and fragmented, specialised knowledge (Ford, 2002; Taylor, 2009), pursuit of new knowledge without adequate concern for local needs and application of this knowledge (Crow, 2010), and also, its historical tendency to study the problems of the world rather than taking measures to solve them (Clarke and Holiday, 2006). On top of this are a host of other concerns that the university, on the whole, has not responded to the global sustainability crisis as ambitiously as it could—and should (Ford, 2002; M'Gonigle and Starke, 2006). Calls from the international scientific community have been particularly strong. A grand re-invention project has emerged from within the scientific enterprise to re-structure and re-orientate academic research to better address the complex sustainability needs of the 21st century (Reid et al., 2010). Principles advocated include collaboration with diverse external stakeholders and the co-design and co-production of knowledge, the generation of concrete solutions for place-based or localised societal challenges, and interdisciplinary approaches cutting across natural sciences, engineering and the social sciences (Future Earth, 2013).

The value of this dissertation, therefore, is its proposal of a model of stakeholder collaboration that could potentially address many of the above-mentioned criticisms and calls for a new model of academic research. Not only this, as will also come to light throughout this study (particularly in Chapter 7) this study's avocation of the co-creation for sustainability model also harbours the potential to address many of the concerns that have accompanied the rise of entrepreneurial activity such as technology transfer in academia.

This study distinguishes itself from others dealing with similar topics such as technology transfer through university-industry collaboration or sustainability partnerships on a number of points. Firstly, it bridges several bodies of scholarship. It does so by examining the dominating model of university-industry collaboration through technology transfer from the perspective of sustainability and the type of stakeholder collaboration that is required to address the complex and inter-related environmental, societal and economic needs of urban areas in this century. Conversely, it considers the implications of the emerging co-creation for sustainability model from the perspective of conventional technology transfer practices and the idea of a 'third mission' for the university. With regard to the existing scholarship on university sustainability partnerships, this study attempts what other scholars have so far failed to do. That is, it employs both quantitative and qualitative methods to conduct a robust and global examination of the growing phenomenon of university initiated cross-sector collaborations aimed at generating societal transformations in a specific area or region towards greater sustainability. It thereby addresses the overwhelming presence of small-*n* size or individual case studies in the literature, which although highly insightful, are unable to generate a 'bird's eye' understanding of this new development in societal interactions from the university. Furthermore, another distinguishing feature of this study is its attempt to consider the significance of the global emergence of co-creative partnerships for sustainability from a socio-historical perspective, also with regard to the other so-called 'missions' of the university.

1.6 Clarification of key concepts

Co-creation for sustainability

This is used to indicate a function or process where the university "collaborates with diverse social actors to create societal transformations in the goal of materialising sustainable development in a specific location, region or societal sub-sector" (Trencher et al., 2013b). This term is also used as an adjective (i.e. *co-creative*) to signify cross-sector university partnerships of which the goal is that just described.

Cross-sector partnerships

A term used to depict strategic alliances between differing sectors of society (i.e. academia, government, industry and civil society). Such partnerships are typically formed in the goal of collectively responding to societal challenges and creating social transformations that could not be achieved with the knowledge or resources of a single societal sector or institution.

Sustainability

In this dissertation, this term is employed interchangeably with the concept of sustainable development in accord with a worldwide tendency observed by Morse (2010). Sustainability is used to indicate the simultaneous and holistic pursuit of environmental improvement or conservation, social progress and economic prosperity. In align with arguments of scholars such as Vos (2007), this concept is used not to signify a fixed state or destination. It is rather utilised in a normative sense to signify a continuous process of evolving towards a more desirable form of human conduct and resolving tensions between human and natural systems (Spangenberg, 2011).

Sustainable urban transformations

After McCormick et al. (2013), this refers to a process of attempting to trigger radical transformations of multiple and interlinked social systems in urban areas towards a more sustainable state. Such societal systems might include multiple dimensions of human settlements relating to the physical environment, economic, social, political, cultural and technological systems.

Technology transfer

This mainly refers to a process where results of scientific research are 'transferred' from the university to industry or government actors. This occurs firstly through the assertion of intellectual property rights (i.e. via patenting) over early stage academic inventions demonstrating potential for commercialisation. Research results are typically brought to the market via one of the following ways. They can be transferred to existing industry via the licencing of patents, or they can be commercialised directly by the university inventor through the creation of a university spin-off company. As argued by Etzkowitz (2002), the process of technology transfer is triggered by an entrepreneurial motivation to generate income for the inventor and the university, and also contribute to the wider goal of driving knowledge-based economic development.

Third mission

The third mission is a normative concept implying that the university has a 'third' responsibility to contribute to society in addition to its 'first mission' of education and 'second mission' of research. Like the term 'sustainability', the idea of a third mission is somewhat ambiguous, with differing interpretations in use (Kremarova, 2012). On one hand the third mission can signify civic and social functions of the university such as community development, service-learning, adult education, sharing of university facilities and consultancy and so on (Culum et al., 2013). Yet the dominating interpretation is that emphasising economic contributions to society such as technology transfer and university-industry collaboration. As a result, the global discourse on the third mission is dominated by discussions on technology transfer and the concept of an 'entrepreneurial university' (Laredo, 2007; Vorley and Nelles, 2008; Yusuf, 2007).

University

In this study 'university' refers to any bachelor awarding higher education institution; a definition also encompassing many US colleges. That said, this research chiefly addressed itself to institutions corresponding to research-intense universities (i.e. 'research universities') around the world.

1.7 Structure of this dissertation

The structure for this thesis has been summarised in Figure 1.1 below. However, it should be emphasised that the approach of this research is both exploratory and re-iterative. That is to say, the theoretical research shaped the empirical research, which in turn, also shaped the theoretical research. As such, Figure 1.1 should be interpreted as a simplification of the *structure* of this dissertation, and not so much the process, which was non-linear due to the re-iterative relationship of the theoretical and empirical research.

As can be seen in Figure 1.1, immediately following this introductory chapter is the theoretical component of this dissertation. A literature review will be conducted in Chapter 2 consisting of a sweeping and interdisciplinary analysis of a broad range of scholarship. In essence, it will deal with previous studies related to the following three core themes: 1) urban sustainability and sustainable urban transformations 2) cross-sector university partnerships for sustainability 3) technology transfer and related topics such as the ‘third mission’, the ‘entrepreneurial university’ and ‘triple-helix’ partnerships. This literature review will thus form a detailed background and problem statement for this dissertation and point out any gaps that this study will attempt to fill.

Chapter 3 will then propose the conceptual framework of ‘co-creation for sustainability’ through which cross-sector partnerships will be viewed for the remainder of this study. After expanding the discussion on the methodological considerations of this research such as research design, scope and methods, it will then propose three analytical tools. These are: 1) a typology based upon core partnership functions, 2) Analytical Framework [A] designed to determine key attributes and patterns in the global sample, and 3) Analytical Framework [B] to assess commonly encountered barriers, drivers and appraise the impacts attained by the global sample. These three tools will then be applied in Chapters 4, 5 and 6, which have in turn helped the construction of the analytical frameworks via a re-iterative process of creation, application and refinement. A more specific overview of the empirical research is as follows.

Chapter 4 will address the first sub-objective. After generating global-level statistical data pertaining to the temporal and geographical distribution of the 70 case sample pool, it will apply two analytical tools from Chapter 3 via results from quantitative surveys. The first is Analytical Framework [A] to detect and compare characteristics such as urban sub-systems targeted, geographical scales of target areas, type of actors and stakeholders involved, partnership triggers and finally, mechanisms used to pursue partnership objectives. It will then conduct a typology-based analysis using the second tool of the definition of four partnership types. This will then be followed by a plot-based analytical exercise to identify different kinds of co-creation for sustainability in the global sample.

Chapter 5 will then continue the global-level empirical analysis by focusing on commonly encountered drivers and barriers. It will do so via the application of Analytical Framework [B] with data obtained from both qualitative and quantitative surveys. In the latter half, it will conduct a statistical evaluation of the impacts attained by the 70 cases in regards to four evaluation areas: economic, social, environmental and sustainability.

Chapter 6 is then given to tackling the third sub-objective. It offers an analysis of two "extreme cases of heterogeneity" (Gerring, 2007, p. 51) to portray highly distinctive models of co-creation for sustainability. The first is the *2000 Watt Society Basel Pilot Region* by the ETH domain (the Swiss Institutes of Technology), chosen as an example of co-creation in the socio-economic context of *innovation, with the second being* the *Oberlin Project* by Oberlin College to illustrate co-creation in the socio-economic context of *regeneration.* Based upon the results of data gathered from secondary documents, field visits and semi-structured interviews, careful attention will be given to the process by which co-creative partnerships for urban sustainability transformations form, develop and prosper, in addition to qualitatively describing the mechanisms and impacts of the partnership.

Chapter 7 is then given to discussing the implications of this study. Tying together the results emerging from the previous theoretical and empirical chapters, it proposes the emerging model of co-creation for sustainability as a desirable form of stakeholder collaboration for the university from two motivations. The first is to address the problems and limitations of the dominating model of technology transfer. The second is to enable a broader form of societal engagement for the university that would take into account the complex and interlinked environmental, social and economic needs of human settlements in this century. After suggesting strategies to enhance the effectiveness of co-creative partnerships in the context of urban sustainability, it considers the way in which the function of co-creation for sustainability can enhance the first two missions of the university; namely education and research. This will lead to a proposal to re-interpret the notion of a third mission from narrow conceptions of economic development via technology transfer to a broader form of social development focused upon place-based sustainability needs. This chapter will then explore some of the policy and scientific implications of the emerging co-creative model, in addition to considering the ramifications of this still developing form of societal collaboration from the evolutionary and socio-historical perspective of the university.

Chapter 8 then concludes this dissertation by bringing together once more the key arguments of this dissertation. Its core message is that expectations regarding desirable forms of societal collaboration for the university need to move beyond narrow conceptions of economic development via predominantly technology transfer—which constitutes but one of many possible ways for the university to engage with external stakeholders and contribute to societal progress. With the worsening global sustainability crisis bringing into question the relevancy of promoting technology transfer and pursuing economic development alone, expectations and incentives for universities to assume a 'third mission' should instead seek to nurture the emerging co-creative potential of the university. That is, the pursuit of a much broader form of stakeholder engagement via cross-sector partnerships seeking to address local and regional challenges and co-create societal transformations towards greater sustainability.

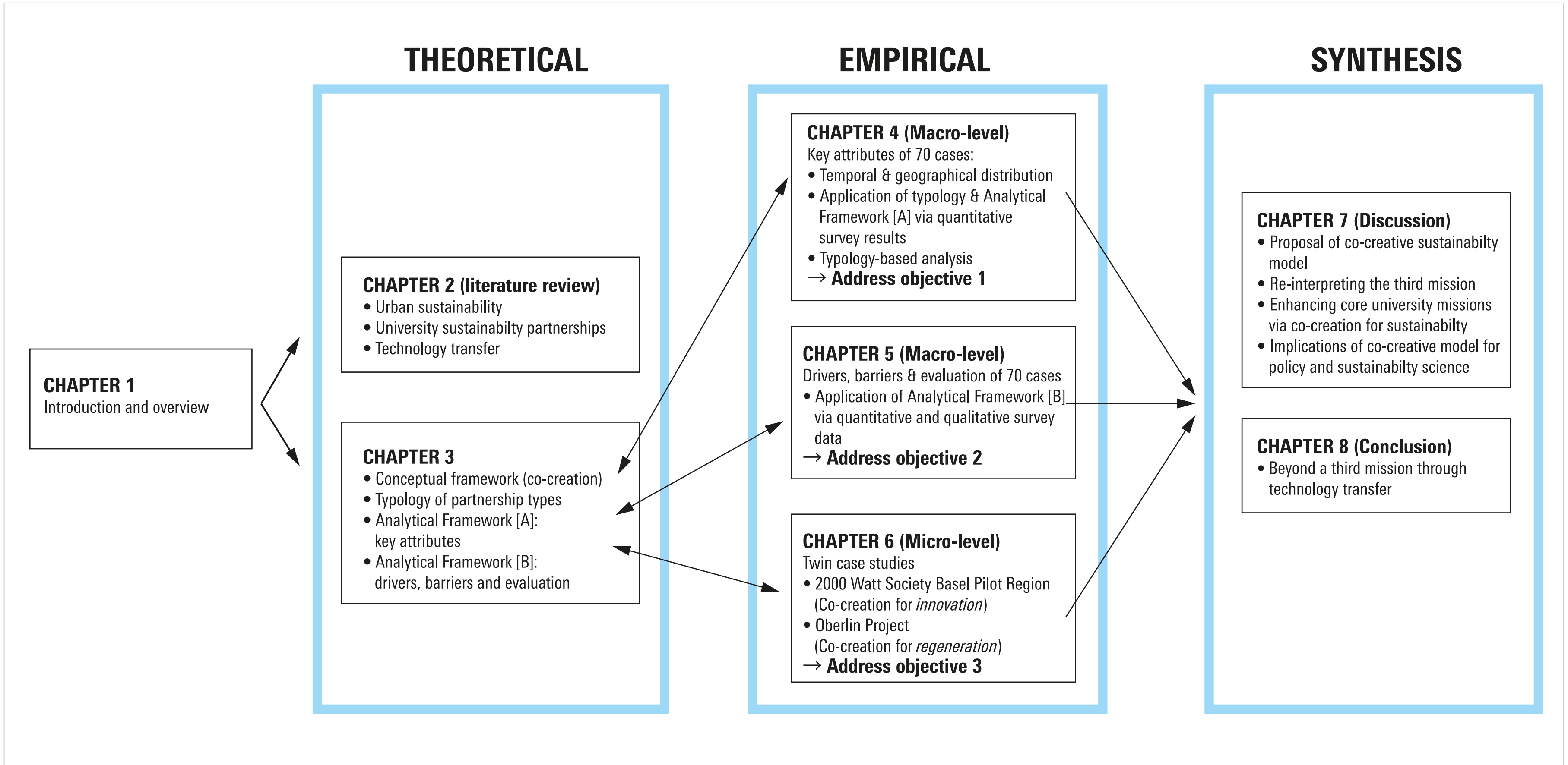

Figure 1.1 Structure of dissertation

Chapter 2
Theoretical research

Purpose: To provide the theoretical and conceptual foundations for this dissertation and position this research against existing literature from an array of fields.

This chapter consists of a literature review seeking to draw out key theory and analytical concepts from scientific literature, which essentially relate to the following three themes:

- Urban sustainability and sustainable urban transformations
- Cross-sector university partnerships for sustainable urban transformations
- Technology transfer and the 'third mission' for the university

Conducted within the context of sustainability science, important methodological principles informing this chapter are interdisciplinarity and holism. In the still emerging field of sustainability science it is believed that more relevant knowledge can be produced by broadly pursuing insights and knowledge from an array of disciplines and viewing phenomena holistically (Clarke and Dickson, 2003; Kates et al., 2001). Informed by this perspective, the author has conducted a broad and sweeping review of scholarship from a diverse array of topics including non-exhaustively:

- urban sustainability
- the global sustainability crisis
- sustainability science
- transitions theory
- history of the university
- university partnerships for sustainability
- university-led urban real estate development
- technology transfer and university-industry-government (triple helix) partnerships
- entrepreneurial universities and the third mission

Supplemented with empirical observations that will be greatly expanded from Chapter 4 onwards, this chapter thus summarises and extracts relevant theory and conceptual frameworks from the literature that are essential to understanding the university function of co-creation for sustainability—the unifying theme of this dissertation. This chapter will also identify gaps and shortfalls in the existing scholarship that this dissertation will seek to address.

2.1 Sustainable urban transformations

Through an extensive literature review, this sub-chapter will in effect link the three key themes of this dissertation: *urban sustainability, urban transformation* and *cross-sector partnerships*. Firstly, it will demonstrate the importance of urban areas as the key focus of a global shift to sustainability. It will offer a framework for summarising a broad array of literature pertaining to (urban) sustainability and connecting the global and local dimensions of the sustainability crisis. It will illustrate that a large degree of consensus exists in this scholarship regarding the particular attributes that a sustainable urban environment might take on and hence identify various principles of urban sustainability. Lastly, it will argue that symptoms of urban unsustainability are results of ‘system failures’ and that the integration of sustainability principles into urban development requires a radical re-structuring and transformation of the physical environment and social, economic and political processes. Due to the limited capacity of single institutions to bring about single-handedly such complex social transformations, the overall message of this sub-chapter is that urban sustainability transformations are more effectively achieved through small-scale experiments conducted between various social sectors such as academia, government, industry and civil society.

2.1.1 Urban areas and global sustainability

The potential for cities and urban areas to contribute to the global shift towards sustainability is extensively documented in the scientific literature and has been energetically expressed by scholars in an array of terms. Rotmans et al. (2000) consider cities as potential ‘motors’ for driving sustainable development, with others regarding them as critical ‘arenas’ (Bulkeley and Bestill, 2005) or ‘battlegrounds’ (Clarke, 2003) for tackling various sustainability issues. Others still regards them as ‘hubs’ for cutting edge innovation (Bulkeley and Castan Broto, 2012), ‘hotspots’ (Grimm et al., 2008) for driving environmental change at multiple scales, or as ‘leverage points’ (McCormick et al., 2013; WWF, 2010) for taking bold action on climate change and other sustainability issues on a local scale, with potential to affect wider changes. This potential for individual urban settlements to bring about their own transformation whilst also functioning as drivers of sustainability on a regional, national or even global stage encompasses a dual dimension of both *inevitability* and *desirability.*

To begin with the former perspective—i.e. the reason why it is *inevitable* that urban areas become key players in the global shift towards sustainability—many scholars point out that the majority of humanity is now concentrated in urban areas around the globe, with this trend forecast to continue well into mid-century (Grimm et al., 2008, Kamal-Chaoui and Robert, 2009; Newton and Bai, 2008). With human systems considered as an integral element of the planetary transition to sustainability, which must encompass both natural systems and social systems (Komiyama and Takeuchi, 2006), urban areas constitute a necessary part of the triple re-alignment of the major planetary systems. The climate crisis in particular is emphasised as signalling the inevitability of advancing the sustainability of urban centres around the globe, with dimensions of both mitigation and adaptation being relevant. From a mitigation perspective, the world’s cities are shown to be responsible for close to 80% of planetary GHG emissions (UN Habitat, 2011; WWF 2010). From the perspective of the US, Grimm et al. (2008) point out that the 20 dirtiest cities emit annually more carbon to the global atmosphere than the entire US landmass can sequester. For global society to successfully mitigate the climate crisis to a level that would allow continued flourishing of the human enterprise, decarbonisation of the world's cities must therefore constitute a core element of the response to climate change. From an adaptation perspective, the World Bank (2010) points out the vulnerability of urban centres, firstly for the reason that they are *immobile*. It is also documented that extreme weather event induced impacts on human society such as sea level rise (Nicholls et al., 2008), disruptions to water and energy supplies, public health and the economy from will be most devastating in urban areas. Essentially, this is due to a high concentration of population, infrastructure and industry in relation to rural areas (UN Habitat, 2011). Consequently, many cities and urban locations around the planet will be forced to bring about their own transformation purely for survival's sake. This will be necessitated by the phenomenon of sea level-rise in particular. It is now becoming increasingly clear that global warming induced sea rise over the next century and beyond will erase permanently large areas of coastal landmass off the world atlas, with rises of up to 1.6 metres (compared to 1900) forecast for this century (AMAP, 2011).

The second dimension addressed in the literature is that of *desirability*—i.e. the reason why it is desirable that development trajectories in urban settlements are shifted towards sustainability. Nevens et al. (2013) and Vergragt and Brown (2004) emphasise that it is cities and urban areas where the concentration of resource consumption, pollution and unsustainable activities is highest. Nowhere is this unsustainability more evident than in the ever-expanding Western city and suburban lifestyle, which has also become a concern for the Obama administration. Speaking at a workshop for the National Research Council of the National Academies, Adolfo Carrion, the Director of the US Office of Urban Affairs, lamented that:

> The United States is becoming more urbanized and the current trend is unsustainable. Our sprawl, the way we continue to spread over the land, the amount of pollution that we create, the inefficiencies that we support, how we have allowed development to take place, doesn't make sense any more (Schaffer and Vollmer, 2010, p. 7).

Grimm et al. (2008) consider urban areas as drivers of global environmental change, with land use, material demands and waste discharges all affecting climate, hydro and biogeochemical cycles at a planetary level. Although urban areas are responsible for less than 3% of the global terrestrial surface (Brown, 2001), they are responsible for close to 75% of global resource consumption (Madlener and Sunak, 2011) and 67% of primary energy demand (IEA, 2008). At the same time, they are the most significant emitters of GHGs, water and solid waste at a planetary scale (McCormick et al., 2013). The sustainable transformation of urban areas, by the sheer weight of their ecological footprint, is therefore a route that can secure the greatest sustainability gains for human society.

Other factors, too, signal the desirability of tackling the unsustainability of urban areas. Bulkeley and Bestill (2012) point out that individual cities possess the ability to act as leverage points for triggering sustainability gains at a larger scale. This potential to facilitate change can be exploited by their functioning as demonstration sites for an array of technical, social and policy experiments. As observed by McCormick et al. (2013), much of urban innovation is replicable. Technologies such as smart grids, district heating, waste water treatment and public transport networks, for example, are demonstrating that many solutions created and tested at the scale of individual cities may be transferred to other locations. Other attributes indicating the potential of cities to function as catalysts for change at a wider geographical scale include their cultural, economic and political influence (McCormick et al., 2013; Nevens et al., 2013). It is argued that city governments harbour a special ability to lobby to national governments after demonstrating the sustainability gains of certain technologies and policies at a smaller scale within their own jurisdiction (Bulkeley and Bestill, 2005). Furthermore, with public and private head offices, economic, industrial and intellectual resources of many nations overwhelmingly concentrated in cities in comparison to rural areas (McCormick et al., 2013; Nevens et al., 2013), urban zones are also well endowed with the necessary tools to bring about their own transformation.

Although action at all geographical scales (i.e. local, national and global) is required to address the sustainability crisis (Vergragt and Brown, 2004), the transformation of the world's urban areas is inevitably going to be a de-centralised process unfolding at the scale of individual communities, towns and cities. This is not to argue that cities should be regarded as individual entities. On the contrary, the worlds' cities must be considered more so as interconnected nodes in a complex web of planetary-scale trade, political and social networks (McCormick et al., 2013). However, with global and central government level regulatory frameworks so far proving largely incapable of mitigating global level sustainability threats such as climate change and loss of biodiversity (McCormick, 2013; Orr, 2013) it is becoming increasingly clear that the fate of each city around the world lies in its own hands. In reflection of this, programmes such as Local Agenda 21, ICLEI Local Governments for Sustainability, Transition Towns and the Clinton Foundation Climate Positive Development Programme have emerged in recent years. Overall, such alliances have mobilised thousands of individual urban centres into knowledge sharing and capacity building networks focused on the scale of individual municipalities and cities. As argued by McCormick et al. (2013), this shifting of emphasis to individual urban areas is being driven by increasing frustrations at the slow pace of national and global responses to the climate and sustainability crisis. On top of this, the logic of tackling global level issues at the local scale is also that cities and towns are the basic scale of policy measures (Nevens et al., 2013), with city municipalities being in the advantageous position of being able to translate and adapt national or international level sustainability agendas to local knowledge and conditions.

In summary, as demonstrated by the above discussion, there is a large degree of consensus in the scientific literature regarding the view that a large part of humanity's eventual transition to sustainability *will* and *must* take place at the scale of individual communities, towns and cities.

2.1.2 Framework for interpreting urban sustainability challenges

This sub-section will seek to summarise and connect the various urban sustainability problems dealt with in the literature. For this purpose it will analyse such challenges through a dual lens of the global level and local level, depicted below in Figure 2.1. As can be seen, the negative impacts of global sustainability issues are experienced on a local scale, where they are influenced by local-level drivers and micro conditions. The net result of these on-going and interconnected impacts is a weakening of local sustainability and resiliency.

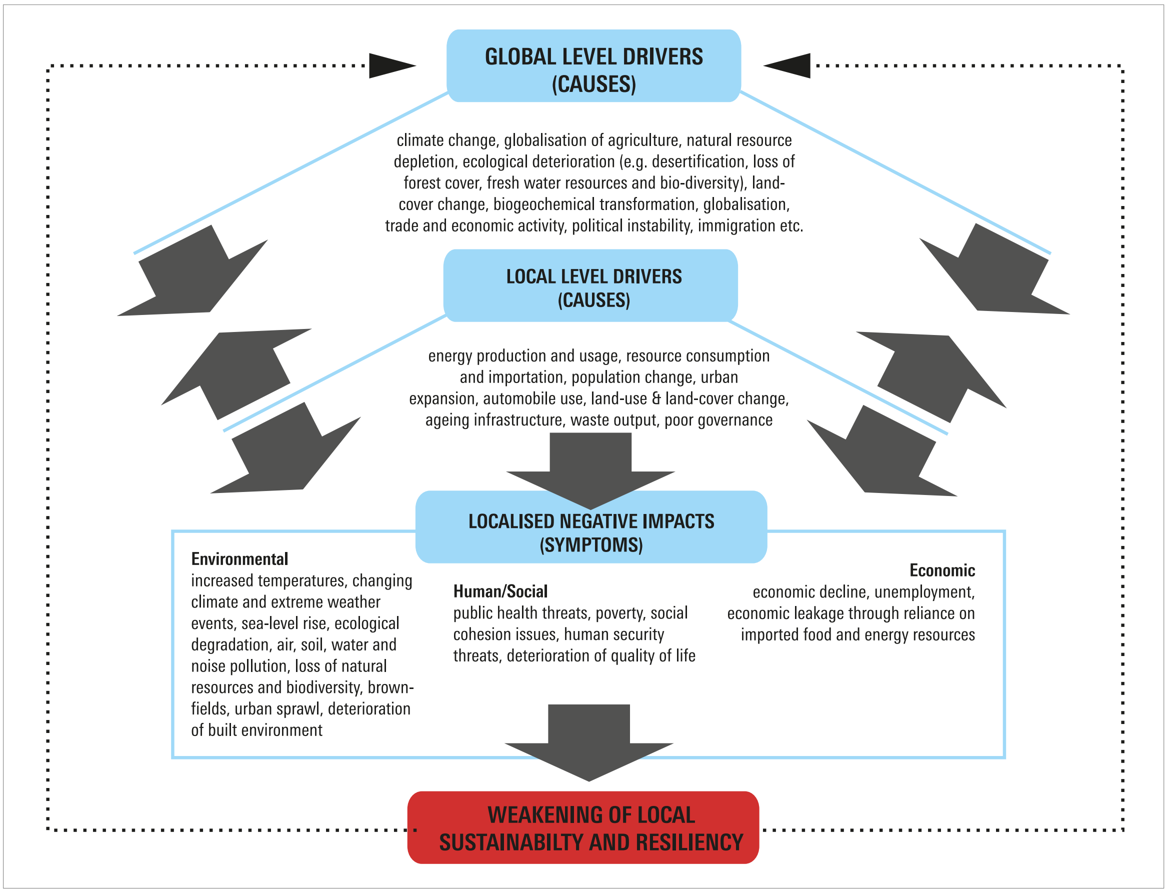

Figure 2.1 Framework for urban sustainability challenges (own source)

Regarding global level drivers (i.e. 'causes') of sustainability challenges, well documented phenomena in the literature include non-exhaustively: climate change and associated impacts such as temperature and sea-level rise and extreme weather events (Bulkeley & Castan Broto 2012, Grimm et al., 2008; McCormick et al., 2013; Rockstrom et al., 2009); degradation of resources or natural capital such as forest cover (Brown, 2011), bio-diversity (Grimm et al., 2008), ocean resources, fresh water reserves and desertification; land use change from expansion of city surface areas and agriculture (Grimm et al., 2008; Newton and Bai, 2008); biogeochemical transformations in the bio-sphere such as anthropogenic disruption to nitrogen and phosphorous cycles; chemical pollution (Grimm et al., 2008; Rockstrom et al., 2009); globalisation and trading of food and energy resources; globalisation of economic, political and social activities, and finally; political instability and immigration (Brown, 2011).

These macro-level drivers interact with local-level activities or drivers (i.e. 'causes') in individual urban regions such as: energy production and usage, economic activity, resource consumption and importation, changing population dynamics, expansion of urban spaces, construction of the built environment and infrastructure, outputs such as solid, liquid or atmospheric waste; and finally, governance and local lifestyles.

The top part of Figure 2.1 also depicts a dynamic interaction between the global and local level. This is because activities and drivers on the local scale must also be seen as major contributors to global level environmental change (Grimm et al., 2008). A good illustration of this is the phenomenon of increasing urban temperatures. Global level climate change is provoking higher average temperatures in many urban environments across the planet (IPCC, 2012). This trend is magnified by localised activities such as land-use change, which itself is a key driver of the heat island phenomenon. The cycle continues as the global phenomenon of climate change is further driven by the collective impact of localised activities such as fossil fuel usage and land-use and land-cover change Grimm et al. (2008).

The lower level of Figure 2.1 summarises an array of local-level negative impacts (i.e. 'symptoms') emerging as a result of the simultaneous influence of local and global drivers. This framework has interpreted such symptoms of unsustainability through the triple lens of *environment*, *human/social* and *economic* impacts. In the physical environment, localised impacts contributing to the weakening of the sustainability and resiliency of an urban area include: climate change effects such as increased temperatures, shifting climate patterns, extreme weather events and sea-level rise; degradation of ecological resources such as green areas and waterways; loss of plant and animal species; air, water, soil and noise pollution; urban sprawl; in addition to the ageing and deterioration of infrastructure and the built environment and manifestation of abandoned properties and brownfields. As for negative impacts emerging in human and social systems, these include threats to public health such as heat stroke and respiratory problems from air pollution, poverty, social cohesion problems and a general deterioration of quality of life. Finally, common sustainability challenges in the literature regarding economic aspects include: the decline of economic activity and income, unemployment and finally; leakage of wealth to external areas through reliance on imported food and energy resources.

The final note to be heeded by this framework is that the cumulative effect of these localised symptoms of unsustainability is a contribution to the weakening of planetary-level sustainability and resiliency. This view is based upon the observation from McCormick et al. (2013) who argue that cities should not be regarded as individual entities, but more so as nodes in a global network. This argument particularly applies to economic challenges, where a perfect illustration of the interconnectedness between localised and global dimensions is the ripple effects provoked by the 2010 Greek financial crisis and the 2008 sub-prime loan crash on Wall Street.

2.1.3 Principles of urban sustainability and resiliency

Just as there is a great degree of diversity in regards to the intensity and type of sustainability problems facing individual urban settlements, there are also many differing conceptions regarding what a sustainable city or urban environment should be. This is apparent from the flourishing in recent years of an array of terms and visions such as 'smart cities', 'green cities', 'compact cities', 'eco-cities', 'low-carbon cities' and 'sustainable cities', in addition to other paradigms for sustainable urban transformation such as 'Transition Towns', '2000-watt society', 'green growth' and the Japanese vision of a 'low-carbon society'. Despite this rich array of expressions, a set of common principles can be nevertheless be detected in the literature regarding the various properties of a sustainable and resilient urban settlement. Some of these are set out below:

- *Compactness and density*
  There is a great deal of consensus in the literature regarding the idea that compact and dense cities are more conducive to sustainable lifestyles (Bulkeley 2006; De Roo and Miller, 2001; Rees, 2003; UN Habitat, 2011; World Bank, 2010; WWF, 2010) and that efforts must be made to combat urban sprawl (Schaffer and Vollmer, 2010). This is

because higher population densities in urban environments are shown to lead to overall lower GHG emissions (UN Habitat, 2011; WWF, 2010). This is achieved by space-efficient and optimal use of infrastructure such as roads, electricity, heating, water and sewerage, which reduces the surface area required for infrastructure provision, thus lowering energy and economic costs per capita. (Rees, 2003). Furthermore, compact city design is increasingly seen as essential for fostering adaptation of alternative transport means such as walking, cycling and public transport. This is opposed to large, low-density cities which typically lead to increased reliance on automobile travel.

- *Renewable energy*
  In virtually all visions of a low-carbon and ecologically sustainable society, wide deployment of renewable energy sources is seen as a precondition for increasing resiliency and sustainability (Brown, 2011; Gore, 2009; Hopkins, 2009; Jochem, 2004; IPCC, 2011; NIES et al., 2008; Taipale, 2012; WWF, 2010). Common sources of renewable energy include solar, wind, biofuels, geothermal, hydro and ocean energy. To begin with an environmental perspective, renewable energy sources represent a powerful way of drastically slashing world GHG emissions. The Intergovernmental Panel on Climate Change (IPCC) predicts that with the right policies and investment, renewable energy could make up to nearly 80% of global energy supply by mid-century and contribute to around a 1/3 decrease in world GHG emissions (IPCC, 2011). Secondly, renewables are widely regarded as an essential means of boosting the resilience and economic vitality of urban settlements. This is because localised renewables have the potential to decentralise energy production (Taipale, 2012) and cut dependence on imported fossil fuels (Brown, 2011). It is widely believed that this can lead to greater energy security and combat economic leakage where a greater volume of funds remain in the local economy to generate employment (Hopkins, 2009).

- *Resource efficiency*
  Most scholars agree that highly efficient use of resources is crucial for attaining urban sustainability. The principle of efficiency concerns both energy as well as materials and resource consumption. To begin with energy, highly energy efficient building stocks (both residential and commercial), manufacturing and transport systems are widely seen as a pre-requisite for enhancing the sustainability of urban areas (Brown, 2011; Jochem, 2004; NIES et al., 2008; UN Habitat, 2011; World Bank, 2010). Efforts to increase energy efficiency involve both supply and demand side management. This focus on boosting energy efficiency is driven by the urgent global need to curb GHG emissions in response to the climate crisis. Yet moves to boost urban energy efficiency are also animated by the need to decrease reliance on limited fossil fuel reserves (Hopkins, 2009; Heinberg and Lerch, 2010; Jochem, 2004) and boost economic development by minimising unnecessary expenditures on energy.

  The other dimension of efficiency involves the closing of material flow loops and pursuit of more optimal resource use to minimalise waste and conserve natural capital. Urban sustainability is therefore perceived by many scholars through the lens of ‘urban ecology’ (Grimm et al., 2008) where material and energy flows and waste outputs are drastically minimised by mimicking nature and circulating resources from one industry or societal sector to another (NIES et al., 2008; Rees, 2003; Taipale, 2012). Concretely, this can involve recycling of energy (as in waste heat), building materials, water, and consumer and industrial waste.

- *Public transport and connectivity*
  Although it is widely envisioned that individual electric vehicles will be a key strategy in reducing urban GHG emissions, development and promotion of public transport systems such as metros, light-rail and taxi networks is widely regarded as another crucial factor for advancing urban sustainability (Kodukula, 2013; Rees, 2003; Schaffer and Vollmer, 2010; Taipale, 2012; World Bank, 2010). Fostering public transport usage also has the advantage of reducing air pollution and freeing up land space and costly infrastructure required to support automobile use.

- *Smart technologies*
  Much consensus exists regarding the critical role of technological innovation in advancing the sustainability of urban centres and increasing energy efficiency. Smart grids and Information Communication Technologies (ICT) are two areas where it is envisioned that substantial sustainability gains can be achieved through digitalisation of previously electromechanical and analogue services (Gore, 2009; Kamal-Chaoui and Roberts, 2009; Taipale, 2012; WWF, 2010). It is envisioned that smart grid technologies will drive energy efficiency by enhancing the distribution, storage and usage of electricity—particularly from renewable energy. ICT enabled smart grids and monitoring infrastructure such as smart meters and energy consumption sensors also have the potential to assist demand side management by rendering visible energy usage in buildings and homes (NIES et al., 2008).

- *Social innovation and engagement of lifestyles*
  In many visions of sustainable urban transformation, it is acknowledged that technology or 'hardware' alone cannot suffice to drive the major socio-economic changes required to avert the sustainability crisis (Morosini, 2010; Vergragt and Brown, 2008). The tackling of consumption and living patterns is therefore seen by many as an inevitable pathway for enhancing urban sustainability (Kamal-Chaoui and Roberts, 2009; McCormick et al., 2013). Some have even argued that sustainability in the West is not possible without the widespread promotion of lifestyles based on "sufficiency" and "abstinence from excessive consumption" (Notter et al., 2013, p. 419). To this end, it is widely recognised that social innovation and experimentation with novel social arrangements are essential means of creating more sustainable models of sustainable production and consumption.

- *Democratic and inclusive governance*
  It is widely acknowledged in the urban sustainability literature that there is no single, viable top-down solution to the sustainability crisis. It is instead agreed that a wealth of innovation and transformative efforts must emerge from the bottom-up, and inevitably at the local scale (Taipale, 2012; Vergragt and Brown, 2008; UN-Habitat, 2009). As local and regional governments take on more of an active role in local sustainability matters, open and inclusive planning and decision making and experimental forms of governance with a variety of stakeholders is increasingly seen as a precondition for kick-starting the

transformation of urban development trajectories toward greater sustainability (Evans, 2012; McCormick et al., 2013).

- *Increased local production*
  Another key strategy for boosting the sustainability and resiliency of urban settlements is that of increasing as much as possible local production and consumption—particularly in agriculture (Hopkins, 2009). With concerns mounting about the ability of modernised food production and distribution systems to withstand an oil-restrained world (Brown, 2011; Hopkins, 2009), the boosting of food security through localised food production is seen as a necessary means of increasing sustainability and resiliency, whilst reducing economic leakage and stimulating local economies.

- *Restoration of the natural environment*
  With the sustainability crisis being also an environmental crisis (Brown, 2011; Rockstrom et al., 2009), the restoration of natural ecosystems and the enhancement of eco-services in urban areas is widely regarded as a desirable means of enhancing urban sustainability (Birch and Wachter, 2008; Gore, 2009; NEIS et al., 2008). The creation or preservation of green areas is therefore another pre-requisite of urban sustainability. As well as mitigating heat island effects, urban green areas have the capacity to sequester carbon, improve air quality, contribute to bio-fuel production, assist with flood control and water treatment, and also, contribute to beautification and improvement of quality of life. In recent years however, there is a growing realisation concerning the importance of urban watersheds and their combined role with urban greenery. A multi-functional 'blue-green' paradigm has thus emerged that strives to simultaneously manage urban green areas and water resources to enhance eco-services and improve sustainability and resiliency (Miller, 2008).

From the above principles emerging from the author's analysis of the literature pertaining to urban sustainability, it is evident that many of the changes called for to advance the sustainability and resiliency of urban environments involve much more than 'tinkering' or 'fine-tuning'. On the contrary, the pursuit of sustainable urban development requires radical and simultaneous transformations across physical and technological infrastructure, political, social, economic and environmental structures and processes. Viewed in this light, sustainable urban transformation corresponds with the view of the IPCC, who points out that "transformation involves fundamental changes in the attributes of a system, including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biophysical systems (O'Brien et al., 2012, p. 441). It should also be underlined here that urban transformation in the aim of enhancing sustainability and resiliency should be seen as an ongoing process or state—and not a goal or end result (Schaffer and Vollmer, 2010). Furthermore, due to the diversity of localised conditions and sustainability challenges, it should also be recalled that the sustainable urban development and sustainable urban transformation are *relative* rather than absolute concepts (Curwell et al., 2005). This is despite the presence of a seemingly universal set of principles resulting from the above review of the literature, that have been summarised into Table 2.1 below.

Table 2.1 Principles of sustainable urban environments

Principle	Sustainability benefits
Compactness and density	Lower GHG emissions, more optimal use of infrastructure, reduces need for automobile replacements.
Renewable energy	Decreased GHG emissions, greater energy security, reduced economic leakage, ability to boost local economy and generate employment.
Resource efficiency	Decreased GHG emissions and waste outputs, economic gains from greater efficiency of material and energy resources.
Public transport and connectivity	Decreased GHG emissions and air pollution, freeing up of land space and costly automobile infrastructure.
Smart technologies	Increased energy efficiency and enhanced distribution, storage and usage of electricity.
Social innovation and engagement of lifestyles	Engagement of citizens and lifestyles, potential to create sustainable models of production and consumption.
Democratic and inclusive governance	Potential to enable bottom-up and innovative solutions optimised for local conditions whilst fostering widespread engagement to sustainability.
Local production	Boosting of food security, economic resilience and decreased economic leakage.
Restoration of the natural environment	Enhancement of eco-services such as carbon sequestration, air quality improvement, flood control and water treatment, contribution to bio-fuel production, beautification and improvement of quality of life.

2.1.4 Strategies for advancing sustainable urban transformations

Urban sustainability challenges such as those described earlier are often characterised in the literature as ‘persistent’ (Rotmans and Loorbach, 2008) ‘chronic’ (Rotmans and Loorbach, 2010) ‘wicked’ (Brown et al., 2008; Yarime et al., 2012) and ‘messy’ (Yarime et al., 2012). Sustainability ailments of the modern age are described in this way because they are on-going (with many worsening) and mostly unsolvable through conventional means. Rittel and Webber’s (1973) articulation of ‘wicked problems’ was to indicate complex socio-environmental issues and contrast these with ‘tame problems’, which on the other hand, can by solved by conventional modes of enquiry and decision making (Brown et al., 2008). Sustainability challenges are also described as ‘messy’ and ‘complex’. This is for the reason that their roots are deeply embedded in societal structures (Rotmans and Loorbach, 2008), cross-cutting across multiple areas of the complex social, economic, technological, political and cultural fabric surrounding us. Rotmans and Loorbach (2008) argue that chronic sustainability problems are symptomatic of *system failures,* which in contrast to market failures, cannot be solved via financial or policy mechanisms alone. The implication of this argument is that in order to combat such system failures, a re-configuration of that societal system is required. In other words, sustainably challenges must be tackled from their roots, and the only way that this can be achieved is by triggering a societal transition or transformation from an unsustainable to a more desirable state. Rotmans and Loorbach’s (2008) use of the term ‘societal system’ is all encompassing, referring to the simultaneous and comprehensive re-alignment of economic, cultural, technological, political and environmental systems to a more sustainable and harmonious configuration.

Regarding the need to tackle sustainability challenges through societal transformations, the problem is that no single actor or organisation possesses the overall knowledge or ability to achieve this singlehandedly (Kania and Kramer, 2011; Sehested, 2003). Collaboration between various societal sectors such as academia, government, industry and civil society is therefore widely regarded as a pre-requisite for bringing about the societal transformations required to materialise sustainable development (Clarke and Holiday, 2006; Hanleybrown et al., 2012; Schaffer and Vollmer, 2010; Talwar et al., 2011; Whitmer et al., 2010; Yarime et al., 2013). A superlative manifestation of the premise that "two heads are better than one", cross-sector or multi-stakeholder partnerships have emerged as the silver bullet in the battle against urban unsustainability. Their promotion across the globe appears to be driven by two converging factors. Firstly, faith in collaboration comes from the belief that, in the words of Kania and Kramer (2011, p. 38): "large-scale social change comes from better cross-sector coordination rather than from the isolated intervention of individual organisations" Secondly, expectations surrounding the power of cross-partnerships appear also to be fuelled by mounting frustrations and disillusionment regarding the incapacity of government institutions to singlehandedly solve society's sustainability dilemma (Hanleybrown et al., 2012; McCormick et al., 2013).

There is also a great deal of consensus surrounding the view that innovation and experimentation is crucial for generating the solutions to persistent sustainability challenges (Bai et al., 2010; Berkhout et al., 2010; Bulkely and Castan Broto, 2012; Evans and Karvonen, 2011, Konig and Evans, 2013; Schaffer and Vollmer, 2010). Such experimentation is required to break away from unsustainable norms and models and demonstrate the impacts of novel arrangements with a variety of various policy, technological, financial, governance and social innovation tools. With multi-actor learning and formalised knowledge production also stressed in order to ensure that lessons become transferrable to other locations and contexts, the idea of using cities as 'living laboratories' or 'test-beds' has become a recent subject of much scholarly interest (Bulkeley et al., 2011; Evans and Karvonen, 2011; Evans and Karvonen, forthcoming). The logic of this approach is that learning and experimentation with societal transformations for sustainability needs to start small, before solutions are up-scaled and transferred elsewhere. Geographical scales such as city-blocks, neighbourhoods or even entire small cities therefore constitute ideal demonstration sites for sustainability gains that can be achieved through cross-sector partnership driven societal interventions.

2.1.5 Summary

In wrapping up, this sub-chapter has demonstrated that it is in individual urban areas where the greatest sustainability gains can be potentially secured for human society. However, with complex and persistent urban sustainability problems being symptomatic of system failures, a re-configuring and transformation of physical environments and various technological, social, cultural, economic and political processes is required to enhance the sustainability and resiliency of urban settlements. Due to the enormous complexity of this task, small-scale experiments with novel practices from multiple societal sectors are increasingly seen as a key means of advancing local or regional sustainability. Furthermore, they also offer the potential to spur wider-scale change by firstly demonstrating the benefits of certain courses of action, and then acting as leverage points for the up-scaling and exportation of solutions to other areas and regions.

2.2 Cross-sector university partnerships for sustainability

The discussion will now shift to the core theme of this dissertation; cross-sector university partnerships for urban and sub-urban sustainability transformations. In essence, this sub-chapter will lay the theoretical foundations for the rest of this study. It will provide a sweeping overview of an emerging global trend where university actors are reaching across the confines of the campus to form experimental partnerships with external stakeholders to advance the sustainability of a particular location, region or societal sub-sector. By doing so, it will summarise key insights from the literature regarding the significance of the university's role in such collaborations, whilst pointing out gaps and shortfalls, that this research will later seek to address. It will then highlight the novelty and some key characteristics of this emerging function by providing a brief overview of several partnerships from around the world.

2.2.1 The emergence of a body of literature

The potential of the academy to play an active role in cross-sector sustainability partnerships and become a societal transformer has been recognised and advocated by international declarations and discourses, in addition to the academic literature. Regarding the former, Zilahy and Huisingh (2009) trace the emergence of an international consensus regarding the need for Higher Education Institution (HEI) involvement in 'regional sustainability initiatives' to the formation of international sustainability declarations such as the Talloires Declaration in 1990 and the Halifax Declaration in the following year. The Talloires Declaration came into fruition after 22 university leaders convened in Talloires France and agreed to a set of ten basic principles concerning sustainability and the role of universities and colleges. This action plan covers various institutional dimensions such as education, campus management, research and outreach. It urges universities around the world to collaborate with external stakeholders from government, industry and the civic sector to "assist in finding solutions to environmental problems" (AULSF, 1990), in addition to actively working across disciplines and raising sustainability awareness across all societal sectors. Today, the document has been ratified by over 350 university presidents and chancellors representing more than 40 countries. In a second declaration emerging the following year from Halifax in Canada, a similar course of action was advocated. HEIs around the world were again called upon to engage in public awareness raising for sustainability, as well as co-operating with each other and external stakeholders to pursue "practical capacity building and policy measures" to reverse those practices driving environmental degradation and North-South and inter-generational inequality (AUCC and LPIID, 1992). A final document covered by Zilhay and Huisingh (2009) is Agenda 21, of which several chapters bring attention to the university's special potential to contribute to the realising of sustainable development. For example, Chapters 31 and 35 (UNEP, 1992) highlight the need for science—thereby implying *academic* science—to work with government and policy makers to ensure that scientific understanding is embedded into policy to drive sustainable development.

In addition to such international declarations and action plans, the OECD has also brought attention to the special capacity of the university to assist in advancing sustainability at the regional level. For example, 2007 saw the publication of a study titled *Higher Education and Regions: Globally Competitive, Locally Engaged*, collating the experiences of 14 regions across

12 nations (OECD, 2007). This document highlights the ability of HEIs to pursue a wide development agenda encompassing not only economic development, but also social and environmental improvements at the regional level. Concretely, the following means are identified, all of which correspond to potential courses of action identified in the earlier mentioned international declarations:

- generation of human capital through educational programmes on sustainable development
- provision of expertise via consulting, research and demonstration
- mustering of regional experts and actors into the sustainability process
- demonstration of good practice via sustainable campus management
- provision of recognition and incentives for staff involved in sustainability leadership programmes in the wider community.

It should be emphasised here that the study fails to provide any detailed analysis on how exactly university actors can drive the 'sustainability process' mentioned in the third point, just as it does regarding the 'sustainability leadership programmes' mentioned in the last.

The unique potential of the university to play a leading role in cross-sector partnerships and drive the sustainable transformation of a particular urban location, region or societal sub-sector has emerged in recent years as a topic attracting the interest of many scholars around the world. The literature on this subject has evolved from a global discourse initially focused upon 'on-campus' sustainability initiatives (Mero, 2011). This momentum to 'green the ivory tower' (Creighton, 1998) has been normatively framed with terms such as a 'green campus' or a 'sustainable university' (Van Weenen, 2000; Velazquez et al., 2006). Key areas of interest to date have included calls to decrease the ecological footprint of higher education through environmentally responsible building design and campus management (Cortese, 2003) and the integration of Education for Sustainable Development (ESD) into the curriculum (Sterling, 2001, 2004; Tilbury et al., 2002). Interest in the latter subject, in particular, has been fuelled by the United Nations Decade of Education for Sustainable Development (DESD), which seeks to promote integration of sustainability in all sectors of education around the world for the period 2004-2014.

However in recent years scholars have began to extend their sights past the confines of campus boundaries. They have realised that as well as being part of the urban environment, the university also harbours the potential to become its transformer and creator. A consensus has emerged that the university possesses an enormous potential to co-ordinate or play an active role in cross-sector partnerships seeking to drive the sustainable transformation of the external communities, regions and socio-technical structures surrounding the university (Bardaglio, 2009; Clark and Holiday, 2006; Evans and Karvonen, 2011; Konig, 2013; Molnar et al., 2011; Stephens et al., 2008, 2009; Whitmer et al. 2010; Yarime et al., 2012; Zilahy and Huisingh, 2009). This transformative potential of the academy to facilitate change for sustainability in wider society has been captured in the literature through the term 'change agent' (Peer and Stoeglehner, 2013; Stephens et al., 2008). The literature abounds with descriptive examples of good practice on the myriad of ways in which academic actors around the world are collaborating with external stakeholders to work as change agents for urban sustainability. Some, for example, document partnerships where university and societal actors use the urban environment as a research site and test-bed for the creation of knowledge and various social or technical tools for sustainability transitions (Molnar et al., 2011; Evans and Karvonen, 2011). Efforts of this type may deal with an array of fields such as energy, buildings, water and transport and will target a scale ranging from a block or neighbourhood to that of the entire city. Tools and knowledge generated at this scale can then be passed onto to other industrial and government actors to carry out sustainability transformations on a wider scale. Some scholars (De Kraker et al., 2013; Valkering et al., 2013) describe a process of mutual learning where academic and societal actors engage in sustainability experiments on a local scale, yet seek to share the knowledge across a network expanding across a wider geographical area. Some scholars (Pothukuchi, 2011) document the unique ability of the university to create social value and increase resiliency by stimulating local food consumption and creating new urban food networks, whilst others (Evans and Karvonen, forthcoming) describe the ability of the university to transform the urban environment through real estate development of both its own and privately owned assets. Others still describe another process where university actors seek to influence local development trajectories by translating knowledge generated from sustainability experiments into policy (Evans, 2011; Evans and Karvonen, forthcoming), or alternatively, seek to aid government decision making via the creation of various decision making and visualisation tools for issues such as energy and transport planning (Peer and Stoeglehner, 2013).

2.2.2 The significance of the university's role

The above-mentioned scholarship consists of mainly *descriptive* (chiefly in the form of case analyses) but also *prescriptive* studies (Stephens et al., 2009; Karatzoglou, 2011; 2013). It thus provides important insight regarding the significance of the university presence in cross-sector partnerships and the special ability of this institution to function as a societal transformer.
The following discussion will summarise some of the important insights from the literature pertaining to this subject.

2.2.2.1 Status as a trusted non-profit institution

Key traits enhancing the capacity of the university to act as a change agent for sustainability in society concerns the special trust that accompanies their non-profit status (Bok, 2003), their longevity and stability as social institutions and their ability to address long-term and pressing societal challenges due to the culture of free-thinking that is encouraged in academia (Stephens et al., 2008). Regarding the special non-profit status of universities, the widespread expectation that universities conduct education and research activities for the greater public good means that knowledge and communications flowing out of universities are generally trusted as highly reliable and devoid of the biases and vested interests that often taint industry or government studies (Bok, 2003; Washburn, 2008). The level of societal trust afforded to academic knowledge and activities is therefore often higher than that received by other market, government and social players. This can therefore function as a powerful driving force for cross-sector partnerships seeking to challenge the status quo and transform socio-economic conditions and development trajectories towards greater sustainability.

2.2.2.2 Innovative power: the special culture of academic research

Cortese (2011) and M'Gonigle and Starke (2006) bring attention to the fact that the university is a powerful generator of social and technological innovation. Experimentation with new forms of technology, governance, infrastructure, policies, lifestyles and services is widely regarded as crucial for advancing sustainability (Calestous and Yarime, 2008; Evans and Karvonen, forthcoming; Vergrat and Brown, 2004). The special capacity of the university to function as a source of social and technological innovation for collaborative sustainability stems directly from the distinctiveness of academic science. University actors operate in a culture where risk taking and innovation is rewarded and encouraged. On the other hand, in other institutions such as government, for example, decision makers are often encouraged to confirm to and duplicate established patterns and procedures, with conservative bureaucratic culture tending to stifle innovation (Vigoda-Gadot et al., 2005). The modern university has long fought to nurture its ability to innovate and pursue risky or speculative paths of enquiry. This has been achieved largely from century old efforts to shelter basic scientific research from the utilitarian demands of government and industry—an ideal that can be traced back to the Humboldtian ideals behind the 1810 birth of the modern university in Berlin (Ford, 2002; Marginson, 2008). As observed by many scholars, university research has long played a crucial role in contributing to industrial innovation and economic growth (Mowery et al., 2004 Sampat, 2006). Washburn (2006) argues that this has only been possible because the university is generally protected from the need to pursue profit generation and immediately 'useful' research. In one sense, the role of academic research can be considered as covering a 'market failure' by addressing long-term and often socially sensitive agendas with little prospect for financial payoffs. As Washburn (2006) argues, no other market player (such as corporate research laboratories) is capable of undertaking research agendas purely for the public good in the absence of prospects for utility and commercial gains in the short-term. Furthermore, the corporate model of science is also restrained by the need for secrecy and protection of intellectual property. In the university, on the other hand, its special ability to innovate and maximise the societal impact of these results lies in the uniqueness of the academic science. In contrast to the closed, utilitarian-driven model of corporations, academic research is traditionally committed to open-collaboration and free sharing of data results, which is important to ensure maximal societal impact of academic knowledge. The special ability of university actors to contribute to collaborative efforts to advance urban sustainability via social and technical creativity is therefore largely the result of the uniqueness of academic science and culture in comparison to innovation models in industry and other public institutions.

2.2.2.3 Regional governance ability

The literature also highlights another innate ability of the university crucial for materialising sustainability development—its ability to assume the role of a societal 'linker' and 'governor'. Arbo and Benneworth (2007) argue that the university operates on many geographical scales, interacting with various regional, national and global networks. The university, as an integral part of local, national, and international knowledge sharing webs is therefore in an institution that, by default, is able to 'think globally and act locally'. Furthermore, their multi-faceted connections with stakeholders and diverse experts from government, industry, civil society and other academic institutions means that they have privileged access to a vast array of knowledge and expertise (Sedlacek, 2013). This means that universities are in a powerful position to act as 'hubs' in their communities (Dyer and Andrews, 2011). Firstly, they are innately capable of utilising such networks—or creating new ones—to promote and enhance cooperation and synergies between the activities of various societal actors and institutions, thereby acting as 'transdisciplinary agents' (Stephens et al. 2008). Their embedment in multi-scalar geographical networks means that they are able to act as 'gatekeepers' by facilitating access to the network for other parties (Zilahy and Huisingh, 2009) and also assume the role of a 'bridging organisation' (Clark and Holiday, 2006) as they function as an interface between science and society and feed knowledge into the network. This role as a linker also means that university actors have a special capacity to assume a key role at the regional level in multi-actor environmental governance (Evans and Karvonen, forthcoming; Sedlacek, 2013).

This ability to perform a governance role is also enhanced by the above-mentioned non-profit focus and longevity of universities, which boosts the level of trust afforded to university actors and knowledge. In conjunction with their positioning in multi-scalar transdisciplinary networks, university actors are able therefore to exploit this trust to act as mediators in the community. They are able to play a crucial role in building the collective consensus required to kick-start a collaborative transformation process towards sustainability. Concretely, they can bring together the required stakeholders, and by creating neutral discussion places, can play a key governance function by identifying and then resolving areas of tension and conflict, and locating areas of synergy and common interest. In this way, university actors are able to exert a special influence over community planning (Peers and Stoeglehner, 2013) and policy making (Evans and Karvonen, forthcoming) at the local and regional level of government.

2.2.2.4 Summary

As can be seen from the above discussion, the literature on university sustainability partnerships abounds with descriptions on the special capacity of the university to function as a societal transformer and play a central role in cross-sector attempts to advance urban sustainability. The combination of the above characteristics thus signifies that university actors have a clear potential to act as societal 'change agents' (Stephens et al., 2008) and enhance the transformative capacity of multi-actor alliances for sustainability.

2.2.3 Gaps in the literature

At this point, several deficiencies in the above literature deserve to be pointed out.

The first meriting attention is that the scholarship is dominated by empirical and descriptive studies, with an overall lack of robust frameworks to analyse the various dimensions and mechanisms of multi-stakeholder university collaborations for sustainability partnerships (Stephens et al, 2009). This argument corresponds with that of Karatzoglou (2011, 2013) whose critique of existing scholarship has revealed an overwhelming presence of 'best practices' with a lack of cohesion and solid theoretical underpinning. The various studies showcased above have provided valuable insight into the various roles by which academic actors can contribute to place-based collaborative initiatives for sustainability. However there appears to be a genuine need to collate this knowledge into a systematic analytical framework, just as much as there is a need to also utilise quantitative methods of analysis. The utility of such a framework could then be boosted if it was verified and applied empirically to multiple case studies in order to generate statistical data that would be more representative of the overall universe of university collaborations for urban sustainability.

Yet this has not been possible due to the overwhelming tendency of the literature to focus on small sets of case studies (Karatzoglou, 2011). In all fairness, individual or small sets of case studies are able to provide rich and context-specific data on the individual experiences of various sustainability partnerships. However, as pointed out by Pattberg et al. (2012), large-*n* studies have the advantage of being able to facilitate macro-level understanding of the entire phenomenon beyond the restricted view offered by individual cases. This arises from the ability of the macro-level approach to identify patterns and trends across cases by comparing key commonalities and differences (Karatzoglou, 2011). The benefit of conducting a large-*n* study in the field of cross-sector university partnerships for urban sustainability would be the ability to put into perspective the details and characteristics of individual cases by positing them against the "overall universe of partnerships" (Pattberg et al., 2012, p. 7). The other shortfall of the literature's failure to 'join the dots' between the countless cases unfolding around the world is that it is difficult to assess with any confidence the extent to which off-campus sustainability partnerships have emerged and proliferated in academia. With the global pool of partnerships so far unquantified, it is at present impossible to assess the full implications of this seemingly growing trend in regards to the other more established missions of the university or paradigms of social engagement.

Another observation to emerge from the author's review of the literature is that the empirical studies published so far are not necessarily reflecting the more pioneering and ambitious sustainability partnerships to have emerged over the last few years. This appears to be essentially for the reason that the majority of case studies appearing in the literature have been compiled by scholars involved in one way or another with that particular partnership (For example De Kraker et al., 2013; Evans and Karvonen, 2011; 2013; Lienen et al., 2004, 2005; McCauley and Stephens, 2012; Orr, 2011b; Peer and Stoeglehner, 2013; Pothukuchi, 2011; Valkering et al., 2011, 2013). This means that the objectives, mechanisms and approaches of many newer and pioneering cases across the world, which although covered by press and informal media sources, are yet to be covered by the scientific literature. Research results from many partnerships may be published via specialised journals and academic conferences, particularly in the fields of engineering and natural sciences. However, such publications are generally not integrated or acknowledged by the academic field dealing with university sustainability partnerships. Furthermore, many other partnerships around the globe remain invisible for linguistic reasons (i.e. those formed in non-English speaking countries) or, alternatively, because they are formed for non-research reasons or neglect to report their activities to the scientific literature. In order to more fully understand the true transformative power of the university and the full implications of the emerging trend of off-campus partnerships for urban sustainability transformations, clearly an effort is required to source and analyse more 'leading-edge' and paradigmatic cases from around the globe. This would also corresponded with Flyvjberg's (2006) argument that case studies of atypical or extreme examples are crucial in order to push the frontiers of knowledge and be at the forefront of one's field.

To summarise the discussion so far, the author's review of the literature has identified the following gaps and shortfalls:

- a lack of systematic, robust frameworks to describe both qualitatively and quantitatively the defining attributes of university sustainability partnerships
- a need to 'connect the dots' and conduct a large-*n* size study of various cases from around the world to: a) generate a macro-level understanding of key patterns, trends and differences, and b) better understand the extent to which off-campus sustainability collaborations are emerging across academia and their collective implications towards the other missions and societal engagement paradigms of the university

- a need to analyse some of the more pioneering and paradigmatic cases to have appeared in recent years, many of which are yet to be covered by scientific literature.

This dissertation will therefore seek to contribute to the development of the academic field of cross-sector partnerships for urban sustainability transformations by addressing these above-mentioned deficiencies.

2.2.4 Empirical 'preview' of pioneering cases

The above-described literature is also reflecting a recent proliferation across the globe of cross-sector university partnerships for sustainability. Yet it should be highlighted that the true extent of this worldwide emergence has not been accurately assessed as many partnerships—if not the majority—are yet to be covered by existing scientific studies. Despite this, some scholars argue that the act of 'town and gown' coming together to form off-campus sustainability partnerships is a recent and novel development (Mero, 2011), with other researchers implying that the overall magnitude of this trend is growing around the world (Zilahy and Huisingh, 2009). Such observations correspond with empirical and quantitative studies from other scholars, who note that the wider global population of non-academic sustainability experiments (Bai et al., 2010) and climate experiments (Bulkeley and Broto, 2012) is also increasing.

The discussion will now bring attention to some of the more pioneering and ambitious university partnerships for urban sustainability unfolding around academia—most of which are not extensively covered in the literature on sustainability in higher education. To this end, the following paragraphs will present briefly several partnerships from Europe, Asia and North America, with Table 2.2 below offering a systematic summary of each. (See Appendix 1 and Chapter 4 for a more exhaustive global analysis).

2.2.4.1 UniverCity (Simon Fraser University, Canada)

UniverCity involves the transformation of 65-hectares of university-owned land adjacent to the Simon Fraser University (SFU) campus into a new, mixed-use community for 10,000 residents. When fully built out in approximately 2020, the development will encompass approximately 4,500 residential units and a large range of amenities such as an elementary school, library, supermarket and other services. Formed for non-research purposes, the project seeks to build a prototype of a compact, sustainable and mixed-use community, whilst also generating a steady source of revenue for the university endowment (SFU Community Trust, 2011). Development of the site has been occurring in stages since 2002, with sustainability regulations for construction become successively stricter. Construction is carried out and financed by the private sector, who receives development rights on a 99-year lease arrangement. Key areas of innovation include a stormwater system designed to mimic nature by treating at the source and returning nearly 100 percent of stormwater to the ground. This has been designed in contrast to conventional methods of channelling stormwater runoff into conventional drainage pipes and sewers (Girling, 2011). Sustainability in the built environment is ensured through medium and high-density housing (with no single dwellings), high-insulation, low-energy and water consumption, and in some projects, use of recycled materials. Buildings are networked to a district energy system for space heating, which will be eventually converted to biomass. Other efforts to reduce ecological disturbance on the site include extensive reforestation with native species. A special feature of the governance of the project is the university establishment of a separate legal entity, comprising of SFU faculty, student representatives, CEOs from local companies and prominent real estate and legal experts around Vancouver.

2.2.4.2 SoMA EcoDistrict (Portland State University, US)

The SoMA EcoDistrict has emerged out a collaborative effort from Portland State University (PSU) and local NPO Portland Sustainability Institute (now called Ecodistricts). It is part and parcel of a larger effort (the EcoDistricts Initiative), formed by Ecodistricts and PSU to set up a series of ecodistrict pilot regions across Portland. SoMA EcoDistrict aims to help PSU and the surrounding community to co-create “a new model of urban sustainability” based upon a holistic vision of community-level sustainability; one encompassing green buildings and infrastructure, connectivity and sustainability transport, economic development and wealth distribution, energy, water and urban ecosystems (Portland Sustainability Institute, 2012, p. 4). Although university faculty contribute to the partnership with technical expertise (e.g. data gathering for creating sustainability baselines, gauging local lifestyles and measuring progress towards sustainability goals), it should be emphasised that the initiative is foremostly a community revitalisation and urban reform project, and not strictly a research programme. Concretely, the initiative is concentrating reform efforts in five areas. The first is the improvement of the liveability of public gathering spaces and the fostering of new retail businesses and mixed-use communities. Second, increasing transport connectivity via pedestrian and bicycle infrastructure, combined with public transport improvements. Third, infrastructure greening involving tree-planting, nurturing of biodiversity, and stormwater management upgrades. The fourth dimension involves the driving of energy efficiency via an expansion of the existing district heating and cooling network, with the final being the implementation of a massive retrofitting of the existing building stock. Formed officially in 2011, the initiative is steered by a committee involving representatives from government, industry, local churches and the civic sector, with faculty, students and administration from PSU involved in both implementation as well as technical advisory. The implementation of projects for each of the various focus areas is carried out by various stakeholders from the city government, industry, private and civic sector.

2.2.4.3 Pecan Street Demonstration (University of Texas at Austin, US)

The Pecan Street Demonstration is a large-scale R&D, demonstration and open-innovation platform set up in the new smart community of Mueller, adjunct to the university campus. It serves as the flagship project for a stand-alone NPO (Pecan Street Inc.) and research institute set up by the University of Texas. This NPO aims to contribute to the re-development of Austin’s energy distribution system by supporting and accelerating R&D, testing and deployment of smart grid technologies and clean electricity services. The Pecan Street Project Demonstration was established in 2009 as a five-year collaboration between the University of Texas, industry, energy utilities and government agencies. It functions as a testing and evaluation platform for diverse residential technologies dealing with smart grids, solar energy and storage, water, electric vehicles and green buildings. This is enabled through the collection of data from smart meters installed in the households of volunteer participants. As residents are able to monitor personal energy consumption on the Internet, the platform has also served to foster sustainable living habits. This has been determined through energy consumption monitoring and increased adoption rates of solar panels and electric vehicles (Barnes, 2013). Data results are used by industry and energy utility partners to enhance product development and technology diffusion strategies, and are also shared with a national network of academics.

2.2.4.4 Bright Low-Carbon Urban Reformation Programme (University of Tokyo, Japan)
The Urban Reformation Program for the Realization of a Bright Low Carbon Society was initiated in 2010 by the University of Tokyo. It brings together various departments and research communities from two campuses (Hongo and Kashiwa) in response to dual and localised challenges posed by climate change and an ageing population. Its objective is to design the foundations of a low-carbon, elderly citizen-friendly community in the local town of Kashiwa and prove its feasibility via a series of interlinked trials and demonstrations (Yarime et al., 2012). Basic and applied research is combined to create both technological and social innovation. These efforts are conducted by a total of six groups: energy (development of solar heating and air-conditioning), senior mobility (trial of super compact electric vehicles), clinical plant science (senior citizen education project to alleviate crop diseases), agriculture and landscape planning (promotion of local agriculture and bio-mass production), city planning (unification of project and housing services for the elderly), and lastly, information systems (unification of project and information management). External stakeholders in the project include local government, a think tank, local enterprises, NPOs, and citizen groups.

2.2.4.5 Verdir (University of Liege, Belgium)
The core vision and objective of the Verdir project is of transformation and regeneration—social, environmental and economic. Formed in 2012, the partnership seeks to diffuse and commercialise an array of technologies to transform industrial waste zones such as closed factories and warehouses into urban centres of food and bio-resource production. By doing so, Verdir is seeking to address the chronic social and economic deterioration characterising the region of Liege that has ensued the closing of many local heavy industries due to globalisation. Therefore, a major expectation of the urban reform effort is that the project will contribute significantly to regional economic revitalisation and employment creation. Concretely, this will be achieved through the dispersion of an array of technologies and production activities to reconvert abandoned industrial zones into areas of economic output. These will encompass elevated hydroponic vegetable systems connected to aquaculture systems, floriculture, production of biomass for energy and agro-materials for agriculture. Although the project will exploit university research and function as a research platform for various departments at the University of Liege, Verdir should be interpreted above all as an ambitious social transformation project. It is founded upon principles of sustainability that encompass respect for the environment, social equity and economic demands. It seeks to generate economic value across the whole chain, including production, storage and distribution, treatment of waste, creation of local markets and education of local consumers.

2.2.4.6 Off4Firms (ETH Zurich, Switzerland)
Off4Firms was formed in 2010 and seeks to contribute to the de-carbonisation of Swiss and other EU companies by creating tailor made carbon-offset schemes for employee households. The project has begun as a research project and is in the process of evolving into a fully operational spin-off and business unit. The first component of the project consists of research to evaluate the effectiveness of existing voluntary measures implemented by various Swiss and EU companies to reduce energy use and CO2 emissions in employees' private lives. This has led to the identification of a set of best practices and guidelines to be considered when implementing similar schemes in other companies. Results have been collated into a tool-kit that is currently guiding firms to implement more effective carbon-offset programmes targeted at employee

households. In the aim of scaling up findings of Off4Firms to other companies across Europe, professors at ETH are working with an external carbon consulting firm to diffuse findings through a spin-off company. This commercialisation process is receiving financial and strategic support from the European Climate-KIC programme.

2.2.4.7 Summary

As can be seen from the above descriptions, this small selection of partnerships is testifying to a radical paradigm shift in the academy. A move from the idea of simply *contributing* to society to that of collaborating with diverse external actors to actually *transform* society and *co-create* new socio-technical and environmental systems. The novelty of this trend is also apparent in the explicit focus on a particular place and set of external stakeholders; a trait that has not always been valued in the modern university due to its tendency to disregard place and context in pursuit of universal knowledge (Arbo and Benneworth, 2007). Also striking is the level of ambition regarding partnership objectives and the extent of the intervention on society. In most of these institutions, the formation of such partnerships appears unprecedented. For example, not only are these collaborations seeking to advance the environmental aspects of sustainability, many are carrying out deep and sustained interventions on socio-economic systems and communities to revive local economies and drive low-carbon economic growth (e.g. Verdir), whilst others seek to foster social cohesion and solidarity (e.g. SoMA Ecodistrict). Furthermore, the above descriptions are also revealing that university actors are exploiting an extremely diverse array of roles as they intervene on society and pursue partnership goals; many of which have not been sufficiently explored by the literature. Such roles include the use of real estate development and construction to accomplish various objectives such as showcase environmentally sustainable building technologies and stimulate low-carbon, economic development in a specific locality (e.g. SoMA EcoDistrict and UniverCity). It also encompasses the act of restoring or creating new natural environments in urban areas to improve ecological services such as water provision, heat-island mitigation and carbon sequestration (e.g. e.g. SoMA EcoDistrict, UniverCity and Verdir). Other roles yet to be thoroughly explored in the literature include experimentation with social innovation in an attempt to re-configure or create new social systems (e.g. Off4Firms); an approach that is often combined with efforts to advance new technologies (e.g. Verdir). Lastly, in the literature there is often a non-explicit assumption that cross-sector sustainability partnerships involving university actors are primarily formed or coordinated by faculty and researchers—and usually for scientific or scholarly purposes. Yet the above cases also contain several cases where non-scientific actors from administration and bridging organisations such as sustainability and community development offices play lead or coordinating roles (e.g. SoMA EcoDistrict and Univercity). A key feature of this emerging academic function of creating societal transformations for sustainability is thus collaboration between not only university actors and external stakeholders, but also internal cooperation across the various sectors of the university.

Table 2.2 Summary of frontrunner cases

Name and continent	Lead Institution(s)	Target area	Objective	Collaboration period	Description	Pioneering attributes
NORTH AMERICA						
Pecan Street Demonstration	University of Texas	USA, TX: Austin	R&D and demonstration	2008 – n/a Status: ongoing	R&D, demonstration and knowledge diffusion platform to utilise local Mueller community as a test bed for smart-grid, solar and water technologies. Project functions as an open-innovation platform for private sector, and also as a data generator to monitor residential behaviour and evaluate low-carbon technologies. **Focus areas:** smart-grids, residential behaviour, water, solar, energy storage, electric vehicles, green buildings, smart appliances	• Extensive use of urban environment as living laboratory and open-innovation platform for various smart grid technologies • Integration of R&D, demonstrations, technology commercialisation and knowledge diffusion into framework to advance low-carbon trans-formation of local energy sector
SoMA EcoDistrict	Portland State University	USA, OR: Portland	Social transformation	2011 – n/a Status: ongoing	Comprehensive sustainable urban transformation effort targeted at the community surrounding the PSU campus. Project has adopted the Ecocities framework developed by local NPO Ecocities to fuse university development needs and a holistic vision of urban sustainability and community revival into a governance and action framework. Overall, the project functions as a community-led transformation project for social and urban revival, but is also exploited as a platform for university research and education. **Focus areas:** green buildings and infrastructure, connectivity and sustainable transport, economic development and wealth distribution, energy, water, waste and urban ecosystems.	• Integration of R&D, demonstrations, technology Integration of university research and campus development goals into governance and action framework for sustainable urban transformation of surrounding community • Comprehensive roadmap and metrics in place to monitor progress in numerous areas including energy, buildings, water and transport • Use of transformation effort as educational and research platform
UniverCity	Simon Fraser University	CANADA, BC: Burnaby	Social transformation	2002 – n/a Status: ongoing	An entrepreneurial real estate development project to drive the new development of a local mountain top area into a model of a sustainable, multi-use community for 10,000 residents. Project is financed by university endowment, with construction implemented by provide sector. Governance is carried out through a special legal entity where university, community, industry and municipal stakeholders serve on the board. **Focus areas:** green buildings & housing, stormwater management, biomass heating, conservation & replanting, economic development.	• Fusion of university development and economic interests with ambitious vision of sustainable community development • Creation of a multi-use community for 10,000 residents, with sustainable innovation fostered in buildings, infrastructure and community planning

Table 2.2 (continued) Summary of frontrunner cases

Name and continent	Lead Institution(s)	Target area	Objective	Collaboration period	Description	Pioneering attributes
ASIA						
Urban Reformation Program for the Realisation of a Bright Low Carbon Society	University of Tokyo	JAPAN: Chiba, Kashiwanoha	R&D and demonstration project	2010 – 2015 Status: ongoing	Various research communities from two campuses have united to develop and test technical and social innovation, together with policies required to address the dual challenges of climate change and ageing population. Collaboration aims to design blueprint for low-carbon, elderly citizen friendly community and demonstrate its feasibility via 'social experiments'. **Focus areas:** domestic energy, senior mobility, agriculture/green zones, plant medicine, urban planning, green information systems.	• Large-scale co-operation across several departments and two campuses • Integration of both technical and social innovation into framework for showcasing and experimenting with diverse aspects of urban sustainability • Integration of local development needs with existing university research agendas
EUROPE						
Verdir	University of Liege	BELGIUM: Liege	Social transformation	2012 – n/a Status: ongoing	Project to combat chronic social and economic decline in Liege region by converting industrial brownfields and closed down factories to green zones and centres of urban agriculture. It is hoped that this initiative will lead to the large-scale creation of local jobs and the stimulation of the local economy. Involves testing and diffusion of various technologies in hydroponic agriculture, aquaculture, floriculture, biomass production and bio-resource recycling. **Focus areas:** urban agriculture, urban aquaculture, urban forestry, urban floriculture, greening of industrial brownfields, economic development.	• Fusion of university research and local development needs into ambitious framework and action plan for economic revival and societal transformation • Holistic integration of social, environmental and environmental needs • Large-scale societal intervention and reform of urban landscape
Off4firms	ETH Zurich	Switzerland: numerous cities	Social transformation		Research and commercialisation effort to contribute to the de-carbonisation of EU companies by creating voluntary carbon-offset schemes for employee households. Project has commenced as a research platform investigating best practices that have led to a tool-kit creation for designing and implementing similar programmes in other firms. Efforts are now concentrated on diffusing results through a spin-off firm. **Focus areas:** corporate carbon reductions, CO2 offset programmes, demand side management, employee lifestyles.	• Use of academic research to generate up-scalable lessons to assist de-carbonisation of EU firms • Exploitation of social innovation to achieve sustainability goals • Integration of sustainability principles into technology-transfer and commercialisation model

2.2.5 A transitions theory perspective

The discussion until this point has been centred on describing a significant paradigm shift in the university. That is, a move from tackling sustainability issues within the confines of the campus and merely 'contributing' to society to collaborating with an array of external actors to transform society and advance sustainability in a specific locality, region or societal sub-sector. Yet it must be understood that the driving forces and characteristics of this function differ starkly to the dominating notions and patterns of social contribution and engagement promoted in academia until now. One way of illustrating this is to borrow concepts from transitions theory such as the 'multi-level perspective' (Geels, 2002), already utilised by Schneidewind and Augenstein (2012) and Stephens and Graham (2010) to describe interactions and tensions between sustainability initiatives and established cultures and norms in academia.

From the multi-level perspective depicted in Figure 2.2, it could be argued that the cross-sector sustainability partnerships described earlier (as well as those presented later in Chapters 4 and 5) constitute a *niche* (the lower or macro level) where groups of *frontrunners* (Loorbach and Rotmans, 2010) are involved in conducting sustainability experiments that deviate from the *regime*. In the transitions theory, a niche is described as a small group of actors experimenting with novel practices and behaviour not conforming with that of the general regime (Geels, 2002; Rotmans and Loorbach, 2010). The regime (the middle or meso level) refers to the mainstream and dominating structure, culture and practices of the residing power and vested interests in a particular societal system (Van den Bosch, 2010). The literature also describes a third layer *landscape* (top or macro-level) representing slow changing external factors such as global environmental change, cultural and political trends, institutional frameworks and long-term economic developments (Bai et al., 2010; Berkhout et al., 2010). Understanding the tensions and contrasts, particularly between individual niches and the regime, is essential to grasping the full implications of the emergence of the trend of university partnerships for urban sustainability. For this reason, a significant focus of this dissertation will be on exploring the qualitative differences between this emerging function of co-creation for sustainability and other more dominant and promoted forms of societal engagement in the university.

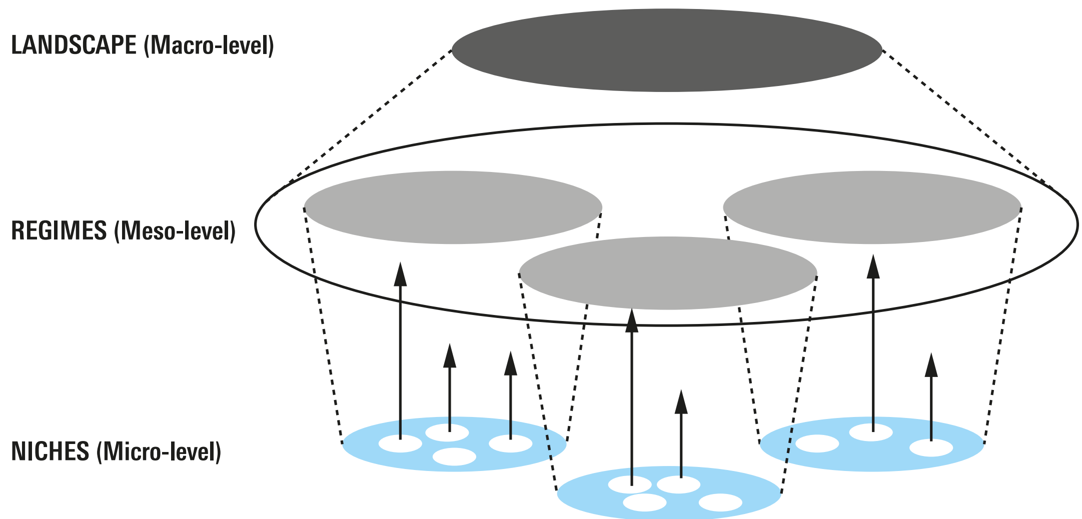

Figure 2.2 Multi-level perspective from transitions theory (Source: Geels, 2002)

Although there are numerous possible ways of describing the many regimes in the academy, this dissertation will focus on what the author has termed the ‘third mission regime’ (Trencher et al., 2013b). In essence, this consists of firmly established and widely promoted concepts of societal contribution such as the ‘third mission’, the ‘entrepreneurial university’, ‘technology transfer’ and ‘triple-helix partnerships’. The articulation of this regime builds upon prior studies describing a rising ‘academic capitalistic regime’ (Bleiklie and Kogan, 2007) or ‘academic capitalist knowledge/learning regime’ (Slaughter and Rhoades, 2004) fuelled by market-driven and neo-liberal logic. Understanding the magnitude of this regime, as well as the changes that this has brought about in the dominating model of the global research university is paramount to any discussion that seeks to harness the full potential of the university to assist society’s transition to sustainability

The goal of the following section is thus to provide a theoretical overview of the global emergence of this third mission regime, as seen from the literature.

2.3 The rise of the entrepreneurial paradigm and the third mission regime

This sub-chapter will describe the worldwide expansion of the third mission regime. It will begin by arguing that the notion of a third mission has been chiefly interpreted and promoted from an economic perspective. This is despite the potential of this term to also signify broader conceptions of various other types of societal contribution. Focusing initially on the US, it will document the rise of the 'entrepreneurial university' and describe the driving forces behind the emergence of this type of institution. It will continue by empirically presenting key entrepreneurial trends such as patenting, licencing and the creation of spin-off firms. After providing an overview of the overwhelmingly positive appraisal that this entrepreneurial model has enjoyed, it will then describe attempts by policy makers and governments elsewhere in the world to emulate this perceived success of American institutions. In doing so, this sub-chapter will thus illustrate how the mythology of an entrepreneurial university has been normalised and promoted around the world, often through the framing of the third mission.

2.3.1 Emergence of the third mission and entrepreneurial university

The articulation of a 'third mission' has emerged since the 1980's as a consequence of global pressure on universities to play a more central role in the knowledge economy (Vendetti et al., 2011). Like the term 'sustainability', the concept is somewhat ambiguous, with varying definitions in circulation in academia and government discourse (Kremarova, 2012). In essence, this expression seeks to capture activities lying outside of the university's so-called first mission of education and second mission of research. According to Culum et al. (2013) there are three chief interpretations in circulation. As depicted in Figure 2.3 below, the first and dominating interpretation is that emphasising *economic* dimensions such as technology transfer and the model of an entrepreneurial university (both of these concepts are discussed in detail below). The second interpretation is that emphasising *civic and social* dimensions such as community development, service-learning, adult education, sharing of university facilities, consultancy and so on. Figure 2.3 also illustrates that there are considerable tensions between these two narrow definitions. The majority of discourse on the third mission prescribes to either one of these polarities, although they could and should be regarded as "two sides of the same coin" (Culum et al., 2013, p. 174). Lastly, the third and broadest interpretation is that integrating both of these economic and social/civic aspects. This more holistic understanding of the third mission corresponds, for example, with that of the E3M project[4] (European indicators and ranking methodology for university third mission). Here the third mission is used to refer to a broad array of activities such as technology transfer, continuing education and social engagement in the form of providing public access to lectures and cultural assets, voluntary work, consultancy and so on (LLP and E3M Project, 2012a). A final point to be retained from the notion of a third 'mission' for the academy is the normative dimension of this term (Vorley and Nelles, 2008). It thereby implies a duty or a societal obligation for universities to pursue activities contributing to either social or economic development—depending on the interpretation stressed. However the problem with this framing of a societal obligation is that the notion of a third mission has been used as a tool to

[4] The E3M project seeks to develop a set of indicators to measure third mission activities, and then employ a ranking methodology to assess performance of European higher education institutions. For more information see: http://www.e3mproject.eu/summary.html

principally promote the economic dimensions. As a result, the global discourse on the third mission is dominated by discussions on technology transfer and the conception of an entrepreneurial university (Laredo, 2007; Vorley and Nelles, 2008; Yusuf, 2007).

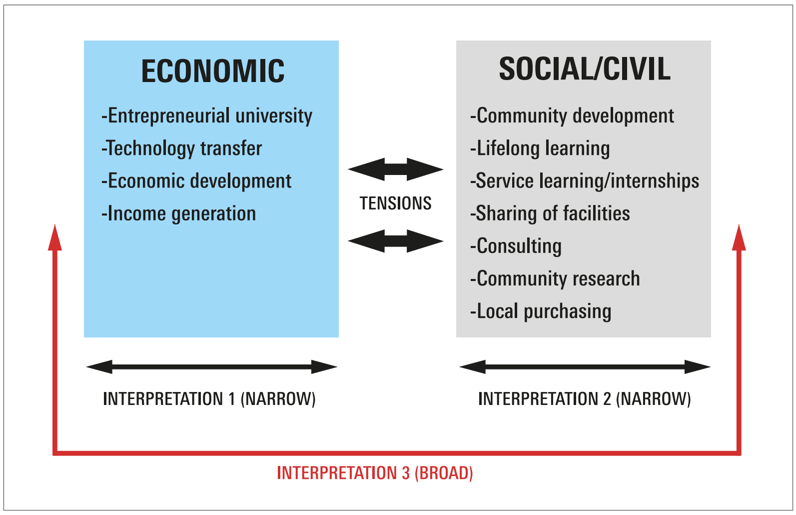

Figure 2.3 Differing interpretations of the third mission (own source)

The phenomenon of the entrepreneurial university emerged out of the US and is epitomised by prestigious research universities such as Massachusetts Institute of Technology (MIT) and Stanford (Clark, 1998; Etzkowitz, 2002). In the entrepreneurial academy, “identifying, creating and commercialising intellectual property have become institutional objectives”, with such activities undertaken in the aim of “improving regional or national economic performance as well as the university’s financial vantage and that of its faculty” (Etzkowitz et al., 2000, p. 313). Just as the integration of basic research into the core activities of the modern research university during the 19th century signified the ‘first academic revolution’, Etzkowitz (2002) claims that the introduction of the for-profit motive and the capitalisation of scientific knowledge has resulted in a ‘second academic revolution’. In this new role as an entrepreneur, the university exploits relations with industry and government to commercialise and generate income from research results by transferring intellectual property to the market. This is typically carried out via patenting and licensing deals with existing companies, yet it can be alternatively achieved through the creation of new industries in the form of ‘spinoff’ firms or ventures. In addition to these hard outputs, a university may also seek to contribute to industry and economic growth via softer means (Philpott et al., 2011). Channels used for this purpose include collaborative and commissioned research, consulting, publication of results via journals and conferences, informal interactions and supply of graduates to industry (Mowery, 2007; Mowery et al, 2004). Etzkowitz (2008, p. 27) describes four defining attributes and conditions necessary for the entrepreneurial transformation of the university:

1. academic leadership and a strategic vision
2. legal control over both physical (such as buildings) and intellectual property
3. institutional ability to transfer technology through patenting, licencing and spin-off firm creation
4. presence of an entrepreneurial spirit amongst administration, faculty and students

As scientific knowledge from the university increasingly becomes a driver of economic activity and innovation, a ‘triple-helix’ of synergising relations has emerged from university, industry and government cooperation (Etzkowitz, 2000, 2008). In this evolution, the three institutional spheres of public, private and academia become increasingly interwoven, with traditional roles merging as each assumes that of others. As a generator of skilled human capital and intellectual property, the university thus becomes a core component of national and regional innovation systems.

In addition to technology transfer related activities, some scholars claim that the for-profit motive and idea of the university operating in accord to market logic has also manifested itself into university governance (Bleiklie and Kogan, 2007; Rhoades, 2005), curriculum design, educational philosophy, student recruitment strategies (Slaughter and Leslie, 2001; Slaughter and Rhoades, 2004), university evaluation systems (Marginson, 2007) and other activities such as sport (Bok, 2003). This wider shift towards closer ties with industry and an expansion of activities taken out in pursuit of income generation has been described by scholars as the commercialisation (Bok, 2003) or corporatisation (Aronowitz, 2000; Washburn, 2006) of the university, the market-model (Washburn, 2006), corporate (Tuchman, 2009) or neoliberal university (Canaan and Shumar, 2011; Gaffikin and Perry, 2008; Kweik, 2003; Saunders, 2010; Slaughter and Rhoades, 2004; Washburn, 2006), in addition to academic capitalism (Etzkowitz, 2000; Slaughter & Roades, 2004; Ueyama, 2010). The translation of academic research results to economic ends via patenting, licencing and spin-off firm creation thus constitutes but one aspect of a much wider, market-logic driven transformation of the university. Yet it is precisely these activities that have been attracting the most attention and expectations from government decision makers across the world keen to utilise the university as a means of generating innovation and competitiveness in an increasingly knowledge-based global economy (Mowery and Sampat, 2005; Philpott et al., 2011).

The emergence of the above-described entrepreneurial paradigm has been fuelled by an array of interlinked factors. The most common and simplistic interpretation is that linking a rise in technology transfer activities in US universities to the formation of the Bayh-Dole Act[5] of 1980. Although this Act did serve to provide instant congressional endorsement for the privatisation of research results financed from the public purse, some scholars (Mowery, 2007; Mowery et al., 2004; Sampat, 2006) point out with empirical evidence that US institutions were already engaged in patenting and licencing activities prior to the Act. This is to say, the growth of entrepreneurial activities in US universities cannot be attributed to the Bayh-Dole Act alone, which merely served to accelerate earlier established trends (Mowery and Sampat, 2005; Mowery, 2007). Instead, the expansion of the entrepreneurial paradigm can be traced back earlier, to the 1970s. During this period a series of converging developments took place, both facilitating and pushing US universities to forge closer ties with industry and commercialise the results of publically funded scientific labour. Washburn (2006) points out that the 1970s in the US were marked by a fear-driven response to the rise of Japanese innovation and economic prowess. She argues that a nexus of political and economic forces emerged to begin pushing US universities to forge closer ties with industry and make greater efforts to transfer academic inventions to industry in a bid to spur innovation and international competiveness.

[5] The Bay-Dole Patent and Trademark Amendments Act of 1980 authorised those undertaking federally funded research to apply for patents to protect intellectual property ensuing such research. It also granted them the right to generate income from those patents by granting licenses (including exclusive licenses) to other parties (Mowery, 2007).

This development coincides with what other scholars have identified as the origins of the so-called 'knowledge-economy' (Etzkowitz and Webster, 1995) or 'new economy' (Slaughter and Rhoades, 2004). Here a new paradigm for economic growth emerged, based on the realisation that it was knowledge and cutting-edge ideas—and no longer monetary capital and natural resources—that were the drivers of economic growth (Etzkowitz and Webster, 1995). In the new economy, intellectual property has an essential role to play (Etzkowitz, 2002). In reflection of this, an array of US policy reforms regarding intellectual property accompanied the formation of the Bayer-Dole Act. These simultaneous legal amendments served to open previously closed doors and facilitate the process of transferring of intellectual property to industry (Mowery et al., 2004; Mowery, 2007). This occurred at a time when US universities were facing funding cuts from federal sources (Sampat, 2006; Washburn, 2006) despite a mounting need to secure funds to remain ahead in an increasingly competition-driven national higher education market (Bok, 2003). Frontrunner universities were therefore quick to seize opportunities presented by the growth of the bio-technology industry in the late 1970s to convert academic research results into vast sums of money via patents, licensing and spin-off firm creation (Mowery et al., 2004). Although US universities had faced funding cuts previously, Bok (2003) points out that lucrative opportunities presented by the transfer of intellectual property to the newly formed bio-technology industry, for example, did not exist in the same magnitude in the earlier part of the 20th century.

The emergence of the entrepreneurial paradigm is thus the result of a complex array of interwoven factors. On one hand federal polices serving to loosen laws on intellectual property and facilitate greater cooperation between academia and industry were driven by university lobbying (Kenney and Patten, 2009; Mowery, 2007). On the other, they were also a federal response to the global transition to a knowledge economy where scientific knowledge and intellectual property plays an increasingly crucial role. The growing significance of this role was reflected by an explosion in the economic value of patenting and licensing in the field of bio-technology in particular; an opportunity that fund-hungry, frontrunner US universities were quick to seize. Finally, the entrepreneurial transformation of the US research university must also be viewed as symptomatic of a much broader neo-liberal shift in society where market logic is increasingly dictating university behaviour in a vast array of activities (Bok, 2003; Washburn, 2006). The mounting influence of neoliberalism[6], it is argued, has brought about drastic cuts in previously state supported services and programmes and the extension of corporate logic to countless other institutions and services in society—amongst which lies the university (Aronowitz, 2000; Saunders, 2010; Slaughter and Rhoades, 2004).

[6] As described by Makwana (2006), neoliberalism is an ideology in which pure market forces, free of government interference and control, are advocated to be the most efficient methods of supplying goods and services and generating wealth. A natural consequence of excessive belief in the virtue of free markets is to shun the role of state and to discourage government interference with a wide range of economic and financial affairs, in addition to the spheres of social and public welfare.

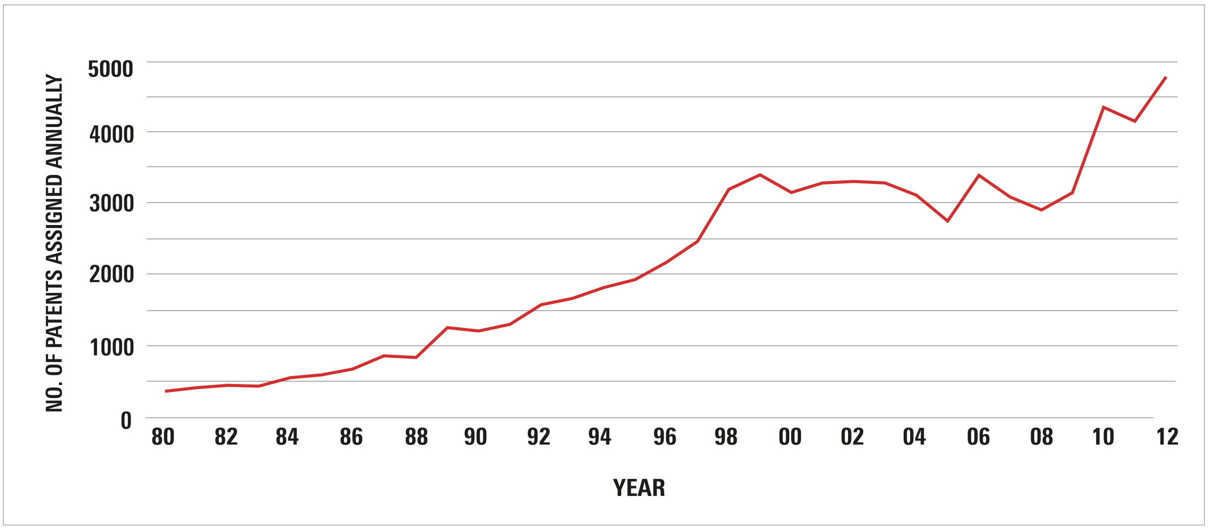

Figure 2.4 Patents assigned annually to all US colleges and universities
(Data: United States Patent and Trademark Office, 2013)

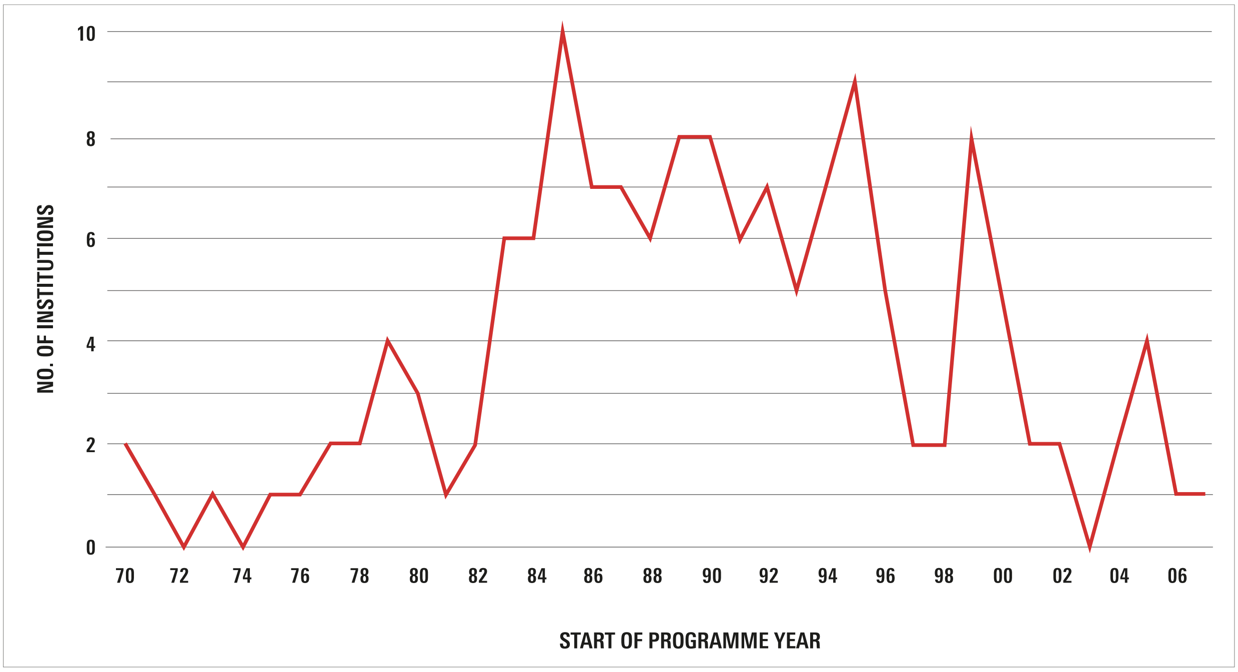

Figure 2.5 Start year of Technology Transfer Office (TTO) for US colleges and universities
(Data: AUTM, 2007)

2.3.2 Growth of entrepreneurial activity in US institutions

The combination of the above forces has served to propel a massive expansion of entrepreneurial efforts in US institutions, particularly in technology transfer activities such as patenting, licensing and spin-off firm creation. The dramatic growth in university patenting since the 1970's may be told in a few simple figures. For the decade preceding 1980, US research universities were registering only between 200 and 300 patents per year (Sampat, 2006, p. 782). However, as shown in Figure 2.4 below, by the year 1988 this number had risen to 834 (for all US universities and colleges), then rising dramatically over the decade leading to the year 1999, where it reached 3439. After plateauing for several years, it can be seen for the last few years since 2009 that there has been a renewed surge in patenting activity, with 2012 hitting a record of 4797. The number of Technology Transfer Offices (TTO) set up to facilitate this new patenting rush also paints a similar picture and coincides much more clearly with the 1980 enactment of the Bayh-Dole Act.

Although Mowery (2007) points out that the number of universities establishing TTOs or hiring technology transfer officers had began to grow during the late 1960s and well into the 1970s, it is worth noting that that until 1980, approximately only 25% of Carnegie Research Universities had established a TTO (Mowery et al. 2004). However by 1995, this figure had exploded to over 90%, all within the space of 15 years. This sudden burst of TTO establishment may be confirmed from Figure 2.5, which depicts that the vast majority of TTOs in US universities and colleges were established during a period extending from 1983 to 2000. These figures are thus reflecting that many US universities, even those who historically had not been involved in formal technology transfer activities, have since interpreted the Bayh-Dole Act as a Congressional mandate to patent and commercialise knowledge assets as much as possible (Washburn, 2006).

The financial figures for this burst of entrepreneurial activity are equally impressive, albeit misleading as will be explained later. In 1991, the newly established Association of University Technology Managers (AUTM) began producing data and reported that in that same year North American research institutions (including universities, colleges, research institutes and hospitals) had negotiated 1,229 licenses with industry, amounting to U.S. $218 million in royalties (AUTM, 2005). For the year 2001, this grew to 3,725 license agreements and $US1.03 billion (ibid). As of 2011, this total income had almost doubled, hitting $US2.5 billion for a further 4,899 new licenses executed (AUTM, 2012).

The creation of start-up firms follows a similarly explosive trend. For the 14-year period of 1980-1993 immediately following the enactment of the Bayh-Dole Act, 1013 start-ups were formed at an average of 72 spin-offs per year (AUTM, 2005). For the following 10-year period of 1994-2003, this number had increased to 3106 at an average of 311 firms per year. This upwards momentum has continued until the present, with 671 start-ups formed for the fiscal year 2011. Of these firms formed until now, AUTM reports that 3,927 are still in operation as of the year 2011 (AUTM, 2012). A point that requires emphasis here is that despite the late entry of smaller, less experienced institutions in the post Bayh-Dole research commercialisation race, it is the veteran entrepreneurial institutions—a list including MIT, Stanford, the University of California system and the California Institute of Technology, along with other major research universities such as University of Illinois, University of Michigan and the Georgia Institute of Technology—which are by far responsible for the bulk of this entrepreneurial activity (AUTM, 2010; Mowery et al., 2004).

Another crucial point to examine in regards to this surge of technology transfer trends concerns the fields in which this activity is taking place. In 2010 the AUTM reported that patent disclosures from US universities, hospitals and research institutes were distributed as medicine (24.5%), biomedical engineering (14.2%), life sciences (10.4%) and computer engineering (9.6%). On the other hand disclosures in other less applied fields, such as the humanities for example, accounted for only (1.5%). This has long been pointed out by Mowery et al. (2004) and Mowery (2007) who stresses that the trend of patenting and licensing is mostly concentrated in a narrow spectrum of highly specialised fields, most particularly the biomedical sciences and some areas of engineering such as software engineering. The uneven concentration of this entrepreneurial activity is also echoed in figures for the distribution of university launched spin-off firms. For example, at the University of California San Diego campus, 58% of 120 start-ups formed from 2000 to 2010 were in biomedicine and life-sciences, with the remainder in engineering, software and physical sciences (UC San Diego, 2010). Similar patterns exist in earlier established figures, with Shane (2005) finding more than half of spinoffs formed at MIT to be biotechnology and software companies and Lowe (2002) reporting two-thirds of spinoffs from the entire University of California system to be in the fields of biotechnology, pharmaceutical or medical devices.

2.3.3 Defining characteristics of the technology transfer process

Seeking to tie together several points surfacing so far, this sub-section offers a quick overview of key characteristics marking the process of technology transfer. When entering into a discussion on technology transfer, it is worth noting that the widely promoted model of patenting, licencing or spin-off firm creation is constituting a sub-set of very specific activities taking place in a wider field of more generic types of university-industry collaboration. In the wider sphere of activity, other forms of technology exchange include consulting, industry training, technology park creation, contract research, joint R&D programmes and joint-publications (Mowery et al., 2004; Philpott et al., 2010) to name but a few of the other 'channels' by which university and industry actors can interact. On top of these, other avenues include conferences and informal meetings. It should also be noted that these other types of interaction (i.e. those aside patenting and licencing) have long been cited by industry as the most important pathways by which university-sourced innovation is assimilated by companies (Cohen et al., 2002; Mowery et al., 2004). Entrepreneurial discussions focusing on the three channels of patenting, licensing and spin-off firm creation are therefore focusing on a very narrow spectrum of activity. However, since it is these areas of activity constituting the core focus of expectations for universities to contribute to economic development via collaboration with external stakeholders, the following discussion will deal with these types of technology transfer.

Regarding the industry types that tend to collaborate with university faculty and researchers, Fritsch and Lukas (2001) and Levy et al. (2007) observe empirically that the most common partner is large industry. To re-iterate what has been argued above, the main fields of industry concerned by the phenomenon of patenting and licencing are in the life sciences (especially biotechnology, biomedicine, medicine and pharmaceutics) and software engineering (AUTM, 2009; Mowery et al., 2004; Mowery, 2007). Laursen et al. (2004) provide further insight into the type of corporations likely to seek innovation from universities. They argue that is mostly those with existing capabilities in R&D, particularly those with an open approach to innovation activities. Empirical research from Mowery et al. (2007) also suggests that the main industry actors involved in entrepreneurial interactions are experts and researchers from the same field.

Concerning the reasons motivating university and industry engagement in the practice of technology transfer, this cannot be entirely explained by the entrepreneurial motive as suggested by (Etzkowtiz 1998, 2003) for example. Through a review of the literature, Goktepe-Hultén (2008) points out that many faculty and researchers choose to engage in entrepreneurial behaviour for a host of personal reasons such as the desire to improve reputation, increase chances of promotion, increase job satisfaction and, above all, enhance research by accessing industrial experience. This last reason in particular is emphasised by D'Este and Perkmann (2011). They shed more details on incentives influencing technology transfer efforts by arguing that faculty engaging in patenting and spin-off company creation are most likely to be motivated by entrepreneurial reasons, with those engaging in contract research and consulting most typically motivated by a desire to advance research activities. As for the reason why industry stakeholders choose to collaborate with universities, this is also a complicated matter. Contrary to belief, it is often reported in the literature that industry does not place a great deal of importance on university research as a source of innovation (Laursen et al., 2004; Mowery et al., 2004). The general consensus from industry seems to be that university research is not essential for new product ideas or inventions, but it can be helpful for accelerating existing R&D programmes, or for providing insight into new techniques.

This brings the discussion to the types of models that can facilitate the flow of scientific knowledge. A review of the literature has shed light on three potential interpretations of the technology transfer phenomenon.

The first is the linear depiction of innovation transfer—from the university to an external party not originally involved in the project. This model confirms with Bush (1945) ideologies of a sequential and one-way flow of research results from the university to industry, which does seem to reflect what happens in many cases today. In this model, academic inventions showing signs of commercial utility are reported by faculty to a university Technology Transfer Office (TTO) in order to protect them via the assertion of intellectual property rights. The TTO will then play a mediating and facilitating role by supervising a patent application process and then marketing the prospective product on behalf of the inventor by seeking to match the technology with a suitable company. Once found, the TTO will negotiate for the technology to be transferred via a licencing arrangement, typically involving a royalty to the university or an equity stake in a startup company launched by an entrepreneur outside of the university (Bradley et al., 2013). A characteristic of this model is therefore an absence of prior relations between the inventor and the eventual purchasing party, and also, the positioning of the scientist as the chief inventor. A variation of this model is also the scenario where the university researcher chooses to launch his or her own spin-off firm, with or without the assistance of the university.

Another type of innovation is this process in reverse (Göktepe, 2005). This process will start from an existing industrial problem brought to the university by industry actors. A technological solution is then developed by university researchers, who will then return the technology to that company. In this case, there is no need to market the invention through the TTO, and there is an established relationship and set of communications between the requester of the research and the undertaker. In this scenario, the contracting company would typically retain the rights to any patents generated.

The third model is based upon the premise that innovation is increasingly occurring in networks, from interactions between various parties and societal sectors (Etzkowitz and Leydesdorff, 2000; Schaffers and Turkama, 2012). This form of technology transfer may take the form of strategic research partnerships, network alliances or collaborative R&D projects (Gorman, 2010; Göktepe, 2005; Shrum et al., 2007). As in the above reverse model of innovation flow, this depiction is characterised by complexity, heterogeneity and a set of intense and dynamic interactions and continuous communication amongst all partners. It is this conception of innovation that also best depicts the cross-sector university partnerships forming the unit of study in this dissertation.

A final point to be made in this depiction of defining features of the technology transfer paradigm (which are summarised in Table 2.3 below) concerns the type of 'products' that ensue this process. The fruits to emerge will evidently be dependent on the field of activity. However if taking into account earlier arguments that the vast majority of technology transfer (through both patenting and spin-off creation) is taking place in a narrow set of fields mainly in the life sciences and computer engineering, common place inventions include early stage proofs of concept of drugs, gene manipulation techniques, medical devices and software packages. In other fields such as applied engineering, typical outcomes include industrial materials or devices (Mowery et al., 2004). Another feature of the products ensuing conventional technology transfer is that, being little more than an embryonic prototype, academic inventions typically require significant further investment and development before being fit for the market (Thursby et al., 2001).

Table 2.3 Key characteristics of conventional technology transfer model

Objective	Commercialise research results and contribute to economic development
Paradigm	Market logic and entrepreneurship
Catalyst	Technical or scientific problem
Product	Technical innovation including: • devices • industrial materials • life science processes
Setting	Laboratory
External actors	Researchers from industry, usually large co-corporations with R&D facilities
Disciplinary relevancy	• Disciplinary • Narrow set of fields, mainly in life sciences and computer engineering
Transfer channels	• Patents and licences • Spin-off firms, technology park creation • Contract research, joint R&D • Consulting, industry training • Publications

2.3.4 The entrepreneurial mythology and popular support for technology transfer activities

Ensuing this explosion of technology commercialisation efforts, an entrepreneurial 'mythology' has emerged, propelled by the highly successful activities of a prestigious set of institutions in a select few fields (Philpott et al., 2011). This mythology has largely been spurred by the appraisal of influential commentators, scholars and policy makers since the 1990s, who despite a lack of robust empirical evidence, have delivered overwhelming support for the Bayh-Dole Act and the subsequent rise in patenting. The Economist magazine for example, went so far as to declare the Act as "possibly the most inspired piece of legislation to be enacted in America over the past half-century", with glowing admiration for the rise in entrepreneurial activity in US universities continuing as follows:

> Overnight, universities across America became hotbeds of innovation, as entrepreneurial professors took their inventions (and graduate students) off campus to set up companies of their own. Since 1980, American universities have witnessed a tenfold increase in the patents they generate, spun off more than 2,200 firms to exploit research done in their labs, created 260,000 jobs in the process, and now contribute $40 billion annually to the American economy. (The Economist, 2002)

Many other commentators and influential organisations have been more explicit in linking the expansion of research commercialisation activities to the growth of US economy. In 2001, the OECD (2001, p. 77) argued that "there is evidence" that the Bayh-Dole Act was a significant factor behind the recovery of US growth performance during the 1990's. Other highly enthusiastic proponents of the flourishing entrepreneurial model include the Association of University Technology Managers (AUTM). In a glowing statement of support for the Bayh-Dole Act that was delivered to Congress and subsequently passed by the U.S. House of Representatives, the AUTM concluded optimistically that:

> The Bayh-Dole Act (Public Law 96-517) has made substantial contributions to the advancement of scientific and technological knowledge, fostered dramatic improvements in public health and safety, strengthened the higher education system in the United States, served as a catalyst for the development of new domestic industries that have created tens of thousands of new jobs for American citizens, strengthened States and local communities across the country, and benefited the economic and trade policies of the United States. (AUTM, 2006)

Far from being limited to public discourse, the spread of the entrepreneurial mythology has also been driven by academic discourse. Figures such as the president of the Association of American Universities, for example, have voiced comprehensive support for the Bayh-Dole Act and growth in entrepreneurial behaviour (Mowery et al., 2004). Scholarly interest around the world in the entrepreneurial model has also been largely shaped by the writings of Etzkowitz. Citing data from AUTM, Etzkowitz (2002) signals his enthusiasm for the entrepreneurial paradigm by writing that in 2002, entrepreneurial activities from US universities earned US$1 billion (mainly from royalty payments). He has also adopted the popular opinion that the evolution of academic technology transfer activities since the Bayh-Dole Act has played a "recognisable and increasingly significant" role in spurring the growth of the US economy (2002, p. 124).

2.3.5 Justification for patenting and the benefits of entrepreneurial activity

To gain a comprehensive understanding of the impacts of increased patenting-based entrepreneurial behaviour in universities, it becomes necessary to re-consider the useful role that patenting is believed to play in the technology transfer process. Broadly speaking, arguments in favour of university patenting tend to relate to either economic aspects or the public interest.

To begin with the former, the basic economic justification for university patenting and the Bayh-Dole Act is that patenting and licencing is crucial to the commercialisation of scientific research results. This view holds that the majority of academic inventions are embryonic, requiring considerable further development before they can be successfully commercialised (Mowery et al., 2004; Thursby et al., 2001). The extension of this argument is that without intellectual property rights (IPRs) to protect the invention, firms and investors would be unwilling to invest further in the research. This reluctance comes from fear of seeing prospects for future profit dissolve as unprotected R&D and product development efforts spill freely over to competitors. When protected by IPRs however, it is argued that firms or individuals are provided with an incentive to make such investments in R&D and product development. This is because unintended knowledge spillovers (and therefore imitation) is prevented, rending surer the prospects of future return (Montobbio, 2009). In this economic argument, patenting and licencing are therefore able to correct a 'market failure' where firms tend to underinvest in R&D and product development for fear of this spillover effect (Washburn, 2006).

The second justification for university patenting and licensing concerns protecting the public interest by preventing imitation and unintended knowledge spill overs. As set out back in a 1933 report from the American Association for the Advancement of Science (AAAS, 1933), the granting of IPRs to scientific inventions protects them from 'patent pirates' who can potentially appropriate the work (and file their own patent application) and subsequently cheat the public by charging monopoly prices or withholding the invention from use. Related to this argument, Mowery et al. (2004) bring attention to the ability of university patents to protect the public interest by ensuring 'quality control'. The ability of IPRs to protect imitation or pirates is particularly important for example in the field of pharmaceutics where patents and licencing can in fact protect potentially harmful imitation drugs from hitting the market. A similar argument is laid out by Montobbio (2009). Here an example of military and weapons research is cited to illustrate that there are cases where patenting and secrecy clauses can protect the public by preventing unintended knowledge spillovers.

The academic literature also contains many insights into the positive impacts that ensue heightened entrepreneurial activity and relations with industry. From the university's perspective, industrial liaisons have both practical and innovative advantages. Firstly, active collaborations with industry can lead to the securement of much needed research funds (Bok, 2003; Ueyama, 2005), the procurement of valuable industry data, expertise and equipment (Nature, 2005), and finally, the fruition of new ideas and inventions that may otherwise not have come about from academic research alone (Etzkowitz et al., 2000). As in the case of Schinazi, a HIV fighting drug developed at Emory University, the commercialisation of research results can also prove highly profitable for both the inventor and the institution. In this instance, a whopping $US 540 million (Clinton, 2005). The advantage of such income generation is that the bulk of this revenue can be reinvested back into academic research (AUTM, 2006). From the perspective of industry, there are numerous advantages that accompany collaboration with academia. This includes the gaining of access to university facilities and a wealth of creativity and expertise that is often not available in corporate laboratories (Philpott et al., 2011), in addition to facilitated access to human capital that can be 'imported' through graduate employment (OECD Secretariat, 1998). Concerning the societal benefits of university-industry technology transfer and entrepreneurialism, it should be noted that US research universities have a long history of contributing to industrial innovation (Mowery et al., 2004). Society not just in America, but all across the world, has since reaped vast and numerous benefits of this contribution. This encompasses significant advances in the fields of agriculture, medicine, engineering and aeronautical technology (ibid), to mention but a few, right through to the development of Gatorade and Google (Washburn, 2006). Others argue that the strengthening of interactions with industry and new opportunities for income generation have made universities more attentive to public needs and the demands of the market (Bok, 2003; Etzkowitz et al., 2000; Ueyama, 2010). Bok (2003) points out that the profit motive can also play an important role in encouraging universities and academic scientists to make the extra efforts required to ensure the successful commercialisation of university inventions.

2.3.6 The economic narrowing of the third mission

In response to the widely praised growth of technology transfer activities across US institutions, scholars and government policy makers elsewhere in the world keen to harness the creative powers of the university to economic ends have been quick to marry the notion of a third mission with technology transfer and the model of an entrepreneurial university (Laredo, 2007). A consequence of this development in the articulation of the third mission has been a move in emphasis from a broad form of societal contribution to a narrow conception of economic development (Culum et al., 2013). This shift in focus from society to the economy may be observed in many spheres, both inside and outside the academy. Goransson et al. (2009) observe as a global trend across 12 OECD nations that discourse on the third mission is generally dominated by the US entrepreneurial paradigm of technology transfer. Others such as Vendetti et al. (2011) and Kremarova (2012) point out that the OECD, in particular, is one of the key drivers of global discussions linking the notion of a third mission to economic activities such as patenting, licensing and creation of spin-off firms and technology parks. Especially over the last decade, this organisation is going to great lengths to emphasise economic benefits and gains in international competitiveness for governments when universities focus their third stream activities on innovation transfer and spurring regional development (OECD, 1999, 2007). In the UK, the national government even went so far as to term 'wealth creation' the key focus of the third mission (Klein, 2002; Vendetti et al., 2011). On an EU level, policy directions for the EU Commission have also been shaped by an explicit linking of entrepreneurialism and wealth creation with the idea of a third mission (Gómez-Gras et al., 2006). In government discourse elsewhere around the world, the core area of interest has tended to centre on exploiting technology transfer channels such as patenting, licencing and spin-off firm creation to drive economic growth (Culum et al., 2013; Laredo, 2007). This is also the case for the World Bank, who has also appropriated the third mission ideology to frame much of its research on technology transfer and research commercialisation efforts (see Thorn and Soo, 2006). Similar tendencies may also be observed within academia itself. In the literature, for example, the third mission is often explicitly linked with the notion of an entrepreneurial university. Often touting the university as an 'engine of economic growth' and advocating success stories from MIT or the high-tech economic prosperity supposedly attained by linkages between Silicon Valley and Stanford, pro-entrepreneurial scholarship (e.g. Clark, 1998; 2004; Etzkowitz, 1998, 2002, 2003, 2004; Etzkowitz et al., 2000; Gibb et al., 2013; Martin, 2012; Schulte, 2004) also appears to have played a large role in shaping government discourse and narrowing the dominating conceptions of the third mission to economic contributions.

The discussion to this point has focused explicitly on the growth of the entrepreneurial paradigm in US research universities. The reason for this is that since the 1900s, US institutions have continued to constitute the most exemplary and influential model of higher education in the world (Ueyama, 2010). Yet this was not to argue that the reach of the third mission regime is confined to the US. Far from being the case, many scholars (Gómez-Gras et al., 2006; Mowery et al., 2004; Philpott et al., 2011; Washburn, 2006; Yusuf, 2007) have observed that since the 1990s, governments outside of the US are pushing universities to adopt the triple-helix model and contribute to regional innovation systems and the knowledge economy though commercialisation of research results. Efforts to spur entrepreneurial contributions from other universities around the world are often carried out through the normative framing of a third mission. The OECD, also a global promoter of the entrepreneurial model largely through its 'regional development' discourse (e.g. OECD, 1999, 2007), has noted a 'copy cat' trend across OECD nations to try and emulate the perceived success attained by the Bayh-Dole Act (OECD 2002). Some of the many countries seeking to spur national innovation systems and unleash the entrepreneurial potential of the academy include Australia, Europe, Japan, Singapore, India and Latin America.

In the case of Japan, for instance, the national government has made explicit efforts to imitate the Bayh-Dole Act with a variety of legislation enactments that have served to loosen intellectual property laws, facilitate the formation of TTOs in universities, and finally, ensure the legal independence of national universities (Baba and Goto, 2007). As observed empirically by Kanama (2011) these efforts have contributed to a marked increase in the number of patent applications, spin-off firms and university-industry collaborative research; particularly since the end of the 1990s and the turn of the millennium. In an analysis of mounting entrepreneurial behaviour in Japan, Jiang et al. (2007) conclude that economic contribution through university-industry linkages now constitutes the dominating conception of the third mission in Japan.

Regarding the situation in Europe, several converging government strategies have been taken as an attempt to emulate the US entrepreneurial model and utilise university research as a key contributor to innovation and knowledge-driven economic growth (Gibb et al., 2013; Philpott et al., 2011). One of the key policy enactments has been the Lisbon Agreement of 2000 from the European Commission, within which spurring knowledge transfer is cited as one of ten key areas for action. In contrast to the US, however, there is currently a lack of reliable, historical data for the European-level to document the impact of these policies or any growth of university-based entrepreneurial activity (Geuna and Nesta, 2006; E3M Project, 2012b). Despite this, as also observed in the US by Mowery et al. (2004) and Mowery (2007), much of the long-term growth in patenting in Europe until 2000 can be attributed to the rise of the biomedicine industry. That said, the UK has established itself as a leader in Europe for taking policy actions to increase the entrepreneurial contributions of its universities to economic growth (Vermij, 2005). With US policies such as the Bayh-Dole Act serving as role model, numerous strategies such as the Science and Innovation Investment Framework for 2004 to 2014 and the Higher Education

Innovation Fund aim to boost the contribution of the UK public knowledge base to GDP (Hugues, 2007). In both of these initiatives, there is an explicit focus on fostering high-tech university start-ups through funding support as well as increasing patenting and licencing activities. Data depicting the rise of entrepreneurial activity in UK universities covers a ten-year period reaching back to 2003-2004. During this period, HEFCE (2013) has shown that there has been a marked increase (roughly around double) for income generated from activities such as consultancy, contract research and licencing of IP. In addition, for the same period, the number of patent applications lodged and granted has also approximately doubled, with the number of spin-offs increasing significantly, with the exception of 2011-2012. Overarching this effort to appraise the economic contribution of research institutions to national productivity is the enthusiastic positioning of UK universities as “drivers of growth” (Willetts, 2013). In reaction to this overt emphasis on economic contribution as constituting the core focus of the third mission, efforts to ‘correct the pendulum’ back towards society have recently emerged. For example, the E3M Project of the European Commission (2012b) is in the process of developing a set of indicators[7] and metrics to promote uptakes of the third mission encompassing broader forms of social and cultural engagement.

2.3.7 Summary

The above literature review has served to paint an overview of the global emergence of technology transfer and the conception of a third mission for the university. In doing so, it has thus described the author’s interpretation of the ‘regime’; a concept appropriated from the multi-level perspective in transitions theory (Geels, 2002). Under this regime, the societal contribution of the university has been predominantly conceived in narrow economic terms, with the idea of *societal* contributions becoming synonymous with contributing to *industry* and the *economy*. The extension of this multi-perspective lens is that the global array of co-creative partnerships tackling localised sustainability challenges could be regarded as a series of ‘niches’. The novel and experimental approaches characterising such partnerships are thus representing a deviation from the dominating practices of technology transfer and market-informed ideologies of the regime. As business as usual economic activity continues to undermine the physical condition of the planet and jeopardise its ability to support future human settlements (Millennium Assessment, 2005; WWF et al., 2012), the relevancy of the prevailing entrepreneurial paradigm in achieving desirable human development must be critically examined (Yarime et al., 2012). A critique of the third mission regime from the perspective of the literature thus becomes the goal of the following sub-chapter.

[7] These indicators encompass the three areas of: Technology Transfer & Innovation, Continuing Education and Social Engagement.

2.4 Critique of the third mission regime

In pro-entrepreneurial discourses some argue that there is no substantial evidence suggesting that the economic focus of the third mission and rise in entrepreneurial activities such as patenting, licencing and creation of start-up firms has had any discernable negative impacts on the university (Yusuf, 2007). Yet such appraisal ignores a mountain of scholarship arguing just the inverse—that the expansion of the entrepreneurial paradigm has provoked some extremely negative consequences for academic science. As Bok (2004) points out, the benefits of increased industrial activity are tangible and immediately visible. Yet the real dangers to the university and scientific research lie in the fact that the risks associated with the acceptance of these benefits are mostly invisible, only becoming apparent when it is too late to take action. Furthermore, as will be discussed below, even though the often exaggerated economic benefits of technology transfer programmes are reaped by only a few major universities, the price that must be paid in exchange for this concerns all of academia, and indeed the entire realm of science itself.

2.4.1 Questioning the relevancy of the entrepreneurial model

In the previous section it was demonstrated that technology transfer activities, along with the entrepreneurial ideology, are being promoted all across the globe in a bid by government policy makers to harness the creative powers of the university to national innovation systems. It was also pointed out that the normative lens of a third 'mission', by connoting a societal obligation, is often used as a key tool in strategies to emulate the perceived success of the US model and increase the economic contribution of academic research. What needs to be understood, however, is that the relevance of the entrepreneurial model is limited to an extremely limited array of specialised academic fields. As demonstrated earlier, these fields are mostly concentrated around biomedicine, pharmaceutics and software engineering (Mowery et al., 2004; Mowery, 2007; Shane, 2004). Furthermore, the relevancy of this model for other universities around the world appears more limited when recalling that entrepreneurial activities have only been demonstrated to work successfully in a very select set of highly prestigious institutions, mostly concentrated in the US (Yusuf, 2007). The need to critically examine the global promotion of technology transfer activities and framing of universities as 'engines of economic growth' also becomes apparent when scrutinising licencing income figures,[8] which constitute the trump cards of pro-entrepreneurial commentators. Closer analysis of these figures reveals that vast majority of income generated from technology transfer programmes originates from a handful of 'hit' inventions, once again, concentrated in an extremely small set of prestigious entrepreneurial institutions with research strengths in biomedicine and engineering (Leaf, 2005; Mowery, 2007; Sampat, 2006; Washburn, 2006). This is confirmed quantitatively by Bulut and Moschini (2009) who reveal that for the five-year period of 1998-2002, 83% of aggregate licence income in the US is traceable to 20% of universities. These findings echo earlier established figures from Sampat (2006). He shows that for the period stretching from 1991 to 2000, 60% of royalty incomes for US universities reported is generated by 10% of universities surveyed by AUTM. The implication of this observation is that the vast majority of US technology transfer programmes are either just breaking even, or running at a loss (Bulut and Moschini, 2009; Sampat, 2006). This is for the simple reason that despite all expectations, academic research rarely generates mature and

[8] For example, as already cited in Section 2.4.3, data from the AUTM shows that total royalty income for North American universities grew from U.S. $218 million in 1991 (AUTM, 2005) to $US1.03 billion in 2001 (ibid), and then $US2.5 billion in 2011 (AUTM, 2012).

commercialisable inventions or prototypes for industry (Mowery, 2007). Instead, as explained in Section 2.2.2, the true value of academic research lies in its ability to conduct blue-sky research and pursue innovative paths of enquiry that are too risky for other economic actors, and then contribute findings to the global knowledge commons. For the above reasons, attempts by policy makers and researchers across the world to enhance the economic contribution of academic research and tout the entrepreneurial model as desired practice deserve critical examination. Firstly, for academic fields outside of biomedicine, pharmaceutics and software engineering where the majority of scientific endeavour around the world is taking place, the relevancy of the entrepreneurial model is yet to be demonstrated. Secondly, financially successful entrepreneurial activities have only been proven to date by an elite set of archetypal entrepreneurial universities, mostly in the US, with technology transfer efforts for institutions outside of this privileged few either just breaking even, or running at a loss.

The second point to be raised in critique of the third mission regime is that patenting has been demonstrated by several scholars to be of extremely low relevance to the overall manner in which academic research contributes to industrial innovation. That is to say, excessive demands for patenting, licencing and spin-off firm creation are actually ignoring the most commonly used channels by which academic research is assimilated by industry. This has been shown to be the case both in the US and in the UK. The most recent study to demonstrate this point is by Cosh et al. (2006) who conducted a comparative survey on UK and US companies to gauge the types of interaction with universities contributing the most to corporate innovation. The results are surprising, and challenge the assumption that patenting is essential for transferring scientific innovation to industry. Informal contacts emerged as the most essential channel, followed by recruitment of graduates, academic publications and conferences. On the other hand, licensing of both exclusive and non-exclusive patents was shown to be the least important for the transfer of innovation to firms in both countries. Interestingly, these results closely mirror those obtained earlier from US firms by Cohen et al. (2002). Their study also concludes that patenting and licensing are of extremely low relevance in the technology transfer process to industry, with ‘softer’ channels (Philpott et al., 2011) such as publications, informal interactions, meetings and conferences and consulting cited as the most important.

Despite these findings, policy makers and commentators around the world continue efforts to propagate the entrepreneurial model, which creates the mistaken assumption that academic research is only useful if patented (Mowery, 2007). The danger of this is that excessive patenting has the potential to disrupt the flow of outputs in the other channels indicated as more significant in the innovation transfer process (Mowery et al, 2004). Piecing these two arguments together, the question that emerges is: *Could the majority of successfully commercialised inventions have been achieved without patenting?* Mowery (2007) argue that it could have, with Mowery et al. (2004, p. 97) contending that “emulation of the Bayh-Dole Act is insufficient and perhaps even unnecessary to stimulate higher levels of university-industry interaction and technology transfer”. Although patenting and licencing can play an important role in the innovation transfer process, especially in some fields such as biomedicine and pharmaceutics (Mowery et al., 2004), excessive emphasis on assertion of intellectual property rights, as will be shown below, can potentially *impede*—and not facilitate—the transfer of scientific innovation to industry.

2.4.2 Concerns that patenting can impede innovation

The core logic of the entrepreneurial paradigm is that the capitalisation of publically funded research results is necessary to maximise the university's contribution to the economy and industrial innovation. However, as set out below, the rise of entrepreneurial activity in academia since the Bayh-Dole reform of 1980 has been accompanied by criticisms from a host of scholars contending just the contrary. That is, current technology transfer trends and aggressive assertion of IPRs, is in many cases, impeding innovation by threating the traditional culture of open-science and upsetting the societal and economic efficiency at which the scientific enterprise operates.

One recurring theme in the literature concerns 'profiteering'. This term describes the temptation—or tendency—of university technology transfer programs to prioritise revenue making over the goal of ensuring that academic inventions are dispersed to interested parties as widely and freely as possibly. The possibility for universities to fall for this temptation has in effect been created by the Bayer-Dole Act, which does not discriminate between exclusive and non-exclusive licensing arrangements (Mowery et al., 2004; Nelson, 2004; Rai and Eisenberg, 2002; Washburn, 2006). This means that US universities (and institutions in those countries emulating the Bayh-Dole Act) have the right to prioritise self-interest and choose their own terms for technology transfer arrangements, even if this involves high-income winning exclusive license agreements. The problem with restricted licensing is that this prevents other bodies from freely utilising a particular patent, thereby penalising the social impact of academic research (Rai and Eisenberg, 2002; Washburn, 2006). Exclusive licenses reduce the social benefit of an invention for the reason that a good that could have been dispersed widely and cheaply through non-exclusive means, becomes controlled by an economically and scientifically inefficient monopoly. It is argued that this results in unnecessary transaction costs for the purchasing party, non-competitive pricing for the consumer, and finally, restricted access for other parties. These factors can subsequently prevent further development, improvement and, ultimately, widespread usage of an invention (David, 2003; Heller and Eisenberg, 1998; Nelson, 2004; Sampat, 2006). Put more simply, profiteering also describes a situation where "the university is simply earning money from what it used to make available for free" (Nelson, 2004, p. 468).

If prescribing to the view that universities, as public institutions, have a social obligation to ensure the widest and cheapest possible dissemination of academic inventions (Mowery et al., 2004; Washburn, 2006), the tendency of universities to pursue profitable exclusive licence arrangements is a troubling development. Reports of universities behaving in this way at the public expense have been reported by both popular literature (Bok, 2004; Leaf, 2005; Washburn, 2006), in addition to an array of scientific studies (Bulut et Moschini, 2009; Heller and Eisenberg, 1998; Kenney and Patten, 2009; Mowery, 2007; Nelson, 2004; Rai and Eisenberg, 2002; Thursby et al. 2001; Walsh et al. 2007). The most convincing evidence has come from Thursby et al. (2001). In a national survey of 62 technology transfer programmes from major universities across the US, it was confirmed quantitatively that revenue from licencing income constitutes the most important criterion by which technology transfer operations measure success. Other evidence testifying to the presence of profiteering behaviour in entrepreneurial universities is mostly qualitative, but nonetheless convincing. Mowery (2007, p. 176) cites an array of testimonies from both scientific and industrial circles (including both biomedicine and information technology) revealing that university tendencies to try and maximise licensing income are proving "a source of friction, rather than a facilitator of collaboration with industry". This aggressive pursuit of profit at the expense of maximising the public benefit has also been criticised earlier by the US National Institute of Health (NIH). In a 1998 report, NIH (1998) reprimanded universities for profiteering tendencies and ignoring the 'gift economy' that traditionally characterizes the realm of science. The report reminds U.S. research universities that "…their principle obligation under the act [Bayh-Dole] is to promote utilisation, not maximise financial returns" (Washburn, 2006, p. 156). The solution to the problem of profiteering appears to be the formulation of policy measures to oblige universities to pursue non-exclusive licences wherever possible (Kenney and Patton, 2009; Mowery et al., 2004; Nelson, 2004; Rai and Eisenberg, 2002). As pointed out by Mowery et al. (2004) and Sampat (2006), the allegation that some universities will pursue profit over the societal obligation to ensure the greatest social impact possible for academic inventions marks a dramatic evolution in university behaviour. This is because throughout most of the twentieth century, universities tended to avoided involvement in patenting and licensing—precisely for fears of being accused of profiteering at the expense of their commitment to open science.

The above discussion on profiteering tendencies of universities leads to another set of arguments against the entrepreneurial model of science, this time from an economic perspective. The economic logic of allowing universities to assert intellectual property rights over tax-payer funded research has been carefully scrutinised in the scientific literature. Conclusions from critics are generally that, despite all expectations, the entrepreneurial model is not geared for economic or scientific optimisation of knowledge resources (e.g. David, 2003; Kenney and Nelson, 2009; Nelson, 2004; Washburn, 2006). A convincing argument is laid out by Washburn (2006) who cites Sampat. Here it is contended that not only is patenting-based technology transfer unnecessary for the commercialisation of most academic inventions, but that it contradicts traditional economic theory. That is, the logic behind government financed academic research is that it attempts to correct a market failure where private companies tend to underinvest in R&D for fear of the 'spillover effect' where the results of privately financed research from one firm would be assimilated free of charge by competitors. To correct this failure, a government has the option of either issuing limited time patents to companies to protect their research results, or fund the research itself. Sampat's argument is that the Bayh-Dole policy's greatest problem is that it applies both these theories at once, hence making the public pay twice for the same invention.

The notion that patenting-based technology transfer can raise the costs of innovation is best illustrated by the case of an exclusive licence arrangement. As mentioned above, from the perspective of the university, licence arrangements restricting the use of an academic invention to a single third-party firm have the advantage of generating much higher income than patents issued widely and cheaply to several parties. From an economic perspective, however, the issuing of restricted licences penalises the market as a whole (David, 2003; Kenney and Patton, 2009; Nelson, 2004; Washburn, 2006). This is for the reason that the increased transaction costs of acquiring the invention are passed onto firstly to the purchasing party, and secondly to consumers, who are in effect forced to pay a second time for an invention that has already been financed by the public purse. Leaf (2005) presents an interesting illustration of this argument by pointing out that prices of computers and peripherals in the information technology industry (where open sharing is still common) have been characterised by spectacular and steady falls since the 60's, whereas prescription drug expenditures in the US have been conversely rising steeply for the same period. The real danger of these high-access charges caused by monopolies is long-term, and it concerns the wellbeing of knowledge driven societies (David, 2003). The sobering truth is that many of the high-profile patents to come out of the leading US entrepreneurial universities are in fact the result of years of open and collaborative research financed by the public purse. As Nelson argues (2004, p. 55), "…the market part of the Capitalist engine rests on a publically supported scientific commons". Not forgetting the earlier observation that the majority of technology transfer programmes in the US and UK are either making "negligible" returns or running at a loss (Bulut and Moschini, 2009), allegations that the entrepreneurial model has the potential to elevate the costs of innovation and penalise the economy as a whole should be heeded when assessing the need for patenting-based technology transfer.

Regarding other criticisms directed at the privatised technology transfer model, perhaps the most worrisome of all come from scholars contending that the entrepreneurial paradigm is threatening the distinctiveness and traditional culture of open science (Bok, 2004; David, 2003; Heller & Eisenberg, 1998; Mowery et al, 2004; Royal Society Working Group on Intellectual Property, 2003). As will be explained in the paragraphs below, it is alleged that the corporate model of closed-science impedes the efficiency of traditional scientific conduct and therefore, harms the process of innovation.

To understand the potential dangers posed by the entrepreneurial model, it is first of all useful to reconsider the distinctiveness of academic science (of which some aspects were briefly touched upon in Section 2.2.2). As pointed out by scholars (David, 2003; Nelson, 2004; Sampat, 2006) science is an accumulative process. Progress is often slow, with the majority of experiments and research efforts merely contributing to a greater 'stock' or 'toolkit' of scientific understanding. This global pool of knowledge is referred to by some as the 'scientific commons' (Heller and Eisenberg, 1998; Nelson, 2004). The logic of this open-access model is that when a breakthrough discovery or invention is eventually made, this is largely due to all of the scientific endeavour conducted previously. Furthermore, one of the key characteristics of the so-called 'republic of science' is a gift economy based on an ethos of sharing and collaboration as scientists freely share techniques and research results with each other (David, 2003; Washburn, 2006). It is this aspect that ensures that open science is an extremely efficient system, both in economic and scientific terms. Firstly, as data and research findings are accessible to all, they may be openly questioned and verified, and then corrected or discarded if found to be inaccurate. This open, collaborative process ensures that the bulk of scientific knowledge is reliable (Nelson, 2004) and a constant real time reflection of the latest understanding in a particular field. Two examples of this logic in action include the concept of open-source code in the field of computer programming (Kenney and Patton, 2009; Washburn, 2006) and the international climate science community. Furthermore, in the traditional open-model, because scientific information is freely accessible and functions as a 'non-rival good' (Mowery et. al, 2001) societal impact is maximised (Kenney and Patton, 2009). This is because there are no transaction costs involved in accessing information and never any need for a scientist to replicate experiments or attempt to reproduce data by him or herself. As such, there is never any need to 'reinvent the wheel'. Science thus rests at an optimal level of scientific and economic efficiency. This is for the simple reason that anyone can freely access, evaluate and contribute to the improvement of this general pool of scientific understanding.

In contrast to the highly efficient model of open-science described above, the entrepreneurial paradigm is characterised by scientists and universities behaving more and more like firms (Etzkowitz, 2008). However this has the potential to threaten the distinctiveness and openness of academic culture, penalising both scientific progress and the innovation process. The problem starts when universities and academic scientists respond to increasing pressures to patent inventions and assert IPRs over scientific information. This results in valuable knowledge being snatched from the open pool of scientific understanding and techniques (Nelson, 2004). As openness and liberal sharing of ideas and data is replaced with a climate of secrecy and competition, scientific progress becomes burdened by a breakdown of collaboration and information exchange (Bok, 2004; David, 2003; Heller and Eisenberg, 1998; Kenney and Patton, 2008; Mowery et al., 2004; Nature, 2001; Nelson, 2004). This clamping down of the lid on the scientific commons also has a secondary effect of preventing other parties further down stream from contributing to the verification or improvement of a particular technique or technology. This ultimately has ramifications for the reliability of science. Such negative effects on academic culture have been found to be particularly rampant in the fields of biomedicine and pharmaceutics where patenting is most widespread (Rai and Eisenberg, 2002). In such disciplines, it is common for corporations to forbid the sharing of information concerning sponsored research with other academics, or presenting at academic conferences (Bok, 2004). The seriousness of this problem becomes apparent when recalling the earlier observation that these traditional channels of informal communication, publications and conferences are essential for the transfer of innovation to industry. Furthermore, in the field of biomedicine, patents are often issued to research tools that used to be distributed freely such as DNA sequences, data and early-stage discoveries. As argued by Rai and Eisenberg (2002) placing restrictions on such research tools causes time and cost consuming burdens on other researchers further down stream wishing to utilise that technology. It is none other than this type of situation that has been famously dubbed by Heller and Eisenberg (1998) in *Science* magazine as the “tragedy of the anticommons”. The spread of this corporate style of proprietary science has prompted Nelson (2004, p. 470) to argue “…our scientific commons is in danger, the costs of having it erode further are likely to be high, and we ought to move to protect it”.

Although the anticommons problem is most prevalent in the life sciences and biomedicine, it is worth pointing out that there have been many protests against the privatisation of the scientific commons from other areas of science. One example is a 2003 report from the Royal Society entitled *Keeping science open: the effects of intellectual property policy on the conduct of science,* which emerged in reaction to increased patenting activities ensuing government policy reforms in the UK. Authored by an international team from both industry and academia, the report demands freer access to scientific databases and journals, imploring universities to “refrain from aggressively seeking so many patents” (Couzine, 2003, p. 406). It is asserted in the report that:

> Advances of technology and commercial forces have led to new IP legislation and case law that unreasonably and unnecessarily restrict freedom to access and to use information. This restriction of the commons in the main IP areas of patents, copyright and database right has changed the balance of rights and hampers scientific endeavour. In the interests of society, that balance must be rectified. (Royal Society Working Group on Intellectual Property, 2003, iv)

The above sentiments were then echoed shortly after by a letter addressed to the World Intellectual Property Organization (WIPO) by an elite team of 59 economists and scientists, including two Nobel Prize laureates. The group urged the WIPO to consider other forms of open-model innovation such as open-source software and Internet standards, which prove that "one can achieve a high level of innovation in some areas of the modern economy without intellectual property protection" (Butler, 2003). The letter also highlights that excessive protection of intellectual property "may be counterproductive" to scientific innovation. It should be underscore that such views continue to exist today, with rapid advances in smart phones and software innovation bringing to light many problems of the patent-based innovation model. For example, 2007 Nobel laureate in economics Eric Maskin argued in a recent letter to the editor in the New York Times in regards to software patenting that, "in an industry with highly sequential innovation, it may be better for society to scrap patents altogether than try to tighten them" (Maskin, 2012).

2.4.3 Attempts to 'tack-on' sustainability to the third mission regime

To this point it has been argued that the growth of the entrepreneurial paradigm in academia is highly problematic, of little relevance for most fields outside of biomedicine and software engineering, and most importantly, assumptions that increased patenting leads to increased innovation are mistaken. In spite of this, some pro-entrepreneurial proponents have attempted to 'tack on' the concept of sustainability and green-innovation to the above described third mission and technology transfer model in a bid to illustrate wider applications of this paradigm.

The OECD (2007), for example, has integrated the notion of sustainability into its 'regional development' discourse and lightly touched upon the potential of universities to assist efforts to spur economic development. This integration of regional development and sustainability in the context of the just mentioned OECD study has then been further explored by Puuka (2008). After lightly exploring the potential of universities to contribute to regional sustainability and climate change initiatives through empirical illustrations, Puuka's argument is that, in the context of the OECD study, "only a few universities have adopted a broad concept of sustainability and embedded it in their mission and core activities". Other scholars such as Carayannis and Campbell (2010, 2011) and Etzkowitz and Zhou (2006) have attempted to integrate the concept of sustainability and green innovation in the triple-helix discourse. By doing so, they have also acknowledged the largely overlooked role of the civic sector in the innovation process, and theoretically considered the potential of triple, quadruple and quintuple helixes to drive sustainable innovation.

In offering an overview of this small body of literature, it should firstly be pointed out that when viewed together, these studies are little more than theoretical attempts to integrate sustainability and green-innovation into firmly established discourses on related topics encompassing the third mission, regional development, triple-helix and entrepreneurial universities. As such, they lack a robust empirical demonstration of how exactly existing conceptions of the third mission or triple-helix partnerships can be used to address place-based sustainably issues. The largely techno-centric studies of Carayannis and Campbell (2010, 2011) and Etzkowitz and Zhou (2006) could also be criticised for failing to take into account non-technical forms of innovation and the many roles by which open-collaboration and experimentation between large sets of stakeholders and can advance the sustainable transformation of a particular area, region or societal sub-sector. Furthermore, with an overwhelming focus on technological innovation in service of economic development, these latter studies have also overlooked the importance of *place*-specific rather than market-specific innovation.

Despite their deficiencies, the above-mentioned scholarship could be acknowledged as harbouring the potential to contribute to the expansion of dominating notions of the third mission. In theory, the addition of the tri-dimensional concept of sustainability (i.e. society, economy and environment) into the entrepreneurial paradigm could assist in bringing the pendulum back from entrepreneurialism in service of economic growth to a broader form of social development based upon specific place-based needs. In reality, however, such ideological attempts to green the entrepreneurial paradigm remain as little more than marginal rhetoric. With the bulk of discussions fixated on tying academic research to economic ends, the sustainability agenda has been greatly overlooked by the third mission regime.

In any case, attempts to incorporate the concept of sustainability into the third mission ideology could be viewed as a futile attempt to 'mix oil and water'. As argued above, the vast majority of technology transfer activities emerging in response to policy measures calling for increased entrepreneurial activity have occurred in the fields of biomedicine, pharmaceutics and software engineering. The role that these disciplines could play in assisting the urban transition to sustainability cannot be dismissed as being zero. Yet it is perhaps not as evident as other fields such as urban planning and design, engineering, agriculture, environmental sciences, energy and many other fields in the social sciences where the relevancy of the entrepreneurial model is yet to be demonstrated. More important still, the incompatibility of sustainability and the third mission may be observed in the capitalist ideologies driving the spread of the entrepreneurial paradigm. With its distinct focus on wealth creation and the privatisation of resources that were once part of the public domain, it becomes quickly apparent that the third mission regime seems largely at odds with the holistic, democratic and value-laden paradigm of sustainability that is required to drive sustainability development in the 21st century (Eckersley, 2006; Griggs et al., 2013).

For the above reasons, the author's position is that the potential of the third mission regime and conventional technology transfer model to function as a guiding concept or propelling force in the quest to advance the sustainability of human settlements is yet to be proven. This is despite the above-described theoretical attempts to integrate the concept of sustainable development or green innovation into the entrepreneurial paradigm.

2.4.4 Summary

Despite the array of problems brought to light in this sub-chapter, it is the above-described entrepreneurial paradigm that currently forms the regime and enforces expectations on the most desirable way for the university to contribute to society. Although the idea of a third mission could potentially signify a broad and varying way of contributing to societal, economic and cultural development, under the current third mission regime all of the focus is upon the economy. Societal contribution has become synonymous with economic contribution.

At present, the vast majority of entrepreneurial activities in academia are shown to be confined to a select few fields in a select few institutions, mostly in the US. However, the entrepreneurial mythology is being widely promoted and normalised across the globe through powerful academic and government discourse fixed on marrying university research activities to the goal of driving knowledge-based economic growth. The prescriptive utilisation of the term ‘third mission’ has been a key part of that strategy. Despite the relative concentration of the entrepreneurial paradigm to a few fields and institutions, the problems provoked by this model of societal contribution have been vast, with serious implications for the entire realm of science. Based upon the evidence present above, it seems only reasonable to conclude that if this model was further propagated in academia, as it currently is, then the magnitude of these problems would only increase. More importantly, the entrepreneurial model has been shown to be largely ignorant of the traditional channels of university interactions with industry that contribute the most to innovation. Further, it has also overlooked the importance of maintaining the distinct ‘gift-economy’ culture of open-science in its quest to further the economic contribution of the academy. Contrary to the capitalist ideologies that pushed the emergence of the Bayh-Dole Act and its subsequent emulations around the world, it is modern science’s very commitment to collaboration and sharing that has made it such a powerful enterprise and an essential contributor to the world economy.

Global and local manifestations of diverse sustainability challenges such as climate change, food, water and energy security, ecological decline and decaying socio-economic conditions are threating the relevancy of pursuing economic development alone. The needs of human settlements in this century are situated at the intersection of social, environmental and economic interests. As conveyed in Section 2.1, the required response to this sustainability crisis is one of open and experimental collaboration between diverse sets of stakeholders; one also employing a vast array of social-technological innovation and social engagement paradigms. More importantly, the adequate tackling of sustainability issues requires a holistic and value-laden paradigm that is fundamentally different to that driving the spread of entrepreneurialism around the globe. In such a context, the relevancy of the prevailing entrepreneurial model in achieving desirable human development in the 21st century appears doubtful, and yet to be proven. The need for an alternative mission and ‘social contract’ between academic science and society (Gibbons, 1999) has thus never been greater. For a research university seeking to apply its expertise and innovation to the goal of building a sustainable community in a specific locality or region, clearly an alternative model of engagement with society is required. It is time to think beyond the third mission.

2.5 Summary of chapter

Coupled with empirical observations, insights from a broad range of literature in this chapter have provided the theoretical underpinnings for the rest of this dissertation. The following discussion summarises some of the key arguments laid out to this point.

Sub-chapter 2.1 presented the theme of sustainable urban transformations. It provided firstly an overview of the literature on urban sustainability, offering a framework for understanding the global and local dimensions of diverse sustainability challenges facing urban settlements around the world. This was in addition to identifying several principles of urban sustainability and resiliency. After drawing attention to the necessity and desirability of advancing the sustainability of urban zones around the Earth, it was argued that the tackling of urban sustainability challenges requires fundamental transformations of the physical environmental and various interlinked social, economic, technological, political and cultural systems. It was also contended that the only feasible way of achieving such complex social transformations was through collaboration and the mobilisation of required stakeholders and institutions into a comprehensive framework for action and experimentation.

Sub-chapter 2.2 then turned to the subject of the university. It provided an extensive review of the scholarly work pertaining to university sustainability partnerships. It began by tracing the historical emergence of the sustainability agenda in higher education institutions around the world. It then examined a growing body of literature on university-driven initiatives (mostly descriptive and in the form of case studies) documenting university partnerships to tackle local or regional sustainability concerns such as energy and food security, energy efficiency, transport, deterioration of the built environment, socio-economic regeneration and so on. The author then brought attention to the special capacity of the university to compliment the transformative potential of cross-sector sustainability partnerships through its a) societal positioning as a trusted non-profit institution, b) ability to generate both technical and social innovation and c) capacity to function as a regional governor and linker. It was then highlighted that the body of scholarship dealing with university sustainability partnerships was still developing and, due to an overwhelming presence of descriptive and small-n sets of case studies, the global emergence of co-creative initiatives to advance urban sustainability is still not well understood. In particular, a need was highlighted for robust theoretical frameworks and strategic comparisons across a large body of cases—gaps that will be addressed by the remainder of this dissertation. Lastly, transitions theory was then utilised to interpret and contrast the emergence of novel and experimental forms of stakeholder collaboration in the context of urban sustainability against the established ‘third mission regime’.

The third mission regime was then explored in detail in sub-chapter 2.3. Here the concept of a third mission was interpreted predominantly from the perspective of a large body of literature dealing with technology transfer and the model of an entrepreneurial university. After tracing the factors shaping the entrepreneurial transformation of the university, growth of technology transfer trends in the US and the rest of the world was demonstrated empirically. Against this backdrop of mounting entrepreneurial activity, it was then asserted that the normative idea of a third mission for the university has been predominantly conceived in narrow economic terms, with conceptions of societal contributions becoming synonymous with contributing to industry and the economy.

From this perspective it was contended that the idea of a third mission for the university seems unlikely to prove a positive driving force in the quest to advance the sustainability and resiliency of urban centres around the world. In essence, this is due to an excessive focus on spurring economic development and technology transfer activities, which as shown, are predominantly concentrated in a narrow set of fields and institutions.

Sub-chapter 2.4 was then given to providing a critical analysis of the rise of entrepreneurial behaviour and conventional technology transfer trends in academia. Core arguments were that, contrary to expectations, current technology transfer trends and the rise of entrepreneurial behaviour are potentially generating detrimental effects on innovation and the traditional culture of academic science. It was emphasised that academic science is able to fulfil its greatest economic and social contribution when committed to values such as a sharing, collaboration and openness.

In this manner, a case was laid out in this chapter to move expectations regarding societal contributions from the university beyond the narrow economic focus of a third mission framed in terms of conventional technology transfer and entrepreneurial interactions with industry. As the summary of worldwide criticisms directed at the dominating IPR-based model of societal engagement revealed, there is a clear need in academia for a new model of stakeholder collaboration capable of addressing the limitations and problems in the dominating paradigm of technology transfer and economic development. This new model must be able to respond to complex and specific place-based sustainability challenges, contribute to the advancement of a more holistic type of environmental, societal and sustainable development, and more importantly, facilitate the university in carrying out existing core missions of education and research.

The rest of this dissertation will now be given to the analysis of the emerging model of co-creation for sustainability. As will become apparent, it will be argued that this alternative paradigm of stakeholder engagement can respond to the many concerns directed at dominating enactments of the third mission. As well as addressing societal needs in a vast array of socio-economic settings, it will be demonstrated that this new model can enable the holistic pursuit of a societal development, with relevance to a large range of academic fields. It will also be contended that the co-creative sustainability model can address complex and pressing sustainability challenges of particular locations and sets of stakeholders and, more importantly, enhance the societal relevance and effectiveness of other university functions such as research and education.

Chapter 3
Co-creation for sustainability: Theory and methodologies

Purpose: To present the conceptual and methodological dimensions of this study, explaining the appropriateness, limitations and potential problems of the various approaches and research methods employed.

The previous chapter laid out the theoretical foundations for this thesis. It accomplished this by conducting a sweeping inter-disciplinary literature review covering various topics such as urban sustainability, cross-sector university partnerships for creating urban transformations towards sustainability, and finally, defining attributes and problems of technology transfer patterns, which currently serve as the dominating paradigm of societal stakeholder collaboration. In brief, a need was laid out for a new university model of societal engagement that would both address these concerns as well as the pressing and complex sustainability needs of humanity in this century.

This chapter begins by presenting the author's concept of 'co-creation for sustainability'. This will form the conceptual lens by which the emerging trend of university-driven and cross-sector partnerships for urban sustainability will be interpreted for the rest of this study. This chapter then outlines and justifies the specific scope of this dissertation, subsequently providing an overview of the research design and process by which the goals of this dissertation have been pursued. Being a mixed-methods and empirical study encompassing both a macro (global) and micro (individual cases) dimension, this chapter then explains the specific data gathering methods employed and discusses their appropriateness, limitations and potential problems. More precisely, the empirical research of this dissertation is driven firstly by both a global-level analysis of 70 partnerships from industrialised nations in Europe, Asia and North America, and secondly by a detailed analysis of two case studies: the *2000 Watt Society Basel Pilot Region* by the ETH domain in Switzerland, and the *Oberlin Project* by Oberlin College in the US. Regarding the macro-dimension, three analytical tools are discussed: a definition of four types of university partnerships for sustainability and two analytical frameworks of which the objective are to identify and compare across the 70 cases in the global sample a) common attributes such as urban sub-systems targeted, actor types involved, partnership triggers and mechanisms; and b) commonly encountered drivers and barriers, in addition to conducting an appraisal of partnership effectiveness and impacts attained.

3.1 Conceptual framework: Co-creation for sustainability

At this point, the author would like to introduce the conceptual framework of 'co-creation for sustainability'. This term is employed firstly as a verb to describe the process by which cross-sector partnerships collectively bring about societal transformations towards greater sustainability. It is also used as an adjective (i.e. *co-creative*) to indicate cross-sector partnerships falling into the scope of the type of partnerships considered for this study (see Section 3.2 below for a discussion on the scope of this study).

The development of the conceptual framework of co-creation for sustainability has been justified by the empirical 'preview' from Chapter 2 revealing that many key attributes of recently formed cases are yet to be adequately explored by the literature. This failure to incorporate the more ambitious and pioneering cases around the world means that existing scholarship has not fully accounted for the degree of novelty, ambition and socio-historical significance of the global emergence of cross-sector university partnerships for urban sustainability transformations. This is because many frontrunner cases like those briefly presented in Chapter 2.2.4 are characterised by highly pioneering approaches and deep, sustained societal interventions. The creation of this conceptual lens for what others have termed 'university-community partnerships' (Stephens et al., 2009), 'regional sustainability initiatives' (Zilahy and Huisingh, 2009) and 'multi-actor learning networks' (De Kraker, 2013; Valkering et al., 2013) is also justified by the earlier argument from scholars that, overall, current literature on university sustainability partnerships is lacking robust methodologies and solid theoretical grounding (Karatzoglou, 2011; 2013; Stephens et al., 2009).

In seeking to address this need for theoretical development, the author defines co-creation for sustainability as a role where the university:

> …collaborates with diverse social actors to create societal transformations in the goal of materialising sustainable development in a specific location, region or societal sub-sector (Trencher et al., 2013b).

The appropriation of the term 'co-creation' is derived from the work of Pralahad and Ramaswamy (2004) and Ramaswamy and Gouillart (2010) who use this to describe an increasing global trend where corporations are allowing customers to participate in product development. This term thus describes a paradigm shift from a firm-centric and closed model of innovation to a process where value is jointly created by both companies and customers. The suitability of this term to describe collaborative experiments and an innovation process carried out in pursuit of advancing sustainable development has been demonstrated recently by a study from the field of transitions management (Nevans et al., 2013). In the context of this dissertation, this conceptual lens of 'co-creation for sustainability' is seeking to describe initiatives driven by university actors which typically:

- involve formal or informal collaborations with any combination of external stakeholders from government, industry or civil society, and other academic institutions

- aim to advance the sustainable transformation of a particular location or region (of any geographical scale) or a societal sub-sector of that area (such as energy, transport or food systems, for example)
- involve societal interventions on a predominantly off-campus location, region or set of external stakeholders

The articulation of the above concept of co-creation for sustainability is also reflective of growing international interest in the ‘co-design’ and ‘co-production’ of knowledge for sustainability—core principles of the Future Earth initiative[9] (Future Earth, 2013). However, the selection of the term ‘co-creation’ is intended to contrast with the notion of merely ‘co-producing’ scientific knowledge (Hegger et al., 2012), which per say, does not necessarily guarantee action or lead directly to the transformation of a particular geographical area or societal sub-system. As a further distinction from other related frameworks in the literature, the use of the term ‘transformations’ in this dissertation as opposed to ‘transitions’ (Geels, 2002) is to emphasise the physical and permanent socio-technical and environmental changes that co-creative partnerships can potentially manifest. Also meriting emphasis is the author’s explicit focus on university-driven acts of physically intervening on society to co-create various social, technological and environmental transformations.

Figure 3.1 Spectrum of co-creation for sustainability (own source)

Another conceptual dimension of the author’s articulation of the function of co-creation for sustainability concerns the objective of the collaboration. As can be seen from Figure 3.1 above, on one end of the spectrum the co-creative function may emerge from a partnership formed primarily for the purposes of conducting research, demonstrations or scholarly investigations such as case studies. Partnerships formed on this side of the scale are mostly about the co-production of knowledge, tools and ‘blueprints’ destined for other actors to drive socio-technical transformations towards sustainability. Collaborations emerging under this paradigm will typically involve few societal interventions. As such, they correspond closely with traditional or more established functions of the university such as scholarship, basic research and technology or knowledge transfer. On the other end of the scale, the co-creative function may also emerge from a collaboration where the chief objective is not so much that of producing scientific knowledge as it is of bringing about the physical transformation of a particular area, region or social system. This is typically the case for those partnerships involving administration-led real estate development, or explicit attempts to generate socio-economic transformations in a particular area or city. Being the more ambitious of these two objectives, partnerships formed on this side of the

[9] See section 7.4.6 for more details on the Future Earth initiative.

scale will involve far more physical and sustained interventions on society than those formed under the traditional paradigm. That said, an inevitable 'by-product' of sustainability initiatives of this nature will often include transferrable scientific knowledge and tools. However, their creation must be viewed more as a means than an end. Collaborations formed on this side of the spectrum can be interpreted as further from the traditional functions of the university, yet much closer to a high-intensity state of co-creation for sustainability.

Figure 3.2 Key properties of co-creation for sustainability (Source: Trencher et al., 2013b)

The other theoretical dimension of the proposed concept of co-creation for sustainability concerns the historical roots of this function. As argued elsewhere (Molnar et al., 2011; Trencher et al., 2013a, 2013b), the trend of university actors reaching across campus confines to collaboratively bring about sustainability transformations in urban and sub-urban settings should be interpreted as an accentuation or evolution of previously established research and social engagement paradigms. For example, the exploitation of real estate development and construction to bring about the physical transformation of urban areas and revive local economies is clearly a manifestation of a well-established trend documented in the 'urban reform' literature (see Perry and Wiewel, 2005; Wiewel and Perry, 2008). The idea of collaborating with others outside of academia in order to tackle real-world problems in the community and utilise the local environs as a 'living laboratory' could be interpreted as a historical extension or re-incarnation of the land-grant mission (Molnar et al., 2011). In other ways, intimate collaborations with industry and government and efforts to trial, commercialise and diffuse technological innovation is a clear manifestation of the 'triple-helix' relations observed by Etzkowitz et al. (2000)

and technology transfer trends (see Mowery et al., 2004, Mowery, 2007). From another perspective still, the collaboration of scientists and practitioners to mutually define and tackle various sustainability problems can be viewed as a development of 'transdisciplinarity' as defined by Haberli et al. (2001) and Scholz (2000). Lastly, the alignment of university functions such as research, education and campus development with regional economic needs is a well-defined mode of societal engagement in the 'regional development' literature (OECD, 1999, 2007).

Despite these historical roots and similarities to other more established research and social engagement paradigms, some aspects of the emerging co-creative function appear to be highly novel. The most significant is the combining of these previous roles into a systematic response to localised sustainability challenges, together with the integration of values of sustainable development[10]. In choosing the term 'co-creation for sustainability', the author is therefore attempting to describe a recent, ambitious and systematic synergising of many previously established research and social engagement paradigms depicted non-exhaustively in Figure 3.2 above. These are exploited in varying degrees and combinations by a coalition built explicitly upon values of sustainable development and used in the goal of driving any combination of technological, social or environmental transformations towards sustainability in a specific location, region or societal sub-system.

[10] The Earth Charter Initiative contains a useful description of the values and principles of sustainable development as agreed to by the international community. See URL http://www.earthcharterinaction.org/content/pages/Read-the-Charter.html

3.2 Research scope and design

3.2.1 Scope of this study

As already mentioned, this dissertation is concerned with analysing specifically university-driven partnerships with other societal sectors of which the goal is to collectively create societal transformations in view of advancing the sustainability of a particular area (i.e. community, town, city or region etc.) or a societal sub-sector (e.g. energy, transport and so on). More precisely, this study has limited its scope to any on-going or completed partnership which:

1. Has the objective of advancing the sustainable transformation of a specific urban area or or societal sub-system in industrialised Europe, Asia or North America.
2. Is mainly initiated and co-ordinated by university actors.
3. Involves a continued collaboration with any combination of partners from academia, industry, government and the civic sector.
4. Mainly addresses a community of *external* stakeholders.

These criteria were deemed necessary to ensure a consistent focus throughout the study. They have been designed in a re-iterative process and fine-tuned over the course of the research and sample collection period (described in Section 3.3.2). The intention has been to exclude various types of other partnerships, for reasons explained in Table 3.1 below.

Table 3.1 Types of cases purposively excluded from this study

Those partnerships…	Rationale
Targeting non-industrialised nations.	To ensure a consistency of socio-economic and political conditions between cases.
Driven chiefly by industry, government or civil society.	To ensure a focus on the specific role of university actors, who are both the focus and chief target audience of this study.
Led by community colleges or government research laboratories.	To ensure a focus on the (research) university; the chief target of this study.
Constituting 'on-campus' initiatives directed mainly at internal actors.	To focus on an emerging trend where universities are shifting their focus to 'off-campus' sustainability collaborations and forming partnerships with diverse external actors.
Seeking chiefly to produce *knowledge* rather than trigger a physical, societal *transformation*.	To concentrate on *transformative action* rather than on *knowledge production.*
Not targeting a specific location, region or country.	To distinguish and analyse specifically place-based initiatives as opposed to those seeking to create generic, universal knowledge.
Targeting a predominantly rural location.	To ensure a consistency of environmental and socio-economic conditions between cases.

Concerning the decision to focus specifically on cases from industrialised (i.e. 'high income' as defined by the World Bank[11]) nations in Europe, Asia and North America, this was firstly to allow for a global perspective and encompass a wide range of cultural, linguistic, political, technological

[11] The World Bank defines as high-income economy as a country with a gross national income per capita above US$12,615 in 2012. See URL: http://data.worldbank.org/about/country-classifications

and academic contexts. Yet, on the other hand, it was to ensure some degree of consistency regarding socio-economic and political conditions. Secondly, this decision was also shaped by an awareness that the vast majority of the world's most influential research universities are disproportionately concentrated in the industrialised nations of these three continents[12]. Finally, this geographic scope was also designed to ensure a manageable sample pool for the reason that all data collection and analysis was carried out by the author alone.

Also regarding the above criteria, a major distinction emerges between this study and other scholarly attempts to identify and analyse large numbers of urban sustainability experiments and collaborations across the world. That is, in this dissertation there is an explicit focus on *academic* partnerships. This is in stark contrast to, for example, the Bai et al. (2010) analysis of 30 *sustainability experiments*[13] from across Asia, which contains no cases involving university actors. It also distinguishes itself from—if not contradicts—results obtained from the *urban climate change experiments* survey of 100 cities around the world by Bulkeley and Castan Broto (2012) and Castan Broto and Bulkeley (2013); again both of which focus on non-academic partnerships. Despite employing similar selection criteria[14] to those used in this dissertation, Bulkeley and Castan Broto came to the surprising conclusion that actors from scientific or academic organisations play "a very limited role" in urban climate change experiments (2012, p. 12).

3.2.2 Research design and process

The research design of this dissertation is founded upon the assumption that, as argued in Chapter 2, existing theory and analytical frameworks in scholarship pertaining to the subject of university sustainability partnerships is insufficient for the following reasons:

- There has been little attempt to 'connect the dots' between a significant number of cases around the world to identify commonalities and differences, and assess the extent to which co-creative partnerships for urban sustainability transformations have propagated in academia.
- There has been little attempt to interpret the academic function of co-creation for urban sustainability transformations from a broad, socio-historical perspective.

Based upon these assumptions, a set of research objectives was formulated in Chapter 1. In this dissertation, the worldview behind the research is that of a *pragmatist* (Tashakkori and Teddlie, 2003) where typically, the researcher allows the research objectives and questions to dictate the choice of methodology, which often results in mixed methods (i.e. both qualitative and quantitative) being employed simultaneously. To facilitate this process and ensure that the research design and process would best serve the fulfilment of these objectives, the research objectives have been rephrased as follows:

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[12] For example, if citing the influential Academic Ranking of World Universities from Shanghai Jiao Tong University (2012), institutions listed in the top 100 are distributed as follows: North America: 56 (USA: 53, Canada: 3); industrialised Europe 29; and industrialised Asia: 4 (Japan: 4)

[13] Sustainability experiments are defined by Berkhout et al. (2010, p. 262) as "planned initiatives that embody a highly novel socio-technical configuration likely to lead to substantial (environmental) sustainability gains."

[14] Bulkeley and Castan Broto (2012, p. 361) define climate change experiments as "purposive interventions in urban socio-technical systems designed to respond to the imperatives of mitigating and adapting to climate change in the city". Their specific criteria is as follows: 1) an initiative or intervention constitutes an experiment where it is a purposive attempt to reconfigure one or more socio-technical system for specific ends 2) a climate change experiment where the explicit purpose is to reduce greenhouse gases or to adapt to the effects of climate change, and 3) urban in so far as it is conducted by or on behalf of an (imagined) urban community.

Objective 1: To create a bird's eye view of the phenomenon and conduct a macro-level analysis
Objective 2: Same as above
Objective 3: To 'zoom up' and analyse the specific attributes, processes and mechanisms of individual cases

These simplified sub-objectives require research to be conducted from the following perspectives:

Objective 1: Global macro-level
Objective 2: Same as above
Objective 3: Individual case micro-level

These perspectives have thus called for the following research methodologies:

Objective 1: Macro-level empirical research (sample collection and database creation, analytical framework creation and application, statistical analysis)
Objective 2: Same as above
Objective 3: Micro-level empirical research (qualitative, individual case studies)

Table 3.2 Summary of research objectives, perspectives and methods

Research sub-objectives	Perspective required	Methods required
1. To determine from a global perspective key attributes, commonalities and differences characterising co-creative university partnerships for urban transformations towards sustainability.	*Global macro-view*	Macro-level empirical research • Sample collection and database • Analytical framework creation • Application of framework and quantitative analysis
2. To determine from a global perspective commonly encountered drivers and barriers, assessing overall effectiveness and impacts.	*Global macro-view*	Macro-level empirical research • Analytical framework creation • Application of framework via both quantitative and qualitative analysis
3. To build an in-depth, qualitative understanding on contrasting co-creative partnerships initiated by frontrunner institutions with a special regard to: motivating factors, stakeholder type and roles, mechanisms, sustainability impacts attained, drivers and barriers encountered, and lastly, strengths and weakness of the approach.	*Micro-view*	Micro-level empirical research: • Individual, detailed case-studies • Data collection via semi-structured interviews, field visits and document analysis

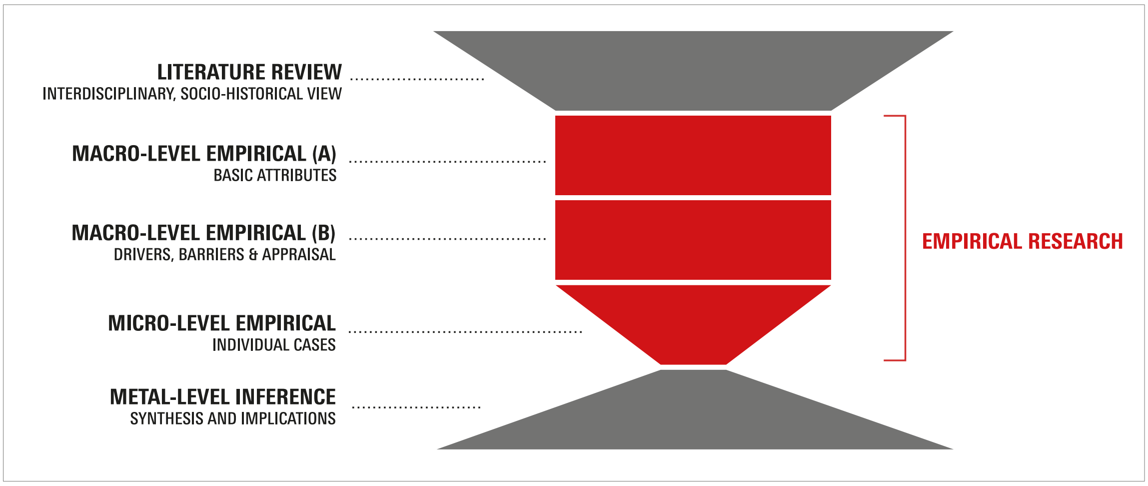

Figure 3.3 Structure of research design

It is therefore these data generation techniques that have determined the overall structure of this dissertation. Table 3.2 below summarises the above discussion, with detailed explanations for each specific method following in later sections.

The above Figure 3.3 shows the ‘physical’ structure of the dissertation emerging from the above pragmatic approach to the research questions and objectives. The aim of the theoretical component or literature review is to enable a pre-understanding of the problem field. This was achieved by acquiring broad, interdisciplinary and theoretical knowledge about the nature of urban sustainability issues, the emergence of co-creative university partnerships for urban sustainability transformations, in addition to the dominating stakeholder collaboration model of technology transfer. The macro-level empirical layer enables a more focused yet still ‘bird’s eye’ view of various cases from around the world and enables a ‘join the dots’ process of identifying key commonalities and differences. The macro-level, or individual case studies component, enables a close-up descriptive and explanatory analysis of factors influencing the partnership type, characteristics, processes and outcomes. Then, as conclusions are inferred from the previous sections, the final objective of the dissertation is to discuss implications of the emerging trend of co-creation for sustainability from a variety of perspectives such as policy and sustainability science, in addition to a broader socio-historical view of the university’s role in society.

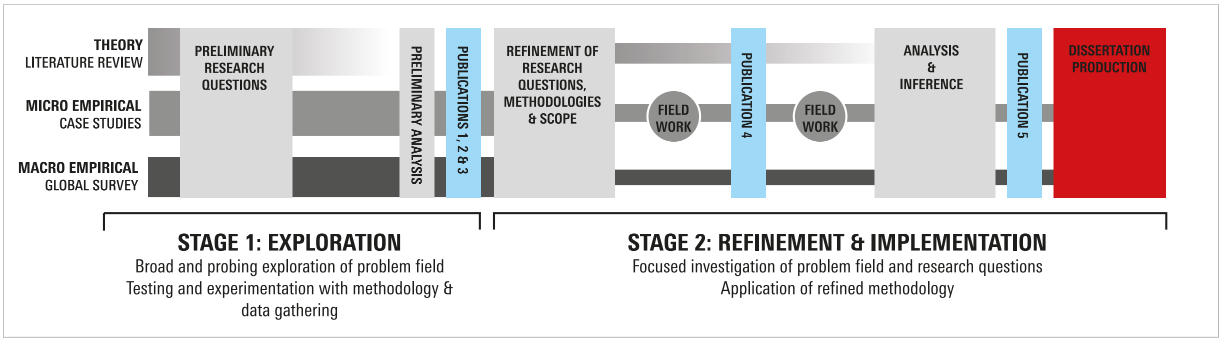

Figure 3.4 Chronological process of research

The chronological process by which research for this dissertation was carried out is described above in Figure 3.4. Regarding Stage 1, research questions were only loosely defined during this period of searching, probing and building of the basic knowledge required to understand the problem field. As can be seen, in this initial exploration period the literature review and data collection for both the macro and micro-level of the empirical research was conducted in parallel to enable a simultaneous pursuit of the first two objectives of the study (as explained in Table 3.2). This was principally for the reason that the *in situ* analysis (i.e. ongoing study of a 'live', unfinished case) and collection of data for both the macro and micro-levels was a continual process requiring an extensive period of time to gain insight into progressive results and mechanisms at work in various cases. As the illustration shows, data collection for both the case studies and database continued for the duration of the entire thesis, even though it became much more focused during Stage 2. This meant that the amount of samples obtained for the database increased steadily over the lifetime of the study, with many cases only being found in the advanced stages of the research. During the latter part of Stage 1, efforts were diverted from the literature review to a preliminary analysis of results after data and an elementary understanding of the problem field emerged. Initial results were compiled into three publications (Yarime et al., 2012; Trencher and Yarime, 2012; Trencher et al., 2013a).

After this exploration stage, the research entered a stage of refinement and implementation. The research approach, methodology and research questions were polished or re-worked, which then led to a much more focused review of the literature and data gathering for both the macro and micro-levels of the empirical research. During this time, fieldwork directly connected to the individual case studies was conducted, with results for all three levels of the research published (Trencher et al., 2013b). Concerning the final process of analysis and inference, this could only be conducted once all findings and evidence had been analysed from the three sub-objectives. This advanced period also marked the contribution to a final publication, which integrated analytical frameworks from this dissertation (McCormick and Trencher, 2014).

3.3 Methods for macro-level empirical research

Results of the macro-level empirical research conducted for this dissertation are presented in Chapter 4 and Chapter 5. These have been generated with a combination of the following three methods, which have also been summarised below in Figure 3.5.

1. The creation of a large-*n* sample of co-creative partnerships for urban sustainability transformations via the identification of suitable cases and construction of a database.
2. The generation of analytical tools. These included:
   - Typology of co-creative partnership types
   - Analytical Framework [A] for identifying key traits, commonalities and differences
   - Analytical Framework [B] for i) identifying drivers and barriers and ii) assessing partnership effectiveness and impacts.
3. The application of the analytical tools to the sample pool through data sourced from secondary documents and quantitative and qualitative questionnaires.

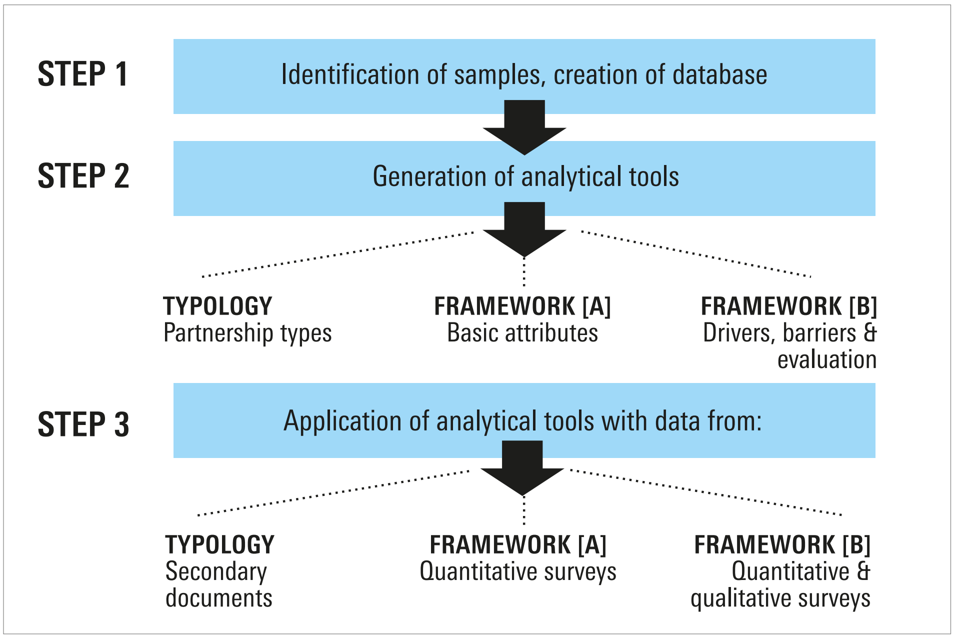

Figure 3.5 Summary of process for macro-level empirical research

3.3.1 Justification of approach

The creation of a large-*n* size sample and analytical frameworks, followed by a statistical analysis through the lens of that particular framework has been previously demonstrated in the context of non-academic cross-sector sustainability partnerships by scholars such as Bai et al. (2010), Pattberg et al. (2012), Bulkeley and Castan Broto (2012) and Castan Broto and Bulkeley (2013). As all of these studies have shown, the combination of these three methods can result in the generation of a rich array of quantitative, macro-level data. Such data can be used to create statistical representations of key traits and patterns for variables such as: societal sub-system targeted, partnership functions, actors involved and reasons behind partnership formation.

Regarding the database method, the necessity of establishing an inventory of various cases from around the world stems from two observations. The first is that to the best of the author's knowledge there is currently no comprehensive database available specifically for *university*-driven partnerships which satisfy the criteria outlined in Section 3.2.1. Secondly, to date most of the scientific literature in the field of off-campus university partnerships for sustainability consists of individual or small-*n* sets of case studies (e.g. Evans and Karvonen, 2013; Lienen et al., 2004, 2005; Mero, 2011; Orr, 2011; Peer and Stoeglehner, 2013; Pothukuchi, 2011; Valkering et al., 2011; 2012). As such, it is currently impossible to a) ascertain to what extent the trend of co-creation for sustainability has emerged in academia across the world and b) to conduct a systematic comparison to identify key similarities and differences between various cases. To solve this problem, a large sample pool and database has been created for this dissertation to establish the initial overview of the phenomenon of co-creative partnerships for urban sustainability transformations. As pointed out by Pattberg et al. (2012, p. 7), a database has the advantage of facilitating a global understanding of the entire phenomenon beyond the restricted view offered by individual case studies. Furthermore, a database has the ability to put into perspective the individual details and characteristics of individual cases by positing them against the “overall universe of partnerships”.

The utility of analytical frameworks to conduct systematic and comprehensive comparisons between a large-*n* pool of cases has also been demonstrated by the literature. For example, Bai et al. (2010) employed a quantitative questionnaire method to obtain data that was used to indicate which variables in their framework best described the various attributes present in a sample of 30 sustainability experiments from developing Asia. This study was able to use the score-based data results to generate a variety of statistical representations showing factors such as: actors involved in the experiment, sustainability focus areas, partnership triggers and various barriers encountered.

In summary, all of the above-mentioned large-*n* studies have led to insightful quantitative and qualitative data that has contributed significantly to a comprehensive understanding in the wider field of non-academic sustainability experiments and climate experiments and partnerships. This observation hence serves as a key justification for the choice to employ in this dissertation the triple method outlined in Figure 3.5 consisting of 1) identification of suitable samples and construction of a database, 2) creation of analytical frameworks, and 3) application of frameworks with data from both secondary sources and quantitative questionnaires. Although from slightly different fields and contexts, the above-mentioned prior studies represent important points of reference for the specific methods used in this dissertation.

3.3.2 Step 1: Explanation of sample collection and database

3.3.2.1 Data collection methods

Having established the criteria for the specific type of university sustainability collaboration targeted by this study and the geographical scope of the sample region, initial efforts were focused on locating suitable examples and collecting data. This period extended from June 2011 to November 2013. In essence, any case found satisfying the criteria outlined earlier in Section 3.2.1 (either ongoing or completed) has been included into the database. In the initial stages, there was no decision to limit the *n*-size of the sample pool. However a decision was made in August of 2013, based on time restraints, to limit the final size of the sample to 70 cases. Over the first 12 months or so, the author refrained from intentionally targeting one country or region more than another. However, as the sample base grew, biases towards certain regions or countries appeared as a result of cases for some nations being easier to locate than for others. Therefore, in the second and third year more time was allocated to search efforts in those countries or regions where suitable sustainability partnerships were not readily found.

To encompass cases from non-English speaking contexts, search activities in English were supplemented with French and Japanese (two foreign languages understood by the author). Regarding specific search techniques, an approximately equal amount of time was devoted to each of the following methods listed in Table 3.3 below.

Table 3.3 Methods used for data gathering

Search method	Specific technique
Internet searches	Systematic searches with various combinations of the following keywords (in English, French and Japanese) with *Yahoo* and *Google search engines*: 'city/country name', 'sustainable', 'low-carbon', 'climate', 'partnership', 'collaboration', 'university', 'corridor', 'smart', 'city', 'urban laboratory' etc. Searches through key databases (see Appendix 5 for full list) including: • government funding agencies • sustainability organisations and research institutes (both public and private)
Document review	Scan of academic literature, press articles and sustainability organisation newsletters.
Communication with peers	Conference participation, in addition to informal (oral) and formal (email) requests for information sharing from other scholars working in diverse fields related to sustainability.
Communication with experts	Formal (email) requests for information sharing from experts working in key organisations such as university sustainability offices, regional development agencies, local government and sustainability institutes and networks.

3.3.2.2 Database method

Once the suitability of a case was determined by analysing websites and online documents relative to the eligibility criteria from Section 3.2.1, efforts then turned to the retrieval of more detailed information. This was then condensed into an Excel spread sheet database, for which a simplified summary has been compiled in Appendix 1. The retrieval of more detailed data was carried out both by online searches and personal requests to key persons in each case for suitable documents. The combination of these two methods allowed the retrieval of an array of secondary data from varied sources such as official Internet sites, press articles, scholarly publications, conference presentations and university or partnership publications. On top of this, qualitative data was also generated from a total of 16 semi-structured interviews for seven individual cases (see Appendix 2)—in addition those for the case studies (see Table 3.10 and 3.11). All of this data was stored in an electronic folder for each partnership. The Excel database was divided into three sheets: Europe, Asia and North America, with the following points of interest integrated into the structure:

- name
- leading university/research institute
- other university/research institutes involved
- target country/area
- implementation period
- objectives

- description of approach and key characteristics
- specific focus areas
- funding information (amount, period and source)
- external partners
- URL address of official website (where available)
- contact information for co-ordinating actors

The above-described construction and analysis of the 70 case global sample and database thus serves as the backbone for the empirical elements of this research.

3.3.3 Data quality issues and limitations

As a result of using the above search techniques for identifying and analysing suitable samples, a number of issues emerged with significant implications for the results of the macro-level empirical analysis. These points therefore need to be kept in mind when viewing data results in Chapter 4 and Chapter 5.

3.3.3.1 Availability of data

Although efforts have been made to include all cases found fitting the criteria outlined earlier, there are inevitably many partnerships from around the world that have escaped the author's attention. It is possible that this number could be far greater than the *n*-size of this study. This would most likely be the case for older, completed partnerships whose Internet presence decreases as time goes by due to the ephemeral nature of digital information. This would also concern those smaller or lower-profile partnerships which have failed to secure coverage from the press or academic community or, for whatever reason, have neglected to build an Internet site or publish relevant information online.

3.3.3.2 Language bias

Even though English is internationally accepted as the universal communication vehicle for science, for institutions in non-English speaking nations a great deal of university activities and research takes place in languages other than those used for this study (English, French and Japanese). Consequently, many co-creative university partnerships for urban sustainability transformations are literally 'invisible' to this study for linguistic reasons. It is imagined that this is particularly the case in Asia (Korea, Taiwan, Hong Kong etc.) and Europe. Although French is widely spoken in many countries across the EU, the sample pool obtained for this study must nevertheless be viewed as being significantly biased towards English and Japanese speaking nations, and slightly towards the French speaking community in Europe. However, efforts were made to correct this bias by devoting more search time to other nations outside of these three linguistic spheres.

3.3.3.3 Scope of sample

Due to the rigid scope of the criteria designed for this study, many partnerships have been intentionally overlooked, as already explained in Table 3.1 above. Such partnerships include notably: those targeted at rural transformations; those driven mainly by actors from industry, government or civil society; and lastly, those targeting non-industrialised nations or areas outside of the geographical scope of this study.

Due to the above reasons, the macro-level analysis of Chapter 4 and Chapter 5 is by no means intended as a complete global assessment. The intention is rather to provide a ‘snapshot’ of the macro-landscape of co-creative university partnerships for urban sustainability transformations in industrialised nations in Europe, Asia and North America; a goal also corresponding to the study of Bulkeley and Castan Broto (2012) and Castan Broto and Bulkeley (2013). The 70 cases found for this study should therefore be viewed as being a mere sample of a much larger worldwide population and trend where diverse actors from academia, industry, government and civil society are engaging in experimental forms of collaboration to collectively bring about societal transformations in the goal of materialising sustainable development.

3.4 Analytical frameworks for co-creation for sustainability

The above-explained identification of a global sample and subsequent construction of a database then facilitated the generation of the following three analytical frameworks. These were applied as analytical tools in the macro-level research component in order to respond to the corresponding research objectives and questions.

1. A typology of co-creative partnership types
2. Analytical Framework [A]: For identifying and comparing basic attributes
3. Analytical Framework [B], which consists of two parts:
    - The identification of commonly encountered barriers and drivers
    - The appraisal of partnership effectiveness and impacts

Although the above analytical tools were produced at differing times throughout the dissertation, they were all reached in the same way. This common process is depicted below in Figure 3.6. That is, they have emerged from a process beginning with both *inductive* and *deductive* reasoning. Regarding the firstly the deductive dimension, insight from existing theory and analytical frameworks was firstly sourced from literature pertaining to a broad range of fields including urban sustainability, transitions theory, sustainability experiments, university regional development, as well as various existing cases studies on the subject of university sustainability partnerships. This body of literature provided a rich spectrum of descriptive data on the types of mechanisms, objectives, motivations and actor types commonly observed in co-creative sustainability partnerships, as well as commonly encountered drivers and barriers. In the same way, inductive reasoning was used to apply knowledge emerging from direct empirical observations of the 70 cases in the global sample. Empirical observations included both knowledge obtained through the database and the processing of secondary documents, in addition to first hand knowledge generated through a series of semi-structured interviews on several co-creative cases in Asia, Europe and North America (see Appendix 2 for interviewee listing).

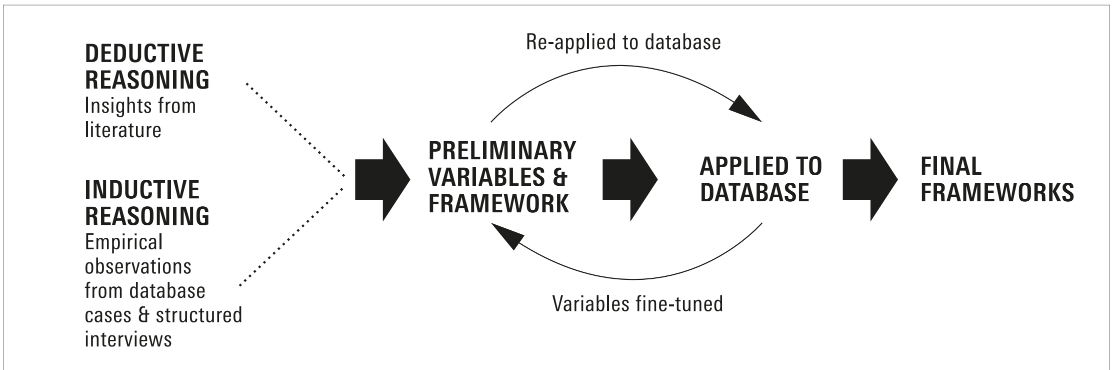

Figure 3.6 Process for creating analytical frameworks

The combination of these two types of reasoning was then used to come up with three sets of generalised, variable descriptions (i.e. one set for the typology and one set for each of the two frameworks). These sets of variables were then applied to each case in the database in a re-iterative process were each range of variable descriptions was modified until it accurately reflected the full spectrum of possibilities portrayed by the 70 cases reflected in the database. In this way, the final frameworks ensuing this process are rooted in both empirical observations from the global sample pool and existing theory from the literature.

3.4.1 Typology proposal for classifying co-creative partnerships

As a first step towards analysing and identifying key patterns and differences in the 70 cases identified for this study, this sub-section will propose an empirical typology. This consists of the following four partnership types, each reflective of four core functions that co-creative partnership for urban sustainability transformations can typically seek to perform:

- Research, demonstration or knowledge exchange platform
- Service-learning platform
- Physical environment transformation project
- Socio-economic transformation project

As with all typologies, that proposed below could possibly be criticised as over simplistic and too general. Yet its purpose is primarily to map out the different types of collaborations contained within the sample so as to contribute to a global understanding of the various forms and functions that cross-sector university partnerships for sustainability may assume when attempting to transform specific urban areas or societal sub-systems. As will become apparent in Chapter 4, the value of this typology is that it allows both a conceptual and quantitative understanding of the nature by which the function of co-creation for sustainability is manifesting in academic and urban settings across the three geographical regions sampled.

3.4.1.1 Explanation of four types of co-creative partnerships

The four different categories of co-creative university partnerships for urban sustainability partnerships are explained individually below, with a summary of this discussion appearing below in Table 3.4:

> Type 1: *Research, demonstration or knowledge exchange platform*
> The most common type of co-creation; here the main objective is to conduct research. Typical activities including knowledge production, product development, real world trials and demonstrations, knowledge exchange between participating parties or societal sector and tool creation (i.e. decision making tools etc.) to assist other societal actors to drive transformations of the physical environment, infrastructures or social, economic, technological, industrial and political processes. Such collaborations typically encompass efforts to translate research outcomes into government policy. Such collaborations may also involve demonstrations or societal interventions but these are usually for data-gathering purposes and weaker in nature, relative to interventions in other partnership types. Some representative examples of cases falling into this category include *TUM-Create* by the National University of Singapore and Munich Technical University, *Pecan Street Demonstration* by the University of Texas, and *SusLabNWE* by DELFT University of Technology and partners.
>
> Insights in the literature aiding the conceptual understanding of the varying characteristics and forms this type of collaboration may take include the notion of

learning networks (i.e. exchanging and co-producing knowledge across societal sectors) by Bartan and Dlouha (2010) and Valkering et al. (2013), *living laboratories* (i.e. using urban environments as open-innovation and research arenas) by Evans and Karvonen (2011) and *technology platforms* (i.e. cross-sector R&D efforts to mobilise a joint agenda and critical mass of innovation and research) by the European Commission (2004) and finally, *knowledge systems for sustainability* (Cash et al., 2003) where scientific research agendas are formed with various stakeholders, and results fed into government policy.

Table 3.4 Summary of four co-creative partnership types

Type	Objective	Typical activities	Level of societal interventions
1. Research, demonstration or knowledge exchange platform	Research	• Publications • Conferences and discussion spaces • Technical demonstrations • Consulting and training • Technology transfer (patents, licences, spin-off creation)	Weak
2. Service-learning platform	Education	• Internships • Community projects • Creation of new social networks	Moderate
3. Physical environment transformation project	Reformation of built or natural environment	• Real estate development • Reform of natural environment • Infrastructure upgrades	Strong
4. Socio-economic transformation project	Socio-economic transformation	• Socio-economic stimulus strategies • Creation of new social networks • Experiments with various economic, financial, legal, policy and social tools • Technology transfer (cluster zones and spin-off creation)	Strong

Type 2: *Service-learning platform*

This describes a platform set up to immerse students into real world projects with external stakeholders and tie educational processes to wider community efforts to advance urban sustainability. Such efforts aim to enhance pedagogy processes in the formal curriculum, with faculty research agendas often incorporated into projects and students receiving course credits for participation. Concretely, service-learning initiatives may involve student internships in municipalities and community organisations, or participation in a range of community projects, that may be led by faculty, students or community stakeholders. Service learning platforms typically aim to exploit the pre-existing knowledge and skill bases of established curricula and tie these to community sustainability issues. Some examples of cases falling into this category include *City Studio Vancouver* by Simon Fraser University, Emily Carr University and partners, and *Sustainable City Year Program* by the University of Oregon.

Literature aiding a theoretical understanding of this type of partnership include the concept of *campus-community partnerships* by Bringle and Hatcher (2002) and *urban sustainability extension service* by Molnar et al. (2011) where class time in formal courses is exploited to allow students and researchers to work with external stakeholders on real world urban sustainability projects.

Type 3: *Physical environment transformation project*
In this type of co-creation, the primary objective is not so much to conduct research as it is to transform the physical environment, typically in a location immediate to the lead institution. Such collaborations will often focus on transforming various buildings (such as university facilities and real estate assets), infrastructures or the natural environment and will typically pursue this through construction (both new and retrofitting), real estate development and various infrastructure upgrades. They may also involve environmental restoration efforts. Good examples of this type of collaboration include the real estate development driven projects of UniverCity by Simon Fraser University, Connective Corridor by Syracuse University, Campus Sostenibile by the University of Milan and Polytechnic Institute of Milan and Corridor Manchester by the University of Manchester and Manchester Metropolitan University, to name but a few.

Key scholarship providing insight into this category of co-creation includes the *urban reform* literature (Perry and Wiewel, 2005; Wiewel and Perry, 2008) describing the global trend of universities tackling urban and socio-economic decline. This is typically carried out by upgrading real estate assets and reforming urban infrastructures and the built or natural environment. Other relevant literature includes individual case studies such as those by Evans and Karvonen (forthcoming) and Girling (2008; 2010).

Type 4: *Socio-economic transformation project*
This type of co-creation involves a large degree of social innovation and deep, sustained societal interventions. Such efforts will experiment with various economic, financial, legal, policy and social tools to revive and enhance the sustainability of existing socio-economic systems. Socio-economic transformation projects may sometimes involve strategic application of university assets such as purchasing policies or technology transfer programmes to the goal of stimulating local or regional economic development. They may also encompass public outreach and awareness raising efforts. Collaborations of this model may also seek to create new social configurations such as, for example, sustainable business, food or consumption systems. Socio-economic transformation projects may or may not involve a research element and are often lead by non-academic actors from administration or university bridging organisations such as community development offices. Representative cases bearing characteristics of this category include the East Bay Green Corridor by University of California, Berkley; Oberlin Project by Oberlin College, Verdir by University of Liege and Hong Kong SME Business Sustainability Index by Hong Kong Polytechnic University.

Theoretical understanding of this type of partnership can be gained from, for example scholarship dealing with the West Philadelphia Initiatives from the University of Pennsylvania (Kromer and Kerman, 2004; Rodin, 2007).

In closing, as will become clear in the Chapter 4 where the above typology is applied to the global sample, most of the 70 cases identified for this study perform functions resembling two or more of the above-described partnership types. This presence of ‘hybrid’ types does not defeat the utility of this typology. Rather, it serves to illustrate the diversity and breadth of activity, approaches and objectives of co-creative university partnerships for urban sustainability transformations[15]. It also portrays the fact that many of the partnerships in the global sample perform multiple functions simultaneously—and in differing degrees and combinations—as they seek to pursue partnerships objectives.

3.4.2 Analytical Framework [A]: Basic attributes and patterns

Seeking to deepen the empirical analysis that began with the above typology of four partnership types, this sub-section proposes a six-level framework designed to identify, compare and analyse key attributes in the 70 cases collected for this study. This framework builds upon the previous work of the author (Trencher et al., 2013a, 2013b). It is essentially a product of the following six questions, which have themselves emerged as a result of attempting to answer research sub-objective one:

1. *In which particular urban sub-system(s) does the partnership attempt to advance sustainability?*
2. *What is the geographical scale(s) of the particular area targeted?*
3. *Who are the main internal (i.e. university) partners and stakeholders involved in the formation or implementation of the collaboration?*
4. *Who are the main external (i.e. societal) partners and stakeholders involved in the formation or implementation of the collaboration?*
5. *Why was the partnership formed?*
6. *How (by which mechanisms) does the partnership seek to achieve its objectives and drive the transformation of a particular geographical area or societal sub-sector?*

Regarding this choice of questions, they have been formulated in accord with the author's specific areas of interest and the belief that knowledge generated from such questions would be crucial to understanding the various qualitative characteristics of co-creative university partnerships for sustainability transformations. The formulation of these questions has also been aided by previous studies demonstrating the relevance and importance of such points of interest. This includes analytical frameworks built upon similar questions forming the basis for statistical analyses of large-*n* samples in the context of sustainability experiments across developing Asia (Bai et al., 2010), urban climate change experiments across 100 global cities (Castan Broto and Bulkeley, 2013; Bulkely and Castan Broto, 2012) and public-private sustainable development partnerships (Pattberg et al., 2012). Despite their utility as points of reference, the suitability of these existing frameworks to achieve the goals of this research is limited. This is essentially due to their specific scope and focus on non-academic partnerships. For these reasons, these existing frameworks are deemed as incapable of describing the wealth of traits and patterns contained by the sample of cross-sector urban sustainability partnerships driven specifically by *university actors*—the core focus of this dissertation.

Additionally, for the reason that Analytical Framework [A] has emerged as a reflection of the specific cases collected for this study, it is by no means intended as a universal methodology. It is rather designed as a specific tool for the context of this research. That said, the applicability of

[15] The diversity of societal engagement paradigms and approaches displayed by various manifestations of the function of co-creation for sustainability have already been discussed above and depicted in Figure 3.2.

this tool has been demonstrated by 70 cases from a vast array of contexts and geographical locations. It is therefore envisioned that this framework harbours a wider potential to serve as a point of reference for other scholars working in similar fields to this research. That said, future studies working with a differing sample would possibly uncover contrasting key actor combinations, motivations and channels to those uncovered observed in the following discussion.

3.4.3 Explanation of variables

The final six-level framework to have emerged from the above questions appears below in Table 3.5, with the following discussion devoted to explaining in detail each layer and set of corresponding variables.

3.4.3.1 Layer 1: Urban sub-systems (What?)

The first distinction created by the framework seeks to answer the question: *In which particular urban sub-systems does the partnership attempt to drive sustainability?* This value of this point of enquiry is demonstrated by the integration of this categorisation into an analytical framework for urban climate experiments in the Castan Broto and Bulkeley (2013) study. With insights from existing frameworks developed by other scholars in the field of urban sustainability (Coyle, 2011; Grimm et al., 2008; McCormick et al., 2013; Newton and Bai, 2008), an analysis of the diverse cases contained in the database has revealed that university partnerships for urban sustainability transformations may target any combination of the sub-systems listed below. The following breakdown could be criticised as being reductionist and ignorant of the fact that many of these sub-systems are in fact intertwined (as for example in the case of the *built environment* and *energy and heating/cooling* where heating and cooling systems are integrated into building structures and urban planning). Yet the utility of this approach is that it allows a systematic comparison of cases and the identification of those areas tending to be the most or least targeted by co-creative partnerships.

Table 3.5 Summary of Framework [A]
(After Trencher et al., 2013a, 2013b)

1. **Urban sub-systems (what?)**
    - Built environment
    - Transportation
    - Energy and heating/cooling
    - Economy, employment or industrial production
    - Natural environment or green spaces
    - Food, agriculture or forestry
    - Water
    - Solid waste
    - Governance and planning
    - Human and social systems

2. **Scale of target area (where?)**
    - Local/neighbourhood
    - City/town
    - Regional/state
    - National
    - Trans-border

3. **Internal actors (who?)**
    - Faculty/researchers
    - Administration
    - Students
    - Bridging organisations

4. **External actors (who?)**
    - Local/regional government
    - State/national government
    - Civic society
    - Other academic institutions
    - Large or multi-national corporation
    - Small-medium enterprise

5. **Motivation (why?)**
    - Missional
    - Funding
    - Scientific/scholarly
    - Social contribution/community relations
    - Developmental/strategic
    - Entrepreneurial

6. **Societal engagement modes (how?)**
    - Knowledge management
    - Governance and planning
    - Technology transfer or economic development
    - Technical demonstrations and experiments
    - Reform of built or natural environment
    - Socio-technical experiments

A. Built environment

This refers to all components such as structures, finishing and interiors of all types of public and private buildings, houses and built infrastructures such as pathways, roads and bridges etc. Partnerships targeting this sub-system may, for example, involve projects in:

- urban development
- new buildings and construction
- retrofits and weatherisation and so on.

B. Transportation

This refers to the technologies, infrastructures and vehicles used for public and individual transport and the circulation of goods. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- EV and hydrogen fuel-cell automobile technology and charging stations
- car-sharing
- logistic networks and ICT traffic control and so on.

C. Energy and heating/cooling

This includes the infrastructures and systems used for the generation, supply, storage and management of electricity or energy for residents, business and industry. It also includes heating and cooling infrastructures. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- renewable energy production and storage facilities
- smart grids and ICT
- energy efficiency measures
- heating or cooling systems and so on.

D. Economy, employment and industrial production

This refers to the sub-system comprising of various economic, financial, manufacturing and business activities conducted by both companies and individuals. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- green cluster zones and start-up support
- green community bonds
- green jobs or training
- fostering of sustainable business and industrial processes

E. Natural environment or green spaces

This encompasses both natural biological resources and manmade green spaces. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- parkland construction
- green-roofing and landscaping
- urban eco-systems regeneration and so on.

F. Food, agriculture and forestry

This refers to the production, processing, distribution and selling of food and agricultural or forestry products. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- urban agriculture and forestry
- food hubs and local food networks
- biomass fuel production and so on.

G. Water

The technology and infrastructures for the supply, treatment and collection of fresh and salt water. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- plumbing systems and storm-water systems
- water collection and recycling
- water consumption reduction measures and so on.

H. Solid waste

The technologies, facilities and vehicles constituting the system that collects, treats, disposes or recycles all forms of solid waste. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- household or industrial recycling
- waste reduction programmes and so on.

I. Governance and planning

The institutional and political structures that govern and plan the various sub-systems of the target area. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- decision making and policy tools, support and consulting
- knowledge transfer to government
- political lobbying activities and so on.

J. Human and social systems

The citizen, cultural and social systems making up an area such as working, living and consumption patterns, social and information networks. Partnerships seeking to transform this sub-system may, for example, involve projects in:

- citizen engagement and training
- sustainable consumption networks
- public outreach and communication
- social network creation etc.

3.4.3.2 Layer 2: Scale of target area (Where?)

The second level of the framework seeks to answer the question: *What is the geographical scale of the area targeted by the partnership?* As pointed out by Pattberg et al. (2012), interventions for sustainable development may involve a local, regional, national or global scale. A systematic comparison of the diverse alliances comprising the sample for this study has revealed that co-creative partnerships for urban sustainability tend to try and drive sustainable development at a scale corresponding with any combination of the following variables:

A. Local/neighbourhood level
The immediate community or neighbourhood or, if targeting an area far from the partnership headquarters, a specific block or area of a town or city.

B. City/town level
A target area comprising of several districts or locations within one city or town, or alternatively, the entire town or city.

C. Regional/state level
An extended area that reaches across the boundaries of the target town/city into other areas, locations or cities, or alternatively, the entire state or province.

D. National level
An area comprising of several locations/areas scattered across one or more towns, cities, counties etc. within a single country.

E. Trans-border level
An area reaching across one or more international borders.

3.4.3.3 Layer 3: *Internal* actors (Who?)

Based upon the awareness that the university is a vast organisation comprising of a diverse array of both scientific and non-scientific actors, this third level seeks to clarify which are the most actively involved in co-creative partnerships for urban sustainability transformations. It thus seeks to answer the question: *Who are the main internal (university) partners and stakeholders involved in the formation or implementation of the collaboration?* An analysis of the global sample has revealed that cross-sector sustainability alliances may be initiated and co-ordinated by a combination of any of the following:

A. Faculty/researchers
This includes both teaching and non-teaching faculty, research fellows and scientists.

B. Administration
This encompasses a vast array of predominantly 'non-academic' personnel such as presidents, rectors, administration and management, strategic specialists and public relations positions, to name but a few.

C. Students
This includes both graduate and undergraduate students.

D. Bridging organisations
This includes actors from community outreach offices, technology transfer offices and

sustainability offices. It also includes other university institutes and foundations set up specifically for the task of tackling real-world problems and forging horizontal linkages between the university and external partners. This category corresponds to the term 'boundary organisations' as suggested by (Clark and Holiday, 2006).

3.4.3.4 Layer 4: *External* actors (Who?)

This fourth layer is driven by two observations. Firstly that co-creative sustainability coalitions are often composed of an extremely diverse array of social actors (including both 'expert' and 'non-expert') and secondly that they don't necessarily confirm with the simplified notion of 'triple-helix' or 'university-industry-government' (Etzkowitz and Leydesdorff, 2000) type of relations. This fourth layer thus seeks to determine: *Who are the main external (societal) partners and stakeholders involved in the formation or implementation of the collaboration?* This layer of the framework also corresponds with other analytical methodologies intended to clarify the type of external actors most involved in sustainability experiments (Bai et al., 2010) and climate experiments (Castan Broto and Bulkeley, 2013).

An analysis of the 70 cases contained in the sample has revealed that any combination of the following external actors may play an active role in university alliances for urban sustainability transformations:

A. Local or regional government/public service sector
In addition to local government offices or representatives, this also includes regional authorities and government financed public service agencies.

A. State/national government
This category comprises of actors from state or federal-level government offices and jurisdiction agencies.

C. Civic society
A wide category including think tanks, NGOs, NPOs, community groups and individuals.

D. Other academic institutions
This includes other higher education institutes and research institutes ranging from community colleges and universities to government research laboratories.

E. Large or multi-national corporations
For the purposes of this study, this is defined as an enterprise with more than 50 employees, typically with several premises across the state, country or globe.

F. Small-medium enterprises
Also for the purposes of this dissertation, this is defined as an enterprise with less than 50 employees in total, typically with premises concentrated in one area.

3.4.3.5 Layer 5: *Motivation* (Why?)

Previous studies by Bai et al. (2010) and Hoereth et al. (2007) have demonstrated the importance of considering the trigger or factors motivating the formation of a particular partnership. The question of '*Why was the collaboration formed?*' hence forms the fifth level of the proposed framework. The logic behind this point of interest is that understanding the reasons why partnerships form could provide valuable insight into the conditions or policies that would be required to foster the further formation of such initiatives in the future. Incidentally, alliances for sustainability transitions are in many cases initiated by individual 'frontrunners' (Loorbach and Rotmans, 2010) or 'change agents' before being taken up on a university level[16]. This implies that the motivating factors behind the formation of a sustainability partnership could be considered on both an *individual*, *departmental* and even *institutional* level. The variables listed below can hence be applied to all of these three levels.

A. Missional motivation

Many of the cases gathered for this study have been initiated by actors from university affiliated outreach or community offices and research foundations established for the specific purpose of forming multi-actor partnerships and implementing solutions for various sustainability or localised issues. Collaborations formed in this context are therefore a natural consequence of such institutes attempting to fulfil their mission.

B. Funding motivation

As documented in the literature, university actors are constantly faced with the need to obtain funding in order to remain competitive (Bok, 2003; Ueyama, 2010). The identification of this variable has thus emerged from the observation that many partnerships gathered for this study have been to some extent 'enticed' into formation by the presence of special funding programmes set up to encourage the formation of collaborative sustainability projects.

C. Scientific/scholarly motivation

Many individuals or universities initiate or become involved in collaborations aimed at generating solutions to urban sustainability issues for the purpose of enhancing research activities. As pointed out by Haberli et al. (2001), much valuable understanding can be obtained from working with external partners and trialling scientific knowledge in real world settings. The result of this transdisciplinary 'mutal learning' (Scholz, 2000) and 'Mode 2' scientific endeavour (Nowotny et al., 2001) is that the total sum of the knowledge produced is far greater than that harboured by any single partner or organisation. Not forgetting the satisfaction and stimulation obtained from trialling academic knowledge in real world settings and translating basic research or scholarly work into tangible or commercialisable results, for an array of specific reasons, scientific and scholarly motivation constitutes a decisive catalyst for the formation of many partnerships. The identification of this variable thus refers to those partnerships formed mainly for scientific or scholarly interests such as the desire to:

- trial and diffuse academic knowledge in real world settings
- learn from external actors and stakeholders
- translate basic research or scholarly work into tangible or commercialisable results

D. Social contribution/community relations motivation

On both an individual and institutional level, various actors from the university may choose to concern themselves with the sustainability of the surrounding community, city

[16] The author is indebted to Derk Loorbach from DRIFT at Erasmus University Rotterdam for insight regarding this point.

or region as a form of social contribution, or in an effort to improve the image of the university and community relations. This motive is easiest to detect in those initiatives targeted at the immediate community and especially those targeting underserved populations.

E. Developmental/strategic motivation
As may be observed in the 'developmental role' defined by Gunasekara (2006) in describing the university's role in regional innovation systems, university partnerships are often animated by a keen desire to shape the future of the surrounding socio-economic fabric. This strategic desire to influence developmental trajectories appears to be driven by a number of factors. Firstly, there is the issue of physical survival as the sustainability crisis threatens the very socio-ecological landscape surrounding the university. As 'anchor institutions', universities do not have the luxury of being able to relocate should this ever become necessary. Secondly, if borrowing the concept of 'enlightened self-interest' from Dixen and Roche (2005), universities may also seize the occasion to transform the local vicinity in order to improve university facilities, thus enhancing competiveness and ability to attract top-rate faculty and students. This broad definition of the *developmental/strategic motivation* variable thus refers to partnerships triggered by the desire to:

- respond to external issues such as climate change, energy security and socio-economic decline to help ensure the physical survival of the university and surrounding community/town/city or region.
- improve the strategic situation of the university by reforming the neighbouring community and economy in a manner that would also benefit the university itself.

F. Entrepreneurial
Green innovation represents a new entrepreneurial opportunity. This fact has not escaped the attention of many universities around the world. An analysis of the 70 cases collected for this study has revealed that the formation of certain partnerships is to some extent influenced by the desire to generate revenue for any of the partners or institutions involved. University actors engaged in partnerships for sustainable urban transformations can pursue revenue generation in a variety of ways. This includes activities ranging from the development of university owned real estate into sustainable buildings and residences, the creation of green technology parks, demonstration centres, spin-off firms and technology transfer deals, to consultation services and the production of business or decision making tools.

3.4.3.6 Layer 6: *Societal engagement modes* (How?)

The last level of the analytical framework seeks to answer the question: *How (by which mechanisms) does the partnership seek to achieve its objectives and drive the transformation of a particular geographical area or societal sub-sector?* In the literature, there have been several previous attempts to map the various avenues by which cross-sector partnerships seek to achieve their objectives. Pattberg et al. (2012) for instance have described and integrated into a framework and large-*n* database 11 functions performed by cross-sector sustainable development partnerships. These are: *knowledge production, knowledge dissemination, technical* *implementation, institutional capacity building, norm setting, campaigning, lobbying, technology transfer, participatory management, training* and, finally, *planning.* In specific reference to the various functions performed by universities in driving sustainable or regional development, other scholars have identified and described other roles. To cite but a few, these include *communication, translation* and *mediation* (Cash et al. 2003), *governance* (Sedlacek, 2013) and *collaborative planning* (Peer and Stoeghlehner, 2013) and *decision making support* (Talwar et al., 2011).

The following analysis stems from earlier work of the author (McCormick and Trencher, 2014; Trencher et al., 2013a, 2013b). Its distinct focus is an attempt to contribute to existing scholarship by mapping the more physical, visible and tangible processes by which university actors may drive a sustainability transformation of a particular location or societal sub-sector. To this end, it has sought to create a broader and more holistic understanding of various engagement modes used by university actors and external partners by also appropriating insights from other relevant fields such as technology transfer and university-led urban reform efforts (Perry and Wiewel, 2005). Therefore, the following descriptions are grounded firstly in deductive and theoretical insights from the literature. More importantly, however, they are the product of inductive, empirical observations from the 70 cases in the sample pool. Note that a summary of the below discussion on the six co-creative societal engagement modes appears in Table 3.6.

A. Knowledge management (scientific knowledge driven)
Here scientific actors and practitioners attempt to create, process and diffuse to key stakeholders and decision makers the knowledge required to drive a technological, environmental or societal transformation in a particular location. In the context of transferring codified knowledge—i.e. easily stored and transferrable 'official' knowledge (Lundvall and Johnson, 1994)—typical manifestations of this engagement mode include collaborative research efforts culminating into publications (e.g. reports, journal articles, websites etc.) and conferences, as well as policy tools and decision making instruments. As for transferring tacit knowledge—i.e. socially embedded, ill-defined and difficult to codify—suitable avenues may include consulting, training of key stakeholders and decision makers and even transfer of graduates. This broad channel also encompasses varied roles such as *communication, translation* and *mediation* as suggested by Cash et al. (2003) where university actors may create discussion spaces for awareness raising, mutual problem defining and resolving conflicts and trade-offs.

B. Governance and planning (governance driven)
This societal engagement mode involves partnership actors playing an active role in local and regional governance and planning in the aim of shaping public policy and development trajectories in the target area. Such a role is described by Peer and Stoeglehner (2013) as *collaborative planning,* which emerges after a democratically and consensus-orientated process between citizens, planners and decision-makers. Implicit in this description is the act of working closely with actors from existing political and governance structures. However this channel may also involve the creation of new governance and planning networks. Concretely, activities falling into this engagement mode may include: management, steering and strategic planning for the target area on behalf of other government actors; rule making; participation in existing political

mechanisms for policy making and planning; and lastly, political lobbying and guidance of government decision making—a role also identified by Pattberg et al. (2012). The notion of *environmental governance* by Evans (2012) and *climate governance experiments* by Bulkeley and Castan Broto (2012) and Hoffman (2011) provide a solid theoretical underpinning for this channel.

C. Technical demonstrations and experiments (science and technology driven)
In this engagement mode, researchers, scientists and practitioners focus on demonstrating and testing unproven or emerging technologies in real-world settings with the basic aim of assessing suitability for, or encouraging wider diffusion. A natural consequence of this mode may entail the eventual transfer of a particular innovation to market via any of the mechanisms in the fourth mode of *technology transfer and economic development.* Also represented in the literature, what is referred to here as a 'demonstration project' is often referred to as an 'innovation project' (Van den Bosch and Rotmans, 2008) or 'pilot project' (Vreugdenhil et al., 2009). Initiatives falling into this category include both temporary testing projects which 'disappear' after a set-time frame and withdrawal of scientific enquiry, and permanent demonstrations or installations where the experiment is left to function after the completion of scientific testing and data gathering.

D. Technology transfer and economic development (technology and economy driven)
The aim of this form of societal engagement is to spur low-carbon economic growth and diffuse green technologies in a specific locality or region. This essentially consists of 'harder' outputs (Philpott et al, 2011) such as patenting and licensing to industry, or the creation of spin-off firms, technology parks and cluster zones (McCauley and Stephens, 2012). It was argued in Chapter 2 that the majority of conventional technology transfer activities are concentrated in a narrow set of fields not aimed at spurring green innovation or sustainable development. In the emerging function of co-creation for sustainability however, diverse university actors such as researchers, technology transfer offices, administration and development officers may exploit what can appear to be conventional technology transfer practices. Yet several peculiarities should be highlighted. Firstly, such efforts are typically part and parcel of a wider transformative strategy typically exploiting other avenues and involving a vast array of societal actors. Secondly, technology transfer and commercialisation initiatives are usually explicitly targeted at a specific set of stakeholders and location, city or societal sub-sector. Further, they will typically seek to drive low-carbon growth by fostering business start-ups, employment, training and widespread adoption of particular technologies in a specific place and set of stakeholders (McCauley and Stephens, 2012).

E. Reform of built or natural environment (environmental transformation driven)
Unlike demonstration or pilot projects implemented for mainly scientific purposes, here the focus is on transforming or restoring the built or natural environment—and not necessarily for scientific reasons. In the built environment, this may involve university administration-led real estate development, neighbourhood reform or infrastructure improvements. Examples include the new construction or revitalisation of existing business and residential areas through green buildings and urban design or the improvement of infrastructures such as energy, transport and communication networks.

For efforts to improve the natural environment, this may include the restoration of natural eco-systems, reform of agricultural or forestry practices, or creation of man-made natural spaces. Funding for such projects may be derived from private investors, philanthropists and government grants, often boosted by heavy financial commitments from the university itself. University-led reform and revitalisation of a particular neighbourhood or area is a well-established trend documented in the ‘urban reform’ literature (see Wiewel and Perry, 2005). Yet what is distinctly new in urban reform efforts implemented in the cadre of co-creation for sustainability is the presence of values and principles of sustainable development, and the combining of other social engagement paradigms depicted earlier in Figure 3.2.

F. Socio-technical experiments (social innovation and multi-actor learning driven)
This channel encompasses a distinctly social dimension—often fused with technical artefacts—leading to new configurations of services, technologies, businesses, policies, financial and legal tools and so on. These may be 'invisible' or 'intangible' in contrast to, for example, technical demonstration projects, the creation of actual products or reform of the built or natural environment. Also, as such experiments may be non-scientific and non-technical, administration and outreach sectors of the university may play a major role in creating innovation in this mode of societal engagement. Concrete examples may include the building or re-configuration of a food or consumption network, local investing or carbon offset schemes, the re-organising of technological artefacts (e.g. car sharing) or the introduction of an experimental incentive or policy tool designed to change behaviour of citizens or the private sector. The definition of bounded socio-technical experiments (BSTEs) from Brown et al. (2003, p. 291); that is: the introduction of a “new technology, service, or a social arrangement on a small scale” provides a solid theoretical starting point for this channel. Due to high levels of uncertainty regarding results, exploring and “learning by doing and doing by learning” (Brown et al., 2003, p. 292) provides the principle means by which a societal transformation occurs. That said, in appropriating this term the author is pursuing a much broader definition, as the term BSTE does not reflect the blurry borders and permanence of certain socio-technical experiments observed in the 70 case empirical analysis.

	Knowledge management	Governance & planning	Technical demonstrations & experiments	Technology transfer or economic development	Reform of built or natural environment	Socio-technical experiments
Objective	To create, process and disperse specific knowledge to relevant stakeholders and decision makers.	To foster sustainability based governance and collaborative planning.	To test, demonstrate and evaluate technical innovation.	To disperse high-tech green innovation and stimulate sustainable, economic development.	To transform or restore the built and natural environment.	To create a new socio-technical configuration
Driver	Knowledge and communication	Governance	Science & technology	Technology and economy	Environmental transformations	Social innovation and multi-actor learning
Mode	Traditional	Post-traditional	Traditional	Post-traditional	Post-traditional	Post-traditional
Typical outcomes	• Collaborative research • Publications • Conferences • Discussion spaces • Consulting and training	• Local or regional governance bodies • 'Rule' and policy making	• Pilot or verification projects • Demonstration and testing facilities	• Patenting & licensing to industry • Fostering of business ventures and employment • Green cluster zones	• Construction & development projects (e.g. buildings, landscape) • Infrastructure upgrades (e.g. power grids, roads, paths, transport facilities) • Natural environment restoration	Stakeholder-driven experiments with various social, business, technical, legal, financial and policy tools.

Table 3.6 Framework of six societal engagement modes in co-creation for sustainability (after Trencher et al., 2013b)

3.4.4 Analytical Framework [B]

The second analytical tool developed for this study is a framework consisting of two parts, each with separate objectives:

> Part 1: Identify commonly encountered drivers and barriers
> Part 2: Appraise each case's effectiveness and impacts attained

Each of these two halves will be discussed separately in the following sub-sections.

3.4.5 Analytical Framework [B] Part 1: Drivers and barriers

To date, several empirical studies have been conducted on the type of conditions that tend to hamper or facilitate the success of cross-sector partnerships assembled for purposes such as spurring socio-technical innovation or responding to sustainability and societal challenges. Such work includes, non-exhaustively, a study by Zilahy and Huisingh (2009) utilising questionnaire-sourced data to provide insight into an array of obstacles facing university actors and stakeholders working in cross-sector 'regional sustainability initiatives'. Other insights come from scholars such as Schaffers and Turkama (2012), who offer a range of lessons learned from the field of 'living laboratories' and cross-border innovation networks for systemic innovation. From a broader perspective still, Hanleybrown et al. (2012) and Kania and Kramer (2011) consider the pre-requisites that enhance the 'collective impact' of cross-sector societal interventions for tackling specific social challenges. In addition to these above studies offering generalizable lessons, a variety of case-specific insights are also present in the literature in the form of descriptive studies on university partnerships for sustainability (Evans and Karvonen, 2013; Lienin et al., 2005; Pothukuchi, 2011; Valkering et al., 2013).

This vast array of existing scholarship has been used as a starting point for identifying a range of critical factors that can either impede or facilitate the formation and implementation of co-creative sustainability partnerships. The following discussion collates and explains the potential of each of these variables to function as either a driver or barrier. Understanding of each of these factors has also been aided by lessons emerging from interviews with multiple co-creative actors in diverse university settings around the world (refer to Appendix 2 for the list of interviewees) and the processing of secondary documents for the cases in the global sample pool.

3.4.6 Explanation of variables

A summary of the following discussion on various factors that can either serve as drivers or barriers for co-creative university partnerships for urban transformations towards sustainability appears in Table 3.7 below.

> *External funding*
>
> The procurement of external funding grants has emerged as a major driving force for the formation and implementation of co-creative university partnerships for sustainability. The author's interviews and past empirical observations (Trencher et al., 2013a) have also revealed that the presence of 'ear marked' funding programmes in particular—often stipulating collaboration with external partners and engagement to localised sustainability issues—are responsible for enticing the formation of several cases around the world. Such funding programmes that have proved a major driving force on many cases in the global sample of this study include the on-going European INTERREG

funding programme, the Social System Reformation Program for Creation of New Society Matching Climate Change by the Japan Society for the Promotion of Science, in addition to various state and federal green stimulus funds targeting smart grids, for example, in the US. These observations correspond with arguments of Whitmer et al. (2011) who contend that targeted funding packages are essential to 'signal' to academics that multi-actor and place-based sustainability collaborations are valued and an important form of scientific conduct. On the other hand, as underscored by findings from Bai et al. (2010) and Zilahy and Huisingh (2009), lack of financial resources tends to prove a highly restrictive barrier for the activities of cross-sector sustainability initiatives. This is essentially for the reason that the scale of funding procured will strongly influence the number of individual actors and partner organisations that a partnership can support, as well as the quantity and scale of the ensuing activities and projects.

Partnership synergy

There is a seemingly universal consensus in the scholarship that cross-sector collaboration is crucial for maximising the impact of initiatives seeking to tackle various societal and sustainability challenges. The logic is that the impact resulting from the combined expertise and resources of multiple sectors and organisations is far superior to that of a series of isolated interventions from any single actor (Kania and Kramer, 2011). Strong faith in the power of collaboration can be observed in a range of literature dealing with the flourishing of cross-sector climate experiments (Bulkeley and Castán Broto, 2012), sustainability experiments (Bai et al, 2010), multi-actor learning (Barton and Dlouha, 2011) and university sustainability partnerships (Yarime et al., 2012). This is also in addition to a body of innovation literature describing the growing reliance on collaborative approaches for driving socio-technic innovation (Schaffers and Turkama, 2012) and carrying out regional governance (Arbo and Benneworth, 2007). The unifying message of the above-mentioned studies is that the synergy attained by cross-sector cooperation is a powerful driving force for university actors seeking to trigger societal transformations toward sustainability.

Lack of unity and harmony

Despite the largely recognised potential of collaborative approaches to magnify societal impacts, large-scale collaborations also run the risk of 'falling apart' and suffering from a local of unity and harmony. This can come about for many reasons, but often this can result from differing understandings of the goals of the partnership; contrasting or conflicting visions, values and approaches amongst the partners and stakeholders (Fadeeva, 2004); and also the sheer physical difficulty of linking different stakeholders and projects together, which may often be separated by vast geographical distances. Alignment of a common vision and approach (Hanleybrown et al., 2012), and a mutual understanding of objectives, results, timeframes and responsibilities (Schaffers and Turkama, 2012) are therefore cited in the literature as factors crucial for the success of sustainability alliances.

Communication difficulties

Also connected to the above obstacle of *lack of unity and harmony*, communication breakdowns—which may arise across large numbers of partners and stakeholders or geographical distances—has also emerged as a specific area of concern for cross-sector partnerships (Valkering et al., 2011). For this reason, Hanleybrown et al. (2012, p. 1) and Kania and Kramer (2011, p. 40) emphasise "continuous communication" as a pre-requisite for successful cross-sector interventions for societal transformations. They emphasise that many years of meetings and communication is often required to build up trust and allow different players to learn to work together. Continuous communication is therefore advocated as a way of sharing key information, measuring progress and providing feedback and guidance between partners and stakeholders; all of which are vital factors to maintaining focus and momentum towards collective objectives.

Government policy
Policy or strategic commitments of local, state or national government have the potential to function as either a driving or hampering force on cross-sector university initiatives for sustainability. Concrete examples of this include formalised climate, energy and sustainability targets, in addition to innovation strategies, all of which have the potential to create either government 'demand' or 'disinterest' towards low-carbon innovation and collaborative solutions to accelerate progress towards such objectives. Proactive local or national government policy and interest in working collaboratively with external partners has been cited as a key driver by various studies across the world in the field of university sustainability partnerships (Bardaglio, 2009; Evans and Karvonen, 2013; Lam et al., 2011). It has also been observed by the author as a major driving force behind the formation of several cross-sector university innovation platforms set up recently in Singapore[17], in particular. Here the national government is highly committed to facilitating inter-university and cross-sector collaborations for sustainability within the cadre of a wider ambition to drive international competitiveness in the knowledge economy. On the other hand, it seems that co-creative university partnerships for sustainability have difficulty in winning government support and thriving in those areas where government policy is not aligned to the pursuit of long-term sustainability targets and working collaboratively with external partners (Zilahy and Huisingh, 2013).

University policy
Just like the influence of above-described government policy, both institutional and departmental policy within the university harbour the potential to serve as either a driving or hampering force. Universities committed to the fostering of cross-sector sustainability collaborations often have the required infrastructures in place in the form of bridging organisations such as sustainability offices and research institutes, or foundations dedicated to forging horizontal linkages with outside partners. Such bridging organisations will often support faculty and researchers with the setting up, mustering of external support and co-ordination of co-creative platforms. Supportive university environments may also seek to support co-creative partnerships by aligning institutional-level priorities and strategies (e.g. purchasing policies and real estate development) with local or regional sustainability concerns, and also by directing university funding and administrative resources to faculty and actors in need. On a departmental level, some faculty are supported in their engagement with external sustainably initiatives from colleagues and superiors through funding or provision of resources such as time and

[17] Such partnerships include, non-exhaustively, TUM-Create by Nanyang Technological University and Technical University of Munich and Energy and Environmental Sustainability Solutions for Megacities (E2S2) by the National University of Singapore and Shanghai Jiao Tong University.

students. The author's communications and interviews with several co-creative partnerships around the world has brought to light the importance of this variable, which also has the potential to impede success if not attuned to such co-creative initiatives for sustainability.

Lack of internal support and incentives

It is widely documented in the sustainability literature that, on the whole, there is insufficient incentive across academia for faculty and researchers to devote time to place-based sustainability work with external stakeholders. Specifically, some scholars such as Crow (2010, p. 488) contend that traditional academic culture, with its emphasis on disciplinary specialisation and new knowledge with "little concern for its application and knowledge" is at odds with the need for cross-departmental collaboration, and time consuming cooperation with external stakeholders. Others such as Karatzoglou (2011), Whitmer et al. (2011) and Yarime et al., (2012) raise the concern that existing internal review and promotion systems in academia overvalue traditional research outputs such as publications and conference presentations, thereby undervaluing achievements such as public outreach and collaborative research with external partners. The sum of these arguments in the literature, combined with the authors' own findings from several interviews, is that traditional academic reward structures are—in many cases—proving a stifling force on efforts to tackle external sustainability issues through cross-departmental and cross-sector collaboration.

Strong leadership

The presence of a strong leader or 'champion' is cited by several scholars as an essential success factor for cross-sector partnerships (Lozano, 2006; Zilahy and Huisingh, 2009). This is because skilful partnership leaders will aid the overall synergy and coherence of the overall effort by, for example: clearly defining goals, expectations and roles; motivating other players; providing feedback, support and guidance; and securing the support of other key external players. Strong leaders also have the passion and strength to endure the long-hours and extra work commitment that sustainability partnerships with external stakeholders involve, as well as secure funding due to their reputation and wealth of connections.

Co-ordination support

In an analysis of the factors facilitating or impeding large-scale cross-sector initiatives, Kania and Kramer (2011, p. 40) argue that "the expectation that collaboration can occur without a supporting infrastructure is one of the most frequent reasons why it fails". They hence stipulate as a crucial success factor the establishment of a 'backbone organisation' with specialist staff and devoted resources. The express role of this backbone organisation to aid in the planning and co-ordination of the collaboration through a variety of functions such as facilitation, communications and administrative support, in addition to data collection and reporting. Although not present in many of the cases sampled for this study, many larger partnerships have realised the need for such supporting resources and set up temporary project offices to assume this function. In other cases still, university bridging organisations such as sustainability offices or technology transfer offices will often undertake this role, which if left to project leaders and principle investigators, can prove an enormous burden on time and energy.

Time restraints

Of strong relevance to the above-described *co-ordination support* factor, lack of time has been widely reported both through the literature (Zilahy and Huisingh, 2013) and the author's interviews as a major obstacle for university actors wishing to engage in co-creative partnerships for sustainability. This is because many university and external actors will participate in external sustainability initiatives not as a core job function, but rather on top of existing work commitments and duties. For those smaller partnerships not supported by backbone organisations, much valuable time will be lost as project leaders and investigators are forced to assume administrative and management duties, in addition to leadership and research roles.

Societal 'need'

A significant portion of the cases identified for this study have emerged in reaction to severe and localised sustainability challenges such as climate change impacts and extreme weather events, food and energy security concerns, shifting population dynamics, economic and social decline, and aging infrastructures and building stocks[18]. Localised manifestations of various sustainability challenges therefore, in many cases, serve as a driving force behind both the initial formation of the partnership, as well as the subsequent mustering of external support and participation.

Socio-cultural and institutional conditions

It is no co-incidence that some of the more pioneering cases of co-creation for sustainability are unfolding in areas around the world long characterised by a high-level of environmental awareness and commitment to tackling social issues. The potential of this factor to function as a driver is explicitly reported in the literature (Lienin et al., 2005), and has also come to light through the author's interview and field-based observations. Here it became strongly apparent that positive external forces such as the presence of socio-political conditions that are socially progressive, environmentally aware and receptive to new forms of experiments and collaborations are powerful drivers of momentum towards societal transformations that co-creative partnerships seek to trigger.

On the other hand, it is also reported in the literature that socio-cultural and institutional conditions can prove a major dampener on cross-sector efforts to drive sustainable urban transformations. To name but a few, these include, locked-in local cultures and lifestyles, aversion to change, low environmental or sustainability awareness (Zilahy and Huisingh, 2009), poor socio-economic conditions and conflicting government policies or institutional frameworks (Bai et al., 2010). Given that such conditions are extremely difficult to control or influence, adverse external conditions can potentially pose a significant challenge for co-creative actors attempting to trigger societal change towards sustainability.

[18] To give but three examples, this includes Rust to Green by Cornell University, the Oberlin Project by Oberlin College and Verdir by the University of Liege.

Table 3.7 Summary of potential drivers and barriers identified

Factor or condition(s)	Impacts as a driver	Impacts as a barrier
Internal factors		
Partnership synergy	• Combined strengths and knowledge magnify impact of isolated interventions	*–n/c–*
Lack of unity and harmony	*–n/c*–*	• Collective impact and synergy is lost
Communication difficulties	*–n/c–*	• Hampers unity, harmony and synergy
Strong leadership	Increases synergy, unity and motivation amongst members Can secure other leaders and resources	*–n/c–*
University policy	• Can provide infrastructure and soft support • Can be aligned with objectives of partnership	• Can alienate co-creative efforts • Can clash with objectives of partnership
Academic incentive structures and norms	*–n/c–*	• Can dissuade faculty and researcher participation
Co-ordination support	• Facilitates co-ordination, planning and data management • Frees up time and energy of principle actors	*–n/c–*
Time restraints	*–n/c–*	• Prevents sustained or deep participation and devotion to activities
Technical barriers	*–n/c–*	• Can hinder progress towards partnership goals
External factors		
External funding	• Can increase the holding capacity of the partnership regarding number of members and projects implemented • Can aid the securing of industry and government participation	• Can decrease the holding capacity of the partnership regarding number of members and projects implemented • Can decrease the securing of industry and government participation
Government policy	• Can generate government support and commitment	• Can reduce government support and capacity to co-operate
Socio-cultural and institutional conditions	• Can generate external support and interest • Can maximise impact of efforts to create societal transformations and accelerate progress toward sustainability targets	• Can reduce external support and interest • Can reduce impact of efforts to create societal transformations and hamper progress toward sustainability targets
Societal 'need'	• Can increase the societal relevance of partnership goals and boost external interest and support	*–n/c–*

Note* *n/c = not considered*

Technical barriers

The vast majority of the cases in the global sample for this study involve a prominent research element. Of these, many concern development and demonstration of unproven or emerging technologies. Due to the central role that technological development and trialling plays in such partnerships, technical difficulties or limitations harbour the potential to negatively effect the success of certain co-creative partnerships.

As a summary of the above discussion, Table 3.7 above collates the above factors and describes their ability to function as either a driver or barrier. As can be seen, the majority of factors discussed above can be regarded as *internal* factors, consisting largely of variables relating to partnership management and internal university conditions. The rest may be regarded as *external* factors. Due to their deep permeation in intertwined socio-cultural and political systems and independence from internal conditions, of the two *external* conditions would seem to be the hardest type of barrier to overcome.

3.4.7 Analytical Framework [B] Part 2: Appraisal of effectiveness and impacts

The second part of Analytical Framework (B) fixed itself the challenging and admittedly subjective task of determining the effectiveness of the 70 cases in the global sample in relation to initial partnership objectives and ascertaining any impacts attained in regards to four dimensions: *economic, environmental, societal* and *overall sustainability*.

As there is no generally accepted definition or measurement of sustainability (Bell & Morse, 2003) the issue of how to evaluate progress towards sustainability is the subject of much debate in the literature (Turcu, 2012; Van Zeijl-Rozema and Martens, 2010). There have been several frameworks developed across the world for measuring progress towards sustainable development in urban settings (European Commission, 2005; United Nations, 2007). However these complex frameworks require substantial amounts of data and processing. To adopt similar frameworks to evaluate the effectiveness and impacts of each of the 70 cases in the global sample would therefore be unsuitable due to time restrictions and lack of suitable data for the task.

The author required an evaluation framework that could be 'outsourced' in the form of a simple questionnaire to the partners and stakeholders involved in each case. The purpose of this primary data collection method would be enable an appraisal of each case and overcome issues such as: a lack of existing data for detailed and technical evaluations, the author's lack of in depth knowledge on each case, and the authors' own biases. Any evaluation framework would also have to take into consideration the vast diversity of partnership types and objectives, as well as their differing status in regards to project implementation periods. Furthermore, as this evaluation task would be converted to a questionnaire and outsourced to multiple actors from differing societal sectors for the 70 cases, any potential framework would have to be easy to understand and relatively quick to complete for the respondents.

Based upon the above considerations, the author made the decision to design a simple self-evaluation framework adapted from a set of guidelines used by the United Nations Development Programme (UNDP, 2009) and Organisation for Economic Co-operation and Development (OECD, 1991) for evaluating individual development projects[19]. In the UNDP evaluation framework, it is recommended that efforts to evaluate individual projects take into consideration the following dimensions:

[19] Note that the project evaluation guidelines employed by UNDP were originally developed by the Organisation for Economic Co-operation and Development (see OECD, 1991)

- Relevance
- Effectiveness
- Efficiency
- Sustainability[20]
- Impact

Based upon UNDP recommendations that not all of the above categories would required for many assessments, the author made the decision to focus upon the three themes of *effectiveness, efficiency* and *impact.* This was for the reason that most cases in the global sample are not intended to continue after the completion of implementation periods, and that the *relevance* of each partnerships' objectives was, in the author's opinion, not a direct measure of project performance. It should be noted that UNDP recommends that data for these areas be obtained directly from project participants in the form of self-evaluation questions. It is also suggested that a set of indicators be developed for the *impacts* dimension.

With this guidance, the author developed an evaluation framework for insertion into a quantitative questionnaire (see Appendix 4), in addition to a set of simple indicators to evaluate the 'impact' dimension from four areas: *economic, environmental, societal* and lastly, *overall sustainability.* The creation of these indicators was aided greatly by those created for appraising the societal, environmental and environmental impacts of university research in the United Kingdom higher education sector (see Research Excellence Framework, 2012). The final evaluation tool to emerge from the above-described logic is summarised below in Table 3.8.

It should be noted that the indicators suggested for the evaluation of impacts were purposely designed to be broad and flexible when integrated into the final questionnaire, thereby inviting the respondents to evaluate each dimension from their own point of reference. For this perspective, the above framework should not be regarded as tool for measuring the *absolute* effectiveness and impacts of each partnership, but more so the *relative* and *subjective* opinions of core members and key stakeholders in regards to partnership performance.

[20] Note that the use here of the word 'sustainability' is not a normative definition, but rather a reference to the physical ability of the project to continue after the initial aid period.

Table 3.8 Summary of evaluation framework for co-creative partnerships

Area	Focus/indicators
Effectiveness	
Synergy	Does the participation of different actors and sectors (e.g. universities, government, industry and citizens) have a positive effect on the partnership and is their presence necessary to achieve the goals of the partnership?
Function	Are the various partners, stakeholders and sectors involved in the partnership successfully carrying out their expected roles and contribution?
Effectiveness	Is the partnership on track to achieving its initial objectives, or for a finished partnership, has it successfully achieved its initial objectives?
Efficiency	
Efficiency	Are resources and inputs such as money, time, people and materials converted efficiently to results?
Timespan	In light of partnership objectives, is the timespan adequate?
Impacts	
Economic	For example: • Stimulation of economic activities • Creation of employment or new products/businesses/services • Increase of industrial or business performance and efficiency • Increase of regional competitiveness and vitality
Environmental	For example: • Improvement of sustainability, environmental impact or resiliency of target area/city/region or business and industry activity in that area • Improvement of infrastructure and/or built or natural environment • Improved management of infrastructure and/or the built or natural environment
Societal	For example: • Improvement of social, political or cultural conditions • Improved liveability and quality of life • Improved public awareness or engagement in sustainability or environmental issues
Overall sustainability	A holistic appraisal of the partnership based upon a simultaneous consideration of the above three impact areas.

3.4.8 Overview of questionnaire method for sourcing analytical framework data

This sub-chapter has so far outlined three analytical tools that will be applied later in Chapter 4 and Chapter 5 to create a series of statistical analyses of the 70 cases in the global sample. These were:

1. A typology of co-creative partnership types
2. Analytical Framework [A]: For identifying and comparing basic attributes
3. Analytical framework [B], consisting of two parts:
    - The identification of most commonly encountered barriers and drivers
    - The appraisal of partnership effectiveness and impacts

The value of the above three tools is that they each allow a quantitative and systematic analysis of the global sample pool. This can be achieved by the assigning of numerical scores to each and every variable in order to express its relevancy towards the partnership in question. As illustrated by other studies quantitatively applying analytical frameworks to large-*n* sample pools of sustainability partnerships (Bai et al., 2010; Bulkely and Castan Broto, 2012; Pattberg et al., 2012), data for the application of such frameworks can be sourced from either analysing secondary empirics or obtained via questionnaires. In this study, the author made the decision to procure data for Analytical Frameworks [A] and [B] through questionnaires sent to key persons in each case. On the other hand, data for the typology of co-creative partnership types was obtained from the author's analysis of secondary documents, which contained sufficient information for this task. Concerning the questionnaire methods used for each of the two analytical frameworks, detailed explanations concerning methodologies and data calculation methods may be found in Chapter 4 and Chapter 5. However, because the survey methodology used for each of these frameworks is similar, this is briefly discussed below.

In essence, two separate questionnaires were prepared to obtain data that would facilitate a chiefly quantitative application of Analytical framework [A] and Analytical Framework [B]. Both contained a summary of the objective of each framework, as well as succinct descriptions of each and every variable. Respondents were instructed to assign a numerical score to all possible variables in order to signal their relevancy to that particular partnership. The totality of the data collected in this way allowed for a range of statistical comparisons depicting the significance of a certain variable in the three geographical regions of Europe, Asia and North America, as well as the entire global sample.

The first questionnaire aimed to source data for the basic attributes identified in Analytical Framework [A] and may be found in Appendix 3. It was sent to one key person in each of the 70 cases—in most instances the project leader or chief investigator. The second questionnaire for applying Analytical Framework [B] and assessing drivers and barriers (and also appraising the performance of each partnership in regards to four areas: economic, environmental, social and sustainability impacts) may be located in Appendix 4. In contrast to the first questionnaire, it was sent to several key partnership members in the host institution, in addition to other participating societal sectors such as government, industry and civic sector.

As with all methods, the decision to employ a questionnaire-based data gathering method had both its advantages and disadvantages. The greatest advantage was that by sourcing data directly from partnership members, potential misunderstandings and biases from the author could be avoided. The price to pay for this however was the risk of inaccurate results due to misinterpreted variable explanations or respondent biases, and also the absence of data for those partnerships from which results were unable to be secured.

3.5 Methods for micro-level empirical research

A major portion of this thesis consists of a set of two complementary and detailed case studies, for which results are presented in Chapter 6**.** Both of these cases are ongoing or *in-situ* analyses. As stated in the Chapter 1, the overall objective of this micro-level empirical component (research objective 3) is to: *build an in-depth, qualitative understanding on contrasting types of co-creative partnerships initiated by frontrunner institutions with a special regard to: motivating factors, stakeholder type and roles, partnership mechanisms, sustainability impacts attained, drivers and barriers encountered, and lastly, strengths and weakness of the approach.* The micro-level case study element is intended to compliment the macro-level research conducted in Chapter 4 and Chapter 5 by 'zooming-in' on specific attributes, processes, challenges, drivers and outcomes achieved by two pioneering examples of co-creative partnerships for urban sustainability transformations. The two cases chosen to this end are the *2000 Watt Society Basel Pilot Region* by the Swiss Federal Institutes of Technology (ETH) domain, and the *Oberlin Project* by Oberlin College[21].

The following sections explain the appropriateness of the case study method and then justify the choice of cases.

3.5.1 Justification of case study method

A case study is defined by Gerring (2007, p. 37) as "an intensive study of a single unit or small number of units (the cases) for the purpose of understanding a larger class of similar units (a population of cases)." In the context of this study this would translate as an in depth analysis of two co-creative sustainability partnerships formed by two separate frontrunner institutions for the purposes of generating generalizable conclusions that could be used to better understand the other cases in the database.

Although this is one key objective of the cases, as will be explained in Section 3.5.3 below, the two units selected are "extreme cases of heterogeneity" (Gerring, 2007, p. 51). Therefore, the principle objective of the cases is to better understand processes, impacts (i.e. 'how' or 'what'?) and mechanisms that have generated these impacts ('how' and 'why'?) in two highly distinctive forms of co-creative partnerships. Case studies, it is argued, are ideally suited to answering 'how' and 'why' questions which are exploratory and descriptive (Eisenhardt, 1989; Yin, 2009) Furthermore, Gerring's (2007) argument that the small-*n* case method is useful for understanding causal insights and mechanisms also serves to justify the use of the case study method in this dissertation, which is heavily interested in describing transformational processes. As Gerring (2007, p. 45) argues, in depth case studies "allow one to peer into the box of causality" and "see the billiard ball crossing the table and hitting the second ball". More specifically, the suitability of the case study for answering the specific research questions of research objective 3 is indicated by Ying (2009) who argues that this method is particularly suitable when:

- The researcher has little or no control over the event in question
- The research is focused on a contemporary phenomenon in a real-life context

[21] As mentioned earlier, in this study a 'university' refers to any 4-year certified academic institution; a definition also encompassing many US colleges.

- The boundaries between the phenomenon and context are not evident
- There are more points of interest than data alone
- The event benefits from the development of theory to guide the data-collection and analysis

Not forgetting the fact that the ‘live’ or *in situ* case study method is commonly used in the field of university partnerships for sustainability (for example Evans and Karvonen, upcoming; Mero, 2011; Orr, 2011; Pothukuchi, 2011; Valkering et al., 2011; 2012) when considering that all of Yin’s above-mentioned conditions apply to the events under scrutiny in this study, it seems that the choice of the detailed case method is particularly appropriate.

3.5.2 Case selection

It is commonly accepted in the literature on methodologies for the social sciences that selection of cases is paramount for research success (Flyvjberg, 2006; Koronen, 2011; Yin, 2009).
The selection of the ‘right’ case(s) is therefore a matter that for most researchers demands much time and consideration.

The second research sub-objective provided several conditions for selecting suitable cases for this research. These were explicit demands for ‘contrasting’ types of co-creation (thereby implying distinctive approaches, motivations and stakeholders etc.) and ‘frontrunner’ institutions (thereby implying ambitious and pioneering cases). The logic behind this decision to demonstrate two ‘extreme’ (Gerring, 2009) yet pioneering variations is the resolve to explore the two polarities of the extremely wide spectrum of co-creative activity in the global sample. The analytical exercise that enabled the identification of two contrasting types of co-creation is outlined in the macro-level research results in Chapter 4.3.2 (Table 4.10). As is outlined here in more detail, a typology plotting exercise generated two distinct clusters of cases. One with a low-level of civic sector participation and a main partnership function of *research, demonstrations or knowledge exchange*, the other with a high involvement of civil society and a partnership function corresponding more so with *socio-economic transformation.*

With this empirical analytical exercise leading to the identification of two distinct sets of cases warranting a further investigation, the idea was then to choose two ‘pioneering’ cases from each polarity. This would also be in accord with Flyvjberg’s (2006) argument that case studies of highly distinctive examples are crucial in order to push the frontiers of knowledge and be at the forefront of one’s field. To aid this selection process, the author further developed the following criteria to identify two cases from each cluster in Table 4.10 to best allowing a balanced representation of the following points:

- vastly differing socio-economic, linguistic, environmental, cultural and institutional contexts
- varying stages of implementation periods (early stages, mid to advanced stages or completed)
- consistency or similarity in objectives
- representation of contrasting variables from Analytical Framework [A]
- demonstration of contrasting processes, approaches and partnership organisation
- high-level of institutional importance afforded to achieving the goals of each partnership

Based upon these criteria, the *2000 Watt Society Basel Pilot Region* by the ETH domain and the *Oberlin Project* by Oberlin College thus emerged as the most suitable cases for this dissertation. The first consists of a veteran partnership initiated by a large-scale, public research university and associated institutes in urban Switzerland. As already illustrated in Figure 3.9 earlier, the *2000 Watt Society Basel Pilot Region* corresponds to an archetypical case of co-creation *for innovation* emerging out of prosperous socio-economic conditions, in an environment where urban sustainability problems such as climate change, renewable energy and low-carbon urban development represent a strategic opportunity for innovation. Being the product of a research-intense set of institutions renowned in engineering, the partnership is characterised by a densely urban setting, a predominantly technical approach and a heavy emphasis on R&D and formal knowledge production.

Table 3.9 Overview of two detailed case studies

	2000 Watt Society Basel Pilot Region	Oberlin Project
Aim	Trial emerging technologies and foster sustainable and low-carbon urban development	Revitalise economy, reduce carbon emissions, improve environmental and social conditions
Lead institution	Swiss Federal Institutes of Technology (ETH) domain	Oberlin College
Institutional profile	Large-scale, public research universities and laboratories	Small-scale private liberal arts college
Target area	High-density medium size city (Basel, SWITZERLAND)	Low-density small country town (Oberlin and Lorain County, Ohio, USA)
Intervention period	Advanced stages (2001–2017)	Early-mid stages (2011–2017)
Long-term targets	2000-watts, 1-tonne-CO2 per capita by around 2075	Climate (GHG emissions) positive by 2050
Main internal actors	Scientific actors (scientists and faculty)	Non-scientific actors (teaching faculty, administration)
Main external actors	City government, industry	City government, civil society
Main drivers	Technical innovation and research	Social innovation and socio-economic development

In contrast, the *Oberlin Project* was chosen as a case of co-creation *for regeneration*. It has emerged in socio-economic conditions of severe post-industrial decline. In this semi-rural setting of approximately 8500 residents, sustainability challenges such as poverty, economic decline, urban sprawl, climate change, energy and local food production represent significant threats to the physical survival of the town itself. In contrast to the institutional profile of the Swiss case, this partnership is the product of a small-scale, private liberal-arts college renowned in the liberal and creative arts. As illustrated previously in Figure 3.8, the Oberlin College corresponds to a hybrid case of a *physical environment transformation project* and a *socio-economic transformation project* where both real estate development and economic development strategies are combined into a comprehensive strategy for low-carbon urban renewal and socio-economic revitalisation. In contrast to the Swiss case, the Oberlin Project is still in its early to mid-stages and characterised by a large degree of social innovation and civic society participation. Although the selection of these two cases resulted in a relatively heterogeneous case selection, the balance of key differences and similarities (see the long-term targets) as summarised in Table 3.9 below ensured that the final selection was not entirely a matter of comparing “apples and oranges” (Gerring, 2009, p. 50).

As a final selection criteria, both cases were deemed as coming from ‘pioneering’ academic settings due to the high level of institutional importance afforded to the extremely ambitious goals of each partnership.

3.5.3 Case study data collection methods

Data gathering for each of the two cases was an ongoing and time intensive task spread out over two and a half years from April 2011 to December 2014. This long-term data collection was vital in order to ascertain the various relationships, mechanisms and impacts of each case, both of which are long-term collaborations committed to the pursuit of extremely long term sustainability goals.

As argued by Yin (2009), evidence for case studies is usually collected in multiple ways:

1. Documentation
2. Direct observation
3. Participant observation
4. Interviews
5. Archival records
6. Physical artefacts

In accord with such norms, the specific procedures by which data (primarily qualitative but also quantitative) was collected for the two case studies was initially through analysis of secondary documents such as websites, academic journal articles, technical publications, general reports and press articles. This was then supplemented via semi-structured telephone interviews and then eventual field visits to each location and academic institution. Such visits also involved direct observation and inspection of physical artefacts such as building and energy production sites, and vehicle prototypes. More concretely, the specific field work and interviews conducted for each of the two cases are detailed below:

3.5.3.1 Fieldwork and interviews for 2000 Watt Society Basel Pilot Region

Semi-structured interviews for the ETH case were initially conducted by telephone and email from March 2012 and were repeated as necessary throughout the research. Fieldwork to ETH Zurich and the City of Basel took place during February 2013 over approximately two weeks. Of this, one week respectively was spent in Zurich and Basel to conduct on-site visits and semi-structured interviews as summarised in Table 3.10 below.

3.5.3.2 Fieldwork and interviews for Oberlin Project

Semi-structured interviews for the Oberlin Project were initially conducted by telephone and email from December 2012 and were repeated as necessary throughout the research. Fieldwork to Oberlin College and Oberlin took place during May 2013 over approximately two weeks. The entirety of this time was spent conducting on-site visits and semi-structured interviews as summarised in Table 3.11 below.

Table 3.10 Semi-structured interview subjects for the 2000 Watt Society Basel Pilot Region

Date	Name	Method	Role/Position	Reason
University				
09.03.2013	Ronald Stulz[22]	Telephone	ETH Domain (Head of Novatlantis)	Founder of Novatlantis and 'champion' of the pilot region
01.11.2012	Ronald Stulz	Telephone		
11.02.2013	Ronald Stulz	In person		
11.02.2013	Prof. Armin Binz[23]	In person	University of Applied Sciences and Arts Northwestern Switzerland (FHNW) Institute of Energy in Building	Head of building programme in Basel Pilot Region, involved since 1998.
12.02.2013	Prof. Daniel Spreng	In person	ETH Domain (ETH Zurich Energy Science Center)	Expert in 2000-watt society and its history.
13.02.2013	Dr. Christian Bach	In person	ETH Domain (Swiss Federal Laboratories for Materials Science and Technology (EMPA)	Leading scientist in mobility programme in pilot region
14.02.2013	Dr. Marco Morosini	In person	ETH Domain (ETH Zurich)	Expert and critic on 2000-watt society
18.02.2013	Prof. Achim Geissler	In person	University of Applied Sciences and Arts Northwestern Switzerland (FHNW) Institute of Energy in Building	Head of building programme in Basel Pilot Region
05.11.2013	Prof. Achim Geissler	Telephone		
Government				
14.02.2013	Toni Püntener	In person	City of Zurich (Department of Health and the Environment, Deputy Head of Division of Energy and Sustainability)	Expert on implementation efforts in Zurich for 2000-watt society
19.02.2013	Nathalie Martin	In person	City of Basel (Department of Economy, Society and Environment)	Expert on implementation efforts in Basel for 2000-watt society

[22] Retired from Novatlantis in 2011 but still serves as an advisor to the steering committee.
[23] Retired from University of Applied Sciences and Arts Northwestern Switzerland.

Table 3.11 Semi-structured interview subjects for the Oberlin Project

Date	Name	Method	Role/Position	Reason
Oberlin College				
06.12.2012	Kristin Braziunas	Telephone	Oberlin Project Office (Head of communications)	Expert overall knowledge of project
10.06.2013	Kristin Braziunas	In person		
05.06.2013	Bridget Flynn	In person	Office of Environmental Sustainability (Sustainability coordinator)	Expert on College role in Oberlin Project
05.06.2013	Prof. David Orr	In person	Department of Environmental Studies	Leader and founder of Oberlin Project
06.06.2013	Assoc. Prof. Cindy Frantz	In person	Department of Environmental Studies	Expert on energy and community engagement in Oberlin Project
06.06.2013	Assoc. Prof. Rumi Shammin	In person	Department of Environmental Studies	Expert on energy and community engagement in Oberlin Project
07.06.2013	Sharon Pearson	In person	Oberlin Project Office (Programme coordinator)	Expert overall knowledge of project
07.06.2013	Heather Alderman	In person	Oberlin Project Office (Assistant director)	Expert overall knowledge of project
Civil society				
04.06.2013	Amanda Woodrum	In person	Policy Matters Ohio (Researcher)	Expert on policy in Oberlin Project
10.06.2013	Robin Jindras	In person	Oberlin Senior Centre (Retired director)	Expert on community engagement in Oberlin Project
12.06.2013	Brian Fredrick	In person	Leadership Lorain County (President)	Expert on economic development in Oberlin Project
Government				
06.06.2013	Steve Dupee	In person	Oberlin Municipal Light and Power System (Director)	Expert on role of energy in Oberlin Project
07.06.2013	Brian Burgess	In person	Oberlin City Council (City Council member)	Expert on government role in Oberlin Project
07.06.2013	Eric Norenberg	In person	Oberlin City (City manager)	Expert on government role in Oberlin Project

3.5.4 Case study limitations and potential problems

As with any method chosen to address a problem field, the case study too has its share of potential problems and quality issues (Scholz and Tietje, 2002). These may emerge at varying stages of the research, from the time of the initial design to the period of data collection and then subsequent analyses (Ying, 2009). In this dissertation, care has been taken to acknowledge potential issues that may affect data quality and validity of results and interpretations, and then to take tactical measures to overcome these. The following discussion deals with four key quality issues and steps taken to address these.

3.5.4.1 Construct validity

Using a hypothetical example of a case study intended to measure ‘neighbourhood change’, Yin (2009) describes the need to state explicitly the types of change that are to be measured (which should be related to the initial objectives of the study) and demonstrate that the measures used to describe these changes are suitable for this purpose. The logic here is to avoid the situation where the researcher fails to develop a suitable set of measurement tools and indicators and thereby uses subjective judgements to collect and interpret the data. Although this argument bears much relevance for the two cases in this dissertation, the principle objective of the twin case analysis is not solely to describe and evaluate the environmental, social and technical transformations—i.e. final outcomes—of each partnership. This is because the specific objectives, structures, implementation periods and contexts of each case differ vastly. As such, a uniform set of indicators for measuring sustainability impacts in each case would, in the view of the author, be largely unsuitable. Instead, the goal of the case studies is more so to describe the processes and mechanisms by which this change occurs, and also to identify the barriers and drivers that have aided or facilitated the final transformation outcomes. With these multiple goals in mind, a specific analytical structure (see Table 6.1 in Chapter 6) has been designed for each case study to ensure that both are analysed from the same perspective. Although the case analyses have strived to evaluate the progress towards environmental, social and technical transformation goals, this is conducted chiefly from the viewpoint of impacts attained by each of the specific societal engagement modes employed.

Other tactics suggested by Yin (2009) to overcome issues relating to construct validity involve using multiple sources of evidence, establishing a ‘chain of evidence’ where results can be traced back to the original source of data, and lastly, having the case study draft reviewed by key informants. All three of these tactics have been used in this dissertation, which draws upon multiple sources of secondary and primary data, clearly organises and cites all articles of evidence, and finally, has regularly sent sections or key findings from the case studies to various interviewees in the ETH domain and actors in the Oberlin Project for feedback and verification of accuracy.

3.5.4.2 Internal validity

Ying (2009) argues that concerns related to internal validity are most relevant for causal or explanatory case studies; a threat that occurs at the time of data analysis. As mentioned above, one part of the case studies does seek to establish cause-and-effect relationships by linking processes and mechanisms within each partnership to real-world transformations and progress towards sustainability goals. One of the tactics suggested by Eisenhardt (1989) and Yin (2000) to overcome this that of considering and laying out both supporting and rival explanations, as well as sourcing theory from the literature to aid generalisation of results. These measures have therefore been incorporated into the discussion part of both case studies.

3.5.4.3 External validity

The third major barrier for case studies listed by Yin (2009) concerns the problem of knowing whether or not the findings of a particular case study are actually generalizable. One tactic for overcoming this is to identify details or components that may be compared and extrapolated to existing, broader bodies of academic theory. In the context of this study, relevant fields and theories of knowledge for cross-comparison and analytic generalisation are discussions on diverse themes such as: technology transfer, entrepreneurial universities, university-industry-government partnerships, university sustainability partnerships, transition experiments, urban sustainability, and finally, sustainability science.

3.5.4.4 Reliability

The final category of quality issues heeding attention is the issue of whether a different researcher would arrive at the same conclusions should they conduct the same case study and procedures of the original. Yin (2009) suggests two tactics to ensure that the same case study may be replicated: a case study protocol and case study database. This research has opted for a database to store the raw information that was collected for each case study. This consists of both primary and secondary data obtained through each of the six data collection procedures outlined earlier. Stored mostly as electronic data, this database contains all of the original information utilised in each case such as semi-structured interview recordings and manuscripts, contact details of interviewees, photographs of sites and artefacts, in addition to notes of the author and secondary documents from various sources such as websites, media, as well as university and academic publications. This careful documenting of all articles of evidence allowed the author to constantly compare the arguments and observations integrated into the final manuscript with those contained in the original raw data of both secondary and primary sources.

3.5.4.5 Data quantity and quality

Other major challenges encountered when conducting the case studies concern the amount of data that could be obtained, and the quality of that data. Regarding the *quantity* issue first of all, in both the ETH and Oberlin College case it was a constant difficulty to secure the amount and type of secondary and primary data that was required to address the specific research questions. Particularly when it came to conducting semi-structured interviews with experts and responsibles from each partnership, there were constant time restraints which, in some cases, prevented the author from being able to meet with certain individuals possessing vital information on each case. On top of this issue, other factors have limited the amount of useful secondary data available for each case. In the case of ETH, this is related to the fact that German is the key communication vehicle of partnership activities. This means that a great majority of secondary documents produced by actors in the ETH case are in German, and therefore inaccessible to the author[24]. This linguistic barrier was also constantly felt during semi-structured interviews conducted in Switzerland in English. That is to say, the capacity of certain actors to express themselves freely in English has possibly affected the *quality* of responses obtained.

[24] Efforts were made to surmount this barrier by using online translators for analysing several documents in German.

For the Oberlin College case, the key issue was not linguistic but rather related to quantity. This is because this partnership has only been in implementation since 2008, with many key impacts and the realisation of long-term sustainability objectives yet to materialise. This means that the amount of secondary data on results achieved so far is extremely scarce. The semi-structured interviews were therefore a key means of obtaining primary and up-to-date data for assessing partnership impacts in both cases.

3.6 Summary of chapter

This chapter has steered through all of the explanations on the conceptual and analytical framework related dimensions of this study.

It began with an overview of the author's conceptualisation of the university function of 'co-creation for sustainability' that will be used to view the phenomenon of cross-sector university partnerships for urban transformations towards sustainability through the rest of this dissertation. It was explained that this conceptual framing was deemed as necessary because many of the attributes, pioneering approaches and ambitious objectives of recently formed cases are insufficiently explored by the existing literature on university partnerships for sustainability.

The second part of this chapter then provided an overview of the scope of this study. It was explained that this dissertation is concerned uniquely with university-driven collaborations with external partners seeking to bring about the sustainable transformation of a specific urban community, town, region or societal sub-sector in industrialised Europe, Asia or North America. This then led to an overview of the structure of this dissertation and the process by which the research was conducted. It was explained that the worldview behind the research is that of a *pragmatist* (Tashakkori and Teddlie, 2003) where the author allowed the research questions and three sub-objectives to dictate the choice of methodology—and therefore research structure. This resulted in an empirical study design employing both quantitative and qualitative approaches. The research structure to emerge from this was an empirical study with two elements: (1) a macro-level seeking to provide a global statistical overview of basic attributes, commonly encountered drivers and barriers and an appraisal of individual partnership performance; and 2) a twin set of detailed qualitative case studies.

The third component of the chapter then outlined the process and methods employed by the macro-level empirical research. It was explained that this involved three tiers: (1) the identification of 70 co-creative cases from Europe, Asia and North America and the construction of a global database (2) the creation of analytical frameworks, and (3) the application of those frameworks to the sample pool through data sourced from both primary documents and secondary sources (quantitative and qualitative questionnaires).

The analytical tools created for generating statistical knowledge from the global sample were then explained in detail in the fourth part of the chapter. The three components developed were: (1) a typology of co-creative partnerships, (2) Analytical Framework [A]: a six-level analytical framework for identifying and comparing basic attributes such as urban sub-systems targeted, geographical size of target region, type of internal and external actors involved, motivating factors, and lastly, mechanisms by which the partnerships pursues its objectives; and (3) Analytical Framework [B]: a tool to identify commonly encountered barriers and drivers, as well as assessing partnership effectiveness and impacts.

The last part of the chapter then covered the methodological aspects of the micro-level empirical research consisting of two cases: *2000 Watt Society Basel Pilot Region* by the ETH domain in Switzerland and the *Oberlin Project* by Oberlin College. It was explained that these were chosen an illustration of two 'extreme' and 'pioneering' variations of co-creation for sustainability. The *2000 Watt Society Basel Pilot Region* was hence chosen as an example of co-creation for *innovation* emerging out of prosperous socio-economic conditions in urban Switzerland. Here sustainability challenges presented a strategic opportunity for university, city and industry actors to experiment with technical means of pursuing ambitious long-term sustainability targets. In stark contrast, it was illustrated that the Oberlin Project represents a case of co-creation for *regeneration*, born out of socio-economic conditions of severe post-industrial decline in semi-rural America. Being the product of small-scale but prestigious liberal arts college, it was explained that the case is characterised by the objective of urban and economic revival, a high-level of social innovation and active participation of civil society. It was highlighted that a significant objective of both two cases is to build detailed, qualitative knowledge on motivating factors, stakeholder type and roles, partnership mechanisms, sustainability impacts, drivers and barriers encountered, and lastly, strengths and weakness of the approach. It was finally explained that for both case analyses data was sourced through secondary documents, in addition to the creation of primary data through field visits and semi-structured interviews.

With the above discussion now in place, the time has now come to apply the three analytical tools created in this chapter to the global sample of 70 co-creative partnerships. This will serve to generate the empirical foundations for this dissertation and paint the initial macro landscape view of the universe of co-creative partnerships for urban sustainability transformations.

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Chapter 4

Macro-level empirical research: Statistical analysis of key attributes

Purpose: To determine from a global perspective key attributes, commonalities and differences characterising co-creative university partnerships for urban transformations towards sustainability.

This chapter addresses the first research sub-objective and seeks to lay the initial empirical foundations for this dissertation. It 'connects the dots' between the 70 cases identified for the global sample pool and provides a 'bird's eye view' of the emerging global trend of university partnerships formed in the goal of advancing the sustainable transformation of a particular geographical area or societal sub-system. In the aim of generating statistical data to describe basic attributes and generate regional comparisons between overall trends in Europe, Asia and North America, a series of analytical tools will be applied to the global sample. The first of these is Analytical Framework [A] that was developed in Section 3.4.2 to identify key attributes such as the urban sub-systems targeted, the geographical scale of the target region, the type of internal and external actors involved, reasons for the partnership formation and finally, mechanisms by which the partnership seeks to create societal transformations towards sustainability. Other tools to be employed in this chapter are typology-based instruments, of which the typology of four co-creative partnership types has already been outlined in Chapter 3.4.1.

The necessity of this macro-level analysis stems from two observations. The first is the current lack of understanding regarding basic characteristics and mechanisms of co-creative university partnerships for urban sustainability. This is undoubtedly related to the relative newness of this model of societal engagement, which appears to be still emerging and expanding across academia. The second is the earlier observation from the literature review in Section 2.2.3 where it was noted that the majority of empirical research in the field of co-creative university partnerships for urban sustainability is in the form of individual, or small-*n* sets of case studies (Karatzoglou, 2011). Consequently, to date there has been no attempt to conduct a systematic analysis across a large body of cases. The contribution of this chapter will therefore be to generate basic knowledge and statistics in an emerging academic field that, until now, has lacked any worldwide databases and robust analytical frameworks (Stephens et al., 2009).

4.1 Global overview of co-creative university partnerships for sustainability

This sub-chapter will seek to respond to the following research sub-question:

1.1 *To what extent have co-creative partnerships for urban sustainability transformations emerged and propagated across academia and around the world?*

As may be confirmed in the database summary in Appendix 1, this study has identified 70 instances of cross-sector partnerships for sustainable urban transformations satisfying the criteria outlined in Chapter 3.2. Although a significant indication that the function of co-creation for sustainability has propagated widely around the globe, this sample is by no means exhaustive. It should therefore be viewed as being no more than a significant representation of a global population that is yet to be fully quantified and assessed.

4.1.1. Geographical and temporal distribution of cases

The objective of this following discussion is to assess the geographical distribution and temporal aspects such as start and completion dates for the sample obtained for this study.

The first point of interest concerns the geographical distribution of the sample pool. Macro-level data collection procedures described in Section 3.3.2 have led to the identification of a total of 70 cases. The distribution of this sample is depicted below in Figure 4.1. As can be seen, the vast majority of cases located for this study are concentrated in Europe (28) and North America (27). However this uneven distribution should be interpreted with a degree of caution as this is undoubtedly linked to the fact that many co-creative partnerships in non-English speaking Asia such as Korea, Hong Kong and Taiwan are 'invisible' to this study for linguistic reasons[25]. Therefore, the distribution of this sample pool is not necessarily reflective of the spread of the actual population in these three geographical zones.

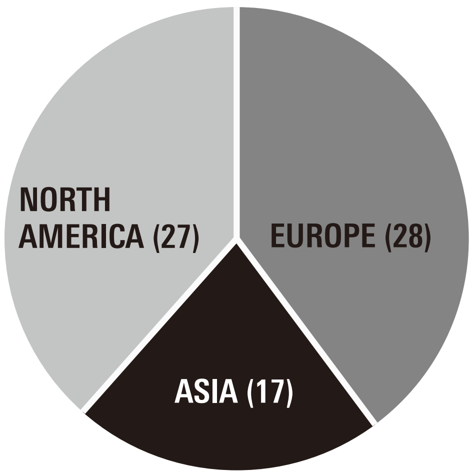

Figure 4.1 Geographical distribution of sample pool (*n*=70)

[25] As mentioned in Chapter 3, this study has attempted to include partnerships from non-English settings by conducting search activities in French and Japanese, in addition to English.

The distribution of the specific towns, cities and regions targeted by each case is collated below in Tables 4.1, 4.2 and 4.3. The column on the right (i.e. *No. of cases)* depicts the quantity of partnerships targeting that particular city, town or region. It should be noted that many cases (especially in Europe) target multiple cities simultaneously. As can be seen, the respective targeted areas for each partnership forming the sample pool are distributed as follows: Europe (a total of 28 cases have activities spread across 47 cities, towns and regions and 18 nations); Asia (a total of 15 cases have activities spread across 8 cities, towns and regions and 4 nations); and North America, comprising of Canada (a total of 4 cases with activities spread across 3 cities, towns and regions and 2 provinces); and US (a total of 23 cases with activities spread across no less than 19 cities, towns and regions and 12 states). As may be confirmed in each table, the majority of towns, cities or regions are targeted by only single partnerships, with overall, little geographical overlapping of cases. That said, various localities in several major urban centres such as Manchester, London, Paris, Berlin, Rotterdam and New York are targeted by multiple partnerships.

The key message from Tables 4.1, 4.2 and 4.3 is that when considering the geographic areas targeted by the various activities in each of the 70 cases, it may be concluded that the university function of co-creation for sustainability appears to be significantly widespread around the world, and not simply confined to one or two cities or countries.

The second point of interest concerns the temporal distribution of the sample pool. Figure 4.2 below depicts the individual partnership names and collaboration periods for each of the 70 cases in the sample. A key finding is that although there are a few on-going 'veteran' partnerships such as the 2000 Watt Society Basel Pilot Region by ETH and UniverCity by Simon Fraser University, more than half of the sample (36 cases) have formed since 2010. Although this could be in part explained by the fact that many older or completed partnerships have a low Internet presence, thereby rendering them invisible to this study, this point nevertheless corresponds with a similar observation from Castan Broto and Bulkeley (2013). In their study of 'climate change experiments' in 100 cities across the world, it was found that 79% of 495 experiments had started after the enforcement period of the Kyoto Protocol beginning in 2005. The interpretation here was that international climate change governance had evolved to a local and regional level as climate change and mitigation becomes an increased area of interest and activity for various urban actors. Keeping in mind that the *n*-size of the database for this dissertation is significantly smaller than that of Castan Broto and Bulkelely's study, the significant concentration of partnerships in this study formed since 2010 suggests two important points.

Table 4.1 Target areas for Europe

Country	Town, city or region	No. of cases*
EUROPE		
Austria	Freistadt	1
	Marchtrenk	1
	Vienna	1
Belgium	Brussels	1
	Liege	2
	Verviers	1
	Eupen	1
	Genk	1
Bulgaria	Sofia	1
Croatia	Ljubljana	1
Denmark	Aalborg	1
	Copenhagen	1
England	Cardiff	1
	Coventry	1
	London	4
	Manchester	3
	Nottingham	1
	Sheffield	1
Finland	Helsinki	1
	Lahti	1
France	Nationwide	1
	Greater Paris	2
	Versailles	1
Germany	Berlin	2
	Aachen	1
	Eschweiler	1
	Karlsruhe	1
	Nordrhein-Westfalen	1
	Stuttgart	1
Ireland	Dublin	1
Italy	Milan	1
	Rome	1
Netherlands	Heerlen	1
	Rotterdam	3
	Northern Provinces	1
Scotland	Edinburgh	1
	Glasgow	1
	Nationwide	1
Slovenia	Ljubljana	1
Spain	Seville	1
Sweden	Malmo	1
	Goteborg	1
Switzerland	Basel	1
	La Chaux-de-Fonds,	1
	Lausanne	1
	Martigny	1
	Neuchâtel	1
	Zurich	1
	Nationwide	1
Wales	South East Wales	1
18 countries	47 cities/towns	**28 cases**

* Several cases target multiple cities/regions

Table 4.2 Target areas for Asia

Country	Town, city or region	No. of cases
ASIA		
Japan	Chiba Prefecture	1
	Kashiwa CIty	2
	Fujisawa City	1
	Okutama City	1
	Kurihara City	1
Korea	JeJu Island	1
Hong Kong	Nationwide	1
	Sha Tin	1
	Tung Chung	1
Singapore	Jalan Bahar	1
	Nationwide	6
	Western Singapore	1
4 countries	8 cities/towns	**Total**

Table 4.3 Target areas for North America

State/province	Town, city or region	No. of cases
CANADA		
British Columbia	Burnaby	1
	Vancouver	1
Ontario	Windsor	1
	Statewide	1
US		
Connecticut	New Haven	1
California	East San Francisco	1
Iowa	Numerous cities and communities	1
Massachusetts	Cambridge	1
	Worcester	1
	Boston	1
	SE Massachusetts	1
Michigan	Detroit	1
	Grand Rapids	1
New Hampshire	New England	1
New York	New York City	2
	Syracuse	1
	Utica	1
Ohio	Oberlin	1
	Statewide	1
Oregon	Gresham	1
	Salem	1
	Springfield	1
	Portland	3
Pennsylvania	Erie	1
Texas	Austin	2
Wisconsin	Statewide	1
14 states/provinces	22 cities/towns	**Total**

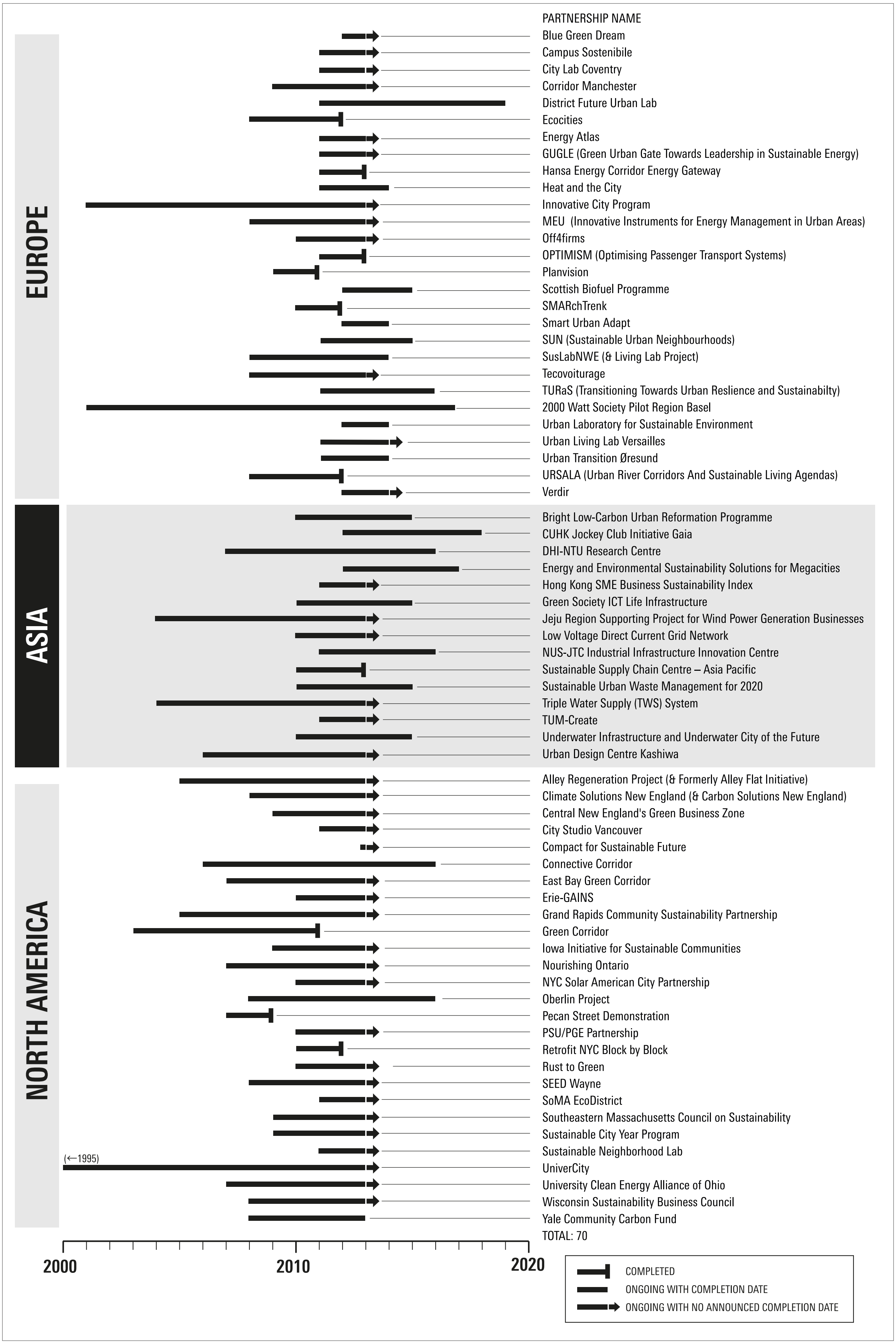

Figure 4.2 Temporal distribution of sample pool (n=70)

Firstly, this is possibly signifying that the global population of co-creative partnerships across academia is increasing; as is also the case for initiatives and interventions on cities around the world for climate change (Bulkeley and Castan Broto, 2012). The second and more certain point is that the function of co-creation for sustainability is still developing and set to further evolve and expand. This is derived from the observation that many alliances are committed to the long-term pursuit of sustainable development, with many lacking concise completion dates. Two give but two examples, the Oberlin Project by Oberlin College and the 2000 Watt Society Basel Pilot Region by the ETH domain are working towards extremely long-term sustainability targets; 2050 for the first and around 2075 for the latter. Although that these partnerships would not continue until such dates, many cases in the sample pool are similarly committed to pursuing long-term targets and are intent on continuing as long as necessary resources such as funding are made available. From this it could be said with a fair degree of confidence that the emerging function of co-creation for sustainability is literally 'scheduled' to continue developing and expanding across academia, for the next several years at the very least—and possibly decades.

A final point regarding the sample pool and potential for future development of co-creative sustainability partnerships concerns the overwhelming presence of research universities as host institutions, many of which are highly influential players on the global stage. This may be confirmed in Table 4.3 below, which contains several 'big names' such as MIT and Harvard, in addition to other prestigious research institutions such as the University of California (Berkley), Cornell University, the University of Tokyo, National University of Singapore and several other major European universities such as the Swiss Federal Institutes of Technology (ETH Zurich), Lund University, University of Manchester, and Milan, to name but a few of the 58 institutions[26] serving as leading partners or coordinators of the 70 cases represented. This final point suggests that the trend of reaching across campus confines to form cross-sector partnerships aimed at driving the sustainable transformation of a particular geographical area or societal sub-sector is far from being a marginalised phenomenon confined to one or two institutions. Instead, it appears to be a significant and relatively widespread trend in academia, observable in a diverse array of academic settings all over the world, many of which are highly influential shapers of the global culture of academic research and education.

To conclude, based upon the above observations concerning the geographical spread of the sample pool, the quantity of cases found and the number and influence of institutions involved, it appears that the function of co-creation for sustainability is a significant and widely propagated trend around the globe. Furthermore, judging from the temporal distribution and future trajectories 'programmed' into the implementation periods indicated in Figure 4.2, it appears that there is still has much potential for this trend to continue expanding and evolving. This is argued in full understanding that the global population for co-creative academic partnerships for sustainability transformations is without a doubt significantly larger than the sample obtained for this study.

[26] It should be pointed out that that the somewhat rigid scope of the criteria outlined in Section 3.2.1 has excluded initiatives from several other influential research universities from insertion into the sample for this study.

Table 4.4 List of lead institutions in global sample pool

Lead institution name	No. of cases
EUROPE	
Aalto University	2
Berlin Institute of Technology	1
Coventry University	1
Coventry University (Coventry University Enterprises)	1
Delft University of Technology	1
Ecole Polytechnique Fédérale de Lausanne	1
Edinburgh Napier University	1
ETH Zurich	3
Imperial College London	1
Johannes Kepler University of Linz	1
Karlsruhe Institute of Technology	1
Lund University	1
Metropolitan University	1
Manchester University	1
Polytechnic Institute of Milan	1
Technical University of Munich	1
University College Dublin	1
University of Edinburgh	1
University of Groningen	1
University of Liege	2
University of Milan	1
University of Natural Resources and Life Sciences, Vienna	2
University of Sheffield	1
University of Versailles Saint-Quentin-en-Yvelines (partner foundation Fondaterra)	2
ASIA	
City University of Hong Kong	1
Jeju National University	1
Jiao Tong University	1
Keio University	1
Hong Kong Polytechnic University	1
University of Tokyo	2
Nanyang Technological University	5
National University of Singapore	3
Hong Kong University of Science and Technology	1
NORTH AMERICA	
Boston University	1
City University of New York	1
Clarke University (partner foundation Institute for Energy & Sustainability)	1
Cornell University	1
Emily Carr University	1
Grand Valley State University	1
Gannon University	1
Harvard University	1
Massachusetts Institute of Technology	1
Oberlin College	1
Portland State University	2
Pratt Institute (Pratt Center for Community Development)	1
Simon Fraser University	2
Syracuse University	1
University of California	1
University of Iowa	1
University of Massachusetts at Dartmouth	1
University of Oregon	1
University of Texas	2
University of Toledo	1
University of Windsor	1
University of Wisconsin-Madison	1
Wayne State University	1
Wilfred Laurier University	1
Yale University	1
Total Institutions: 58	

4.2 Application of Analytical Framework [A]

This study will now proceed to apply the six-level framework proposed earlier in Chapter 3.4.2 to the 70 case sample. By doing so, it will respond to the following research sub-questions:

1.2 *From an overall global perspective, what are the most and least common:*

- *urban sub-systems targeted?*
- *geographical scales of target areas?*
- *internal and external partners and stakeholders involved?*
- *factors motivating the formation of partnerships?*
- *mechanisms used to achieve sustainable urban transformations*

4.2.1 Methodology and calculation method

As already outlined in Chapter 3, the application of this analytical framework was carried out via quantitative questionnaires (see Appendix 3) administered to one key university personnel in each case—in most instances the project leader. Data was obtained by explaining each level and variable in the six-level framework and asking recipients to assign a numerical value of 0 (*not at all relevant*), 1 (*partly relevant*) or 2 (*extremely relevant*) to signify the degree to which each variable reflected the attributes of that particular partnership.

For the 70 cases sampled, responses were obtained from 67 partnerships; a response rate of 96%. This extremely high response rate can be explained by the long period (January 2013 to October 2013) during which surveys were administered. This enabled the author to make repeated requests to those individuals from which results had not yet been secured, and where necessary, send questionnaires to alternative contacts in that partnership. For the three cases for which results were unable to be secured, two were discarded from the following analysis. With the last case, the author's knowledge and familiarity with the partnership has sufficed for the generation of data, thus enabling its inclusion into the following results.

The following quantitative survey results for each of the six-levels of the analytical framework have been calculated firstly by tallying the scores (i.e. 0, 1 or 2) obtained from each case in regards to a particular variable, and then dividing this by the total score possible for all partnerships[27]. This has resulted in a percentage distribution signifying the importance of a particular variable relative to others in that level of the framework. It should be noted that only key findings, figures and tables from this macro-level research element will be presented below.

4.2.2 Results for level one: Societal sub-systems targeted

This level of the framework attempts to determine which areas in the urban environment tend to be the most or least commonly targeted by co-creative university partnerships for sustainable urban transformations.

Results from the quantitative surveys are listed in Table 4.5 below which, as well as presenting overall world results, also allows a comparison between each of the three geographical regions. As can be seen, the three sub-sectors of *built environment* (81%), *energy heating and cooling*

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[27] To take the case of Asia (n=15), for example, the maximum possible score for any variable in the framework would be n x 2 = 30.

(74%) *and governance and planning* (71%) have emerged as the three most common sub-systems where co-creative university partnerships are attempting to advance sustainability. Special attention deserves to be brought here to the widespread targeting of *governance and planning* in various towns and regions around the world. This could be regarded as a key characteristic of the function of co-creation for sustainability. As noted by Evans, and Karvonen (forthcoming) and Bulkely and Castan Broto (2012), actors in co-creative partnerships will often attempt to transform particular social, economic, environmental and technological systems by advancing sustainability-based governance and decision-making in local and regional governance structures.

Table 4.5 Regional comparison of societal sub-sectors targeted

Societal sub-system targeted (% share of maximum score possible)	**Europe**	**Asia**	**N. America**	**World total**
Built environment	80	70	88	81
Transportation	64	43	58	57
Energy, heating or cooling	73	77	74	74
Economy, employment and industrial production	46	60	76	60
Natural environment or green spaces	54	53	74	61
Food, agriculture and forestry	38	40	48	42
Water	39	47	60	49
Solid waste	34	43	40	38
Governance and planning	71	57	78	71
Human and social systems	66	50	78	67

Again on a global level, other frequently targeted sub-systems are *human and social systems* (67%), *natural environment or green spaces* (61%), *economy, employment and industrial production* (60%) and *transportation* (57%). Regarding all of these above-mentioned sub-systems, individual results in Europe, Asia and North America also show a high degree of consistency. The one minor exception to this is Asia where *human and social systems* results (50%) are considerably lower than in Europe (66%) and North America (78%). This could most probably be explained by the high frequency of *research and knowledge exchange platforms* in Asia (see Section 4.3.1), which typically involve little intervention on human and social systems due to their focus on formal knowledge production and early stage R&D. On the other hand, the sub-sectors of *solid waste* (38%) *food, agriculture and forestry* (42%) *and water* (49%) have emerged as being the least commonly targeted for both the world total; a trend which is also consistent with individual region results.

It should also be noted that the cases analysed in this study typically target several sub-systems simultaneously as they seek to bring about the sustainable transformation of a particular location, region or sub-sector. As may be seen in Figure 4.3 below, very few partnerships target single sub-systems. Instead, most cases address several simultaneously, with the bulk of the 70 cases sampled targeting between four to ten sub-systems. Furthermore, it can be seen that there are four instances of large-scale and ambitious cases attempting to drive sustainability in all ten of the listed sub-systems[28].

[28] These cases are District Future-Urban Lab by Karlsruhe Institute of Technology, Verdir by the University of Liege, the Oberlin Project by Oberlin College and Sustainable Neighbourhood Lab by Boston University.

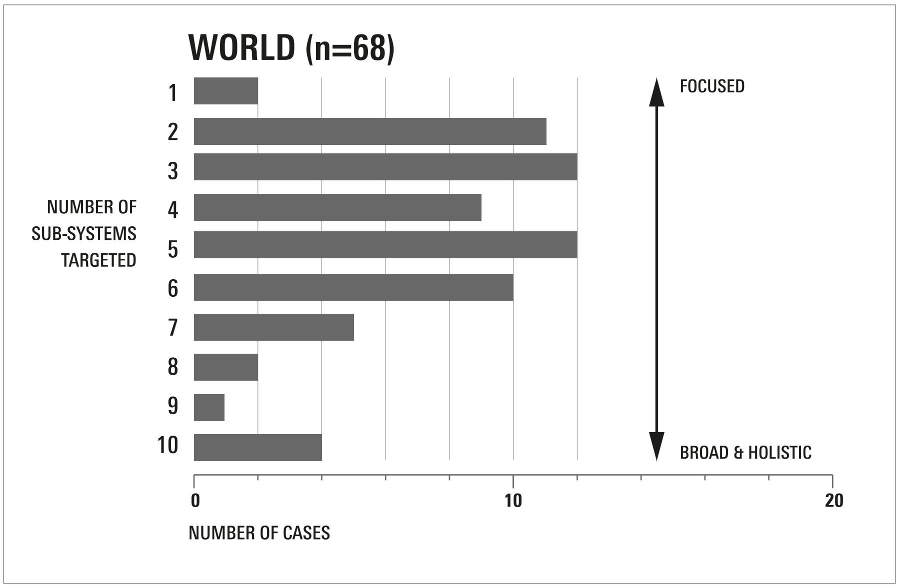

Figure 4.3 Quantity of urban sub-sectors targeted[29]

A few consistencies concerning these results and those of other studies deserve to be pointed out here. For example, Bulkeley and Castan Broto (2012) and Castan Broto and Bulkeley (2013) also found in their survey of climate change experiments in 100 cities that the vast majority of experiments in their database targeted urban infrastructure (energy, water and waste) the built environment and transport, with almost half of experiments having an energy focus. On the other hand, a breakdown of urban infrastructure revealed that 78% of experiments targeted energy, with waste and water only representing 17% and 5% respectively (Bulkeley and Castan Broto, 2012).

4.2.3 Results for level two: Geographical scale of target areas

The next level of the analytical framework seeks to determine the geographical scale of the area(s) targeted by each case.

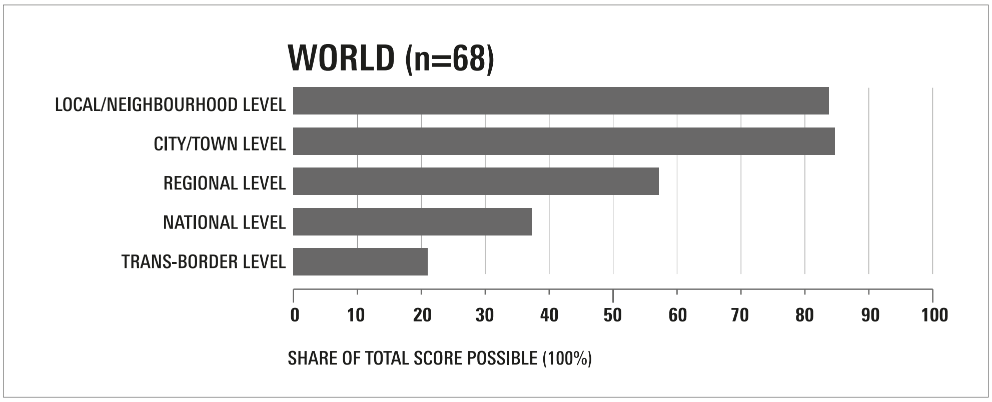

Figure 4.4 Geographical scale of area(s) targeted by partnership

Figure 4.4 above depicts the geographical size of the area(s) where the core of partnership activities and projects are taking place or, in other words, the area targeted by that case. As can

[29] The quantity of sub-systems targeted has been calculated by tallying the total amount of sub-systems scoring a 2 (i.e. 'this strongly applies to our partnership') for each case.

be seen, in terms of world results, the overwhelming majority of partnerships sampled are focused on either the *local/neighbourhood level* (84%) or *city/town* level (85%). In parallel to this overwhelming focus on the *local/neighbourhood* or *city/town* scale, Figure 4.4 reveals a trans-border focus (21%) for several partnerships predominantly concentrated in Europe (6 cases) and Asia (2 cases). As well as reflecting smaller land-surface areas in many European countries compared to North American counterparts, this presence of trans-border cooperation is most certainly the result of a growing European identity and many efforts to spur inter-European cooperation by government bodies such as funding and regional development agencies. In support of this, many of the cases in the European sample have been fostered or 'coaxed' into formation by the presence of funding programmes for trans-border development such as Interreg IV, financed by the European Regional Development Fund (ERDF) for the period 2007-2013. To name but two, this includes SUN (Sustainable Urban Neighbourhoods) by Liege University and Hansa Energy Corridor by University of Groningen.

It should be kept in mind that the activities of actors carrying out the function of co-creation for sustainability may correspond with several of these geographical scales simultaneously (see for example the Oberlin Project and the 2000 Watt Society Basel Pilot Region case studies in Chapter 6). For example, whilst reforming the physical environment and conducting various experiments at the *local/neighbourhood level* or *city/town level*, such collaborations also seek to advance the sustainability of a greater geographical area by translating experiences and research results into government policy for regional and national settings.

4.2.4 Results for level three: Internal actors

The third level of the analytical framework seeks to determine the type of internal actors involved in the formation, implementation and co-ordination of each partnership.

Results for this layer appear below in Table 4.6. It can be seen that from a global perspective, it is predominantly *faculty and researchers* constituting the main university actors engaging in the function of co-creation for sustainability (96%) followed by *students* (61%). Despite the significant role of students emerging in the results, it should be underlined that the student role is in all cases a supporting and secondary role mostly associated with the *research* rather than education function of the university. Further, it should be noted that it is was other internal actors such as *faculty and researchers*, *administration* or *bridging organisations* that were responsible for the formation and overall co-ordination of all partnerships in the sample. This is no doubt related to the structure of academic semesters, study expectations and commitments, just as much the limited capacity of students to obtain funding grants and direct large-scale cross-sector partnerships.

This above-observed trend is constant with results from the three individual regions, with European cases in particular showing a stronger tendency to be driven by faculty and researchers. That said, results from Europe indicate that student involvement is overall around half that of Asia and North America. This suggests that the potential of co-creative partnerships for urban sustainability transformations to function as educational platforms for either undergraduates or graduates is yet to be realised in Europe.

Table 4.6 Regional comparison of internal actor types

INTERNAL actors involved (% share of maximum score possible)	**Europe**	**Asia**	**N. America**	**World total**
Faculty or researchers	96	100	88	96
Administration	48	43	66	54
Students	34	73	82	61
Bridging organisations	48	57	60	55

The participation of non-academic areas of the university such as *administration* and *bridging organisations* should also be noted. This is signifying that many partnerships are formed for non-scientific reasons and co-ordinated by actors from administration and bridging organisations such as sustainability or community outreach offices (e.g. NYC Solar American City Partnership by City University of New York and Yale Community Carbon Fund by Yale University). It also testifies to the supporting role that administration and bridging organisations can play by establishing external contacts and leveraging university resources to the goals of *faculty or researcher* led partnerships.

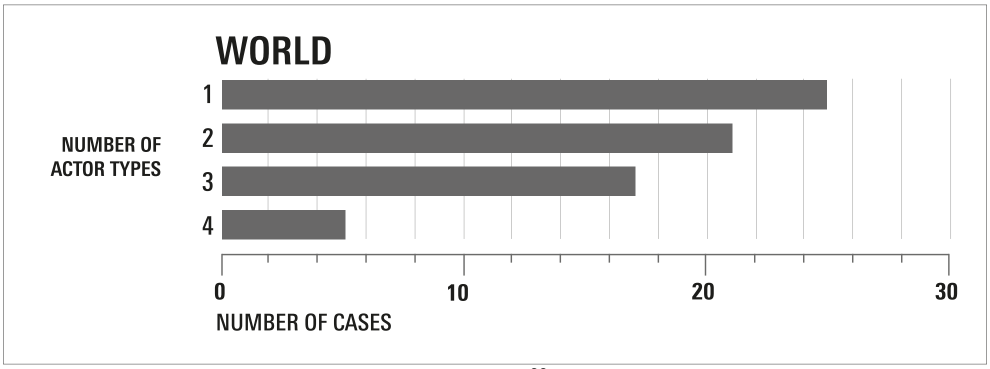

Figure 4.5 Number of internal actor categories[30]

Another key point to be retained from the internal actor analysis is that the co-creative function is characterised by internal collaboration between different areas of the university—across academic disciplines and departments and also between scientific and non-scientific areas. This tendency may be confirmed in Figure 4.5 above, depicting the number of actor categories actively participating in each case. As can be seen, although many cases are driven mainly by only one internal actor type, the far majority consists of internal collaborations between two, three or even four actor categories.

4.2.5 Results for level four: External actors

The fourth level of the framework analysis seeks to determine the type of external partners and stakeholders involved in the formation, implementation and co-ordination of each case.

From Table 4.7 below, it can be seen from results in all three regions that it is by far the *local or regional government/public service sector* constituting the most common external partner for university actors engaging in co-creation for sustainability. State or national government has emerged overall as the least frequent. These results are reflective of the earlier observation from

[30] The number of actors actively involved has been calculated by tallying the total amount of variables (i.e. actor types) scoring a 2 (i.e. 'this strongly applies to our partnership') for each case.

the second level revealing that the majority of cases around the world attempt to advance the sustainability of areas corresponding to a *local/neighbourhood level,* a *city/town level* or a *regional level*. In addition to the overwhelming participation of local government, it is the strong presence of civil society that constitutes another defining characteristic of the university function of co-creation for sustainability. With a score of 48% in the world total, it is worth noting that all but seven cases in Europe, four in Asia and seven in North America involved some sort of participation from the civic sector. That said, civil sector participation in Europe (38%) has emerged as significantly lower than in Asia (57%) and North America (82%).

Table 4.7 Regional comparison of external actors

EXTERNAL actors involved (% share of maximum score possible)	**Europe**	**Asia**	**N. America**	**World total**
Local or regional government/public service sector	84	93	84	71
State or national government	23	73	38	33
Civic society	38	57	82	48
Other academic institutions	73	53	46	49
Large or multi-national corporations	52	83	28	41
Small-medium enterprises	59	57	42	43

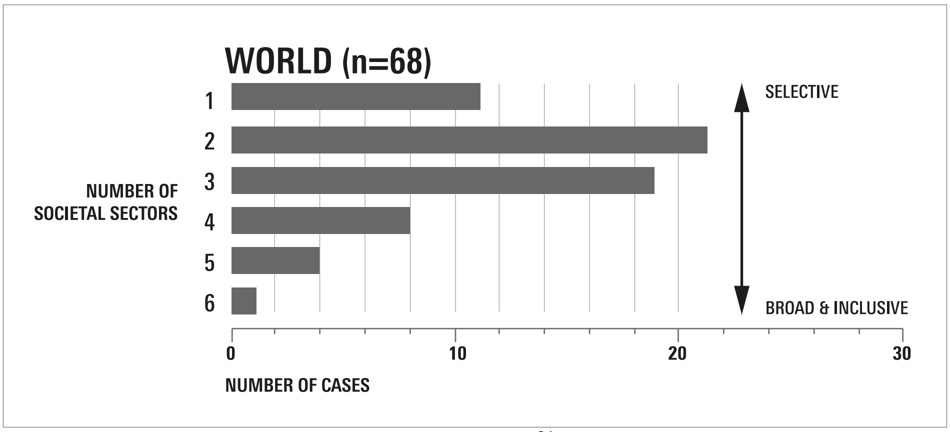

Figure 4.6 Number of external actor categories[31]

Other points to be retained from the external stakeholder results are firstly the strong collaboration between academic actors across different universities (which should also be viewed as collaborations across differing departments and disciplines), and secondly, the significant presence of small-medium enterprises (SMEs). It can be seen in Europe that collaborations tend to involve actors from other academic institutions more than in other countries. This is undoubtedly related to the above observation that many funding programmes in the EU are seeking to foster cross-border cooperation. On a global level, the involvement of SMEs, which is just as significant as that of large or multi-national corporations, is testimony to the commitment of many cases to spur low-carbon development by fostering new, or supporting existing SMEs (e.g. the Scottish Biofuel Programme by Edinburgh Napier University and the Oberlin Project by Oberlin College).

[31] The number of external societal sectors actively involved has been calculated by tallying the total amount of variables (i.e. external actor categories) scoring a 2 (i.e. 'this strongly applies to our partnership') for each case.

A final point to be made concerning this layer is that co-creative sustainability collaborations typically involve vast combinations of partners and stakeholders from several external actor categories. This tendency is depicted by Figure 4.6 above. As may be confirmed, although several cases consist of only bi-lateral (or 'double-helix') relations between university actors and partners from other societal sector, the vast majority consists of broad and inclusive alliances involving academic actors and external partners and stakeholders from two, three, four or even five external actor categories. The diversity of both *internal* and *external* actors involved—often including both experts and non-experts—is therefore another defining characteristic of many co-creative university partnerships for urban sustainability.

4.2.6 Results for level five: Motivations and triggers

The fifth level of the framework analysis aims to establish the particular reasons why the partnership was formed. Results for this level appear below in Figure 4.7. As also the case with other layers of the framework, although various motivational factors and triggers are listed in isolation, it should be emphasised that in most cases several of these variables simultaneously apply to the same partnership.

To begin with one core finding, the author would like to draw attention to the significantly low relevancy (40%) of the *entrepreneurial* motivation in explaining the reason(s) why co-creative partnerships for sustainable urban transformations come into fruition. In other words, in contrast to triple-helix partnerships formed under the entrepreneurial paradigm described by Etzkowitz et al. (2000), very few co-creative partnerships come about primarily from the desire to generate income for any of the parties involved. Instead, the reasons behind the formation of such collaborations are much more complex, and are best described by a combination of the following motivating factors.

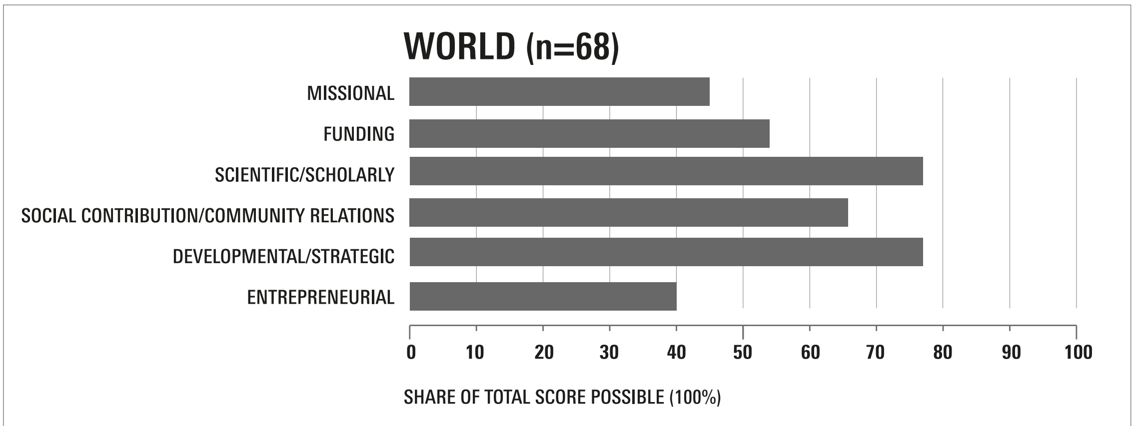

Figure 4.7 Factors motivating partnership formation

The two motivational factors emerging as the most significant in the survey results are the *scientific/scholarly* motivation (77%) and the *developmental/strategic* motivation (77%)[32]. In other words, the formation of all but five partnerships around the world has been to some extent influenced by the desire to enhance academic knowledge production by engaging with real world situations and translating scientific knowledge into tangible and useful outcomes (i.e. the *scientific/scholarly* motivation). Just as importantly, the formation of most cases around the world

[32] These results for the world total are also largely consistent with regional results, which have been omitted here.

can also be partly explained by the desire to influence local or regional development trajectories in order to respond to various societal needs and conditions. For some partnerships such as the Oberlin Project by Oberlin College or Verdir by the University of Liege, co-creative partnerships come into being in reaction to persisting or worsening circumstances of socio-economic decline. For other partnerships, the act of reforming the urban environment and altering development pathways is also animated by a strategic desire to transform the local environs in a manner that would above all benefit the university itself—i.e. 'enlightened self interest' as noted by Dixen and Roche (2005). This is particularly the case for those partnerships driven by real estate development such as Corridor Manchester by the University of Manchester and Manchester Metropolitan University, and the Connective Corridor by Syracuse University.

A final observation to be made from this layer of the framework concerns the significant relevancy of the *funding* motivation (54%) in explaining the many interlinked reasons behind the formation of co-creative university partnerships for urban sustainability. This reflects that the formation of many cases in the global sample has been influenced or 'coaxed' by the presence of external funding programmes targeted, which are often established to foster cross-sector sustainability collaborations.

4.2.7 Results for level six: Societal engagement modes

This last level of the analytical framework seeks to establish the societal engagement modes—or mechanisms—by which the collaboration seeks to achieve its objectives.

Table 4.8 Regional comparison of societal engagement modes

Societal engagement modes used (% share of maximum score possible)	**Europe**	**Asia**	**N. America**	**World total**
Knowledge management	88	90	94	90
Governance and planning	68	60	78	70
Technical demonstrations and experiments	70	87	64	71
Technology transfer or economic development	48	70	54	55
Reform of built or natural environment	54	63	80	65
Socio-technical experiments	48	53	56	52
Average number of modes per partnership	3.0	3.3	3.2	3.2

The results for this layer of the framework are listed in Table 4.8 above. Before proceeding to analyse the distribution of the individual engagement modes in isolation, a core message deserves emphasis in advance. In contrast to the conventional technology transfer model, the function of co-creation for sustainability involves a much broader range of societal engagement modes. Therefore, co-creative partnerships will almost always attempt to drive urban transformations towards sustainability through a *combination*—rather than a single exploitation—of a particular engagement mode. This point has already been argued in Figure 3.2 in Chapter 3.1 and is equally expressed quantitatively at the bottom of Table 4.8 (i.e. average number of modes used per partnership), in addition to Figure 4.8 below. The latter indicates that co-creative partnerships will typically exploit simultaneously several engagement modes, with the bulk of cases sampled involving activities in several, and in some cases, up to five[33] or six[34]. Co-creative sustainability partnerships should therefore be viewed as formal representations of numerous, de-

[33] For example, TUM-Create by the University of Singapore and Munich Technical University and the East Bay Green Corridor by the University of California, Berkley.
[34] For example, Verdir by the University of Liege and the Oberlin Project by Oberlin College.

centralised initiatives, each embedded in a larger and integrated system seeking to advance social, technical and environmental transformations for sustainability. This appears to be demonstrating both the necessity of each engagement mode for pursuing the objectives of each partnership concerned, as much as it does the capacity of the listed modes to co-exist and synergise each other.

In all regions across the world, it can be seen that activities falling into the knowledge management category (i.e. the co-design, co-production, collection, processing and diffusion of knowledge) are by far the most common means by which academic actors attempt to advance the sustainability of urban areas or particular societal sub-systems (88% in Europe, 90% in Asia and 94% in North America).

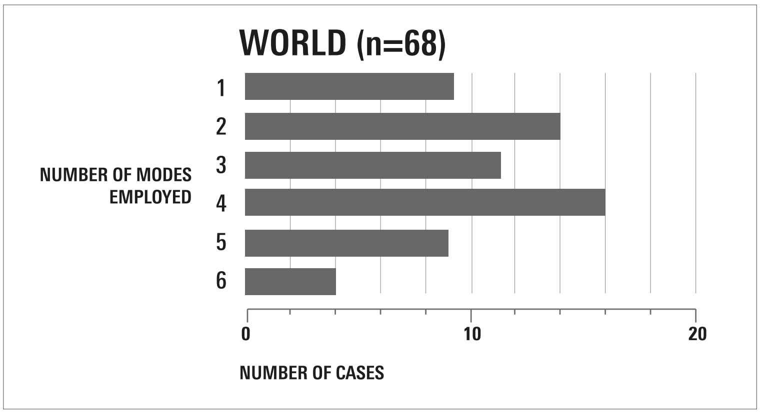

Figure 4.8 Number of societal engagement modes employed[35]

Governance and collaborative planning has also emerged as a significantly commonplace engagement mode (70% world total). Often involving political lobbying or collaborative work with government policy makers, partnerships utilising this engagement mode often attempt to translate into government policy the results of technical experiments and demonstrations, or knowledge obtained from other modes. The widespread tendency of university actors to engage with existing local and regional political structures and processes—or even create new governance structures—should therefore be retained as another defining characteristic of university efforts to co-design and co-produce urban transformations towards sustainability.

Another significant finding to emerge is an overall bias towards *technical* rather than *social* forms of innovation, a trend particularly strong in Asia. This is conveyed by results for the societal engagement mode of *technical demonstrations and experiments* which are world total (71%), Europe (70%) and Asia (87%) than in North America (64%). On the other hand, social innovation, as reflected by s*ocio-technical experiments,* has emerged as being far less prevalent in both world (52%) and regional results. The relatively low exploitation of this societal engagement mode is therefore signalling an overall global tendency to address urban sustainability issues through predominantly techno-centric approaches.

[35] The number of societal engagement modes utilised has been calculated by tallying the total amount of variables (i.e. modes) scoring a 2 (i.e. 'this strongly applies to our partnership') for each case.

Another important finding is the relative low exploitation of the *technology transfer and economic development* mode both on a global level and in Europe and North America—despite widespread promotion in academia of this mode of societal engagement through the framing of a 'third mission' and 'entrepreneurial university'. The exception to this however is Asia (70%) where overall results are influenced by the presence of several R&D and demonstration platforms in Singapore involving an explicit objective of generating commercialisable research results[36]. On a global level, the low significance of the mode of *technology transfer and economic development* is undoubtedly indicative of the involvement of many university actors (both scientific and non-scientific) from outside research-intensive engineering and hard science disciplines where commercialisation of academic inventions is most prevalent. Yet in the cases where this mode is being exploited, *technology transfer and economic development* initiatives are taking place in tandem with other modes as part of a wider transformative strategy. This is signalling the capacity of the conventional technology transfer model to co-exist with and complement the broader and still emerging function of co-creation for sustainability.

[36] For example, such partnerships include TUM-Create by the National University of Singapore and the Technical University of Munich, and Sustainable Supply Chain Centre – Asia Pacific collaboration also at the University of Singapore.

4.3 Typology-based analysis

This sub-chapter seeks to respond to the following research question:

> 1.3 *What different types of co-creative partnerships for urban sustainability may be found around the world?*

It will proceed to analyse the 70 cases through two typology-based analytical exercises. The first is a statistical application of the typology of four core functions performed by co-creative sustainability partnerships (described earlier in Chapter 3.4.1). The second is a plot typology of the global sample according to the degree of civic sector participation and the core function of the partnership—whether this be orientated mostly towards *research, demonstrations or knowledge exchange,* or alternatively *socio-economic transformation.* The combination of these two approaches will enable further insight into key defining characteristics of co-creative university partnerships for urban transformations towards sustainability.

4.3.1 Geographical distribution of four partnership types

As mentioned already in Chapter 3, a significant portion of the 70 case sample may be considered as 'hybrids' (i.e. those performing multiple functions) with the remainder considered as 'pure' types. To reflect this situation, the histograms in Figure 4.9 below depict both a 'pure' type of partnership (i.e. an instance of a partnership depicting characteristics corresponding mainly to one category) and a 'hybrid' type (i.e. an instance of a partnership displaying qualities corresponding to both this and other categories).

To begin with results for the Europe pool, it can be seen overall that overall the most common type of co-creative partnership is that of a *research, demonstration or knowledge exchange platform*. Regarding the plenitude of hybrids, it can be seen that many of these exhibit characteristics also responding to *socio-economic transformation projects* or *physical environment transformation projects.* On the other hand, it can be confirmed also that no cases are being exploited as *service learning platforms.*

In Asia, essentially the same situation is reflected. That is, no cases are utilised as service learning platforms, and the vast majority of partnerships classify as either pure or hybrid *research, demonstration or knowledge exchange platforms.*

In North America however, it can be seen that the sample contains a far more diverse array of cases. One defining characteristic here is the presence of several pure *service learning platforms* (three in total) and *physical environment transformation projects* (three in total). Overall, it can be seen that there are relatively less *research, demonstration or knowledge exchange platforms,* and a greater abundance of hybrid partnerships sharing characteristics with *socio-economic transformation projects* and *physical environment transformation projects.* Consequently, it can be said that as a general trend in North America, partnerships tend to involve deeper societal interventions for two reasons. Firstly, due to the prevalence of hybrid cases partly resembling *socio-economic transformation projects* and *physical environment transformation projects.* Secondly, for the reason that, overall, there are less pure instances of *research, demonstration or knowledge exchange platforms,* which of the four collaboration types outlined in Chapter 3.4.1 (Table 3.4) typically involve the weakest level of societal interventions.

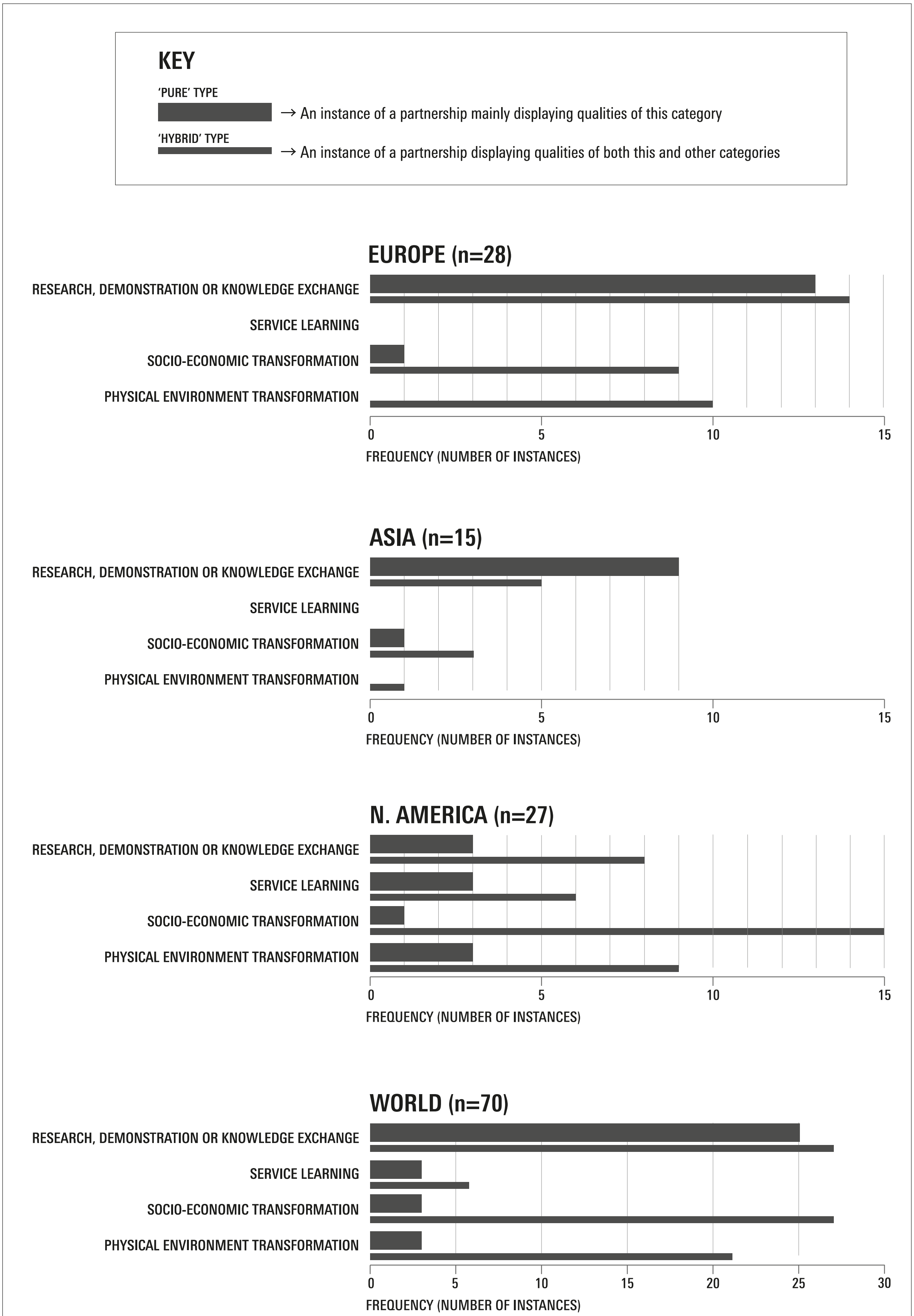

Figure 4.9 Geographical distribution of four partnership types[37]

Fusing all of these regional findings together, it can be seen in the world results that the vast majority of partnerships in the global sample (both pure and hybrid) bear characteristics of *research, demonstration or knowledge exchange platforms.* In other words, a significant portion of projects and activities represented by the 70 cases from across the world involve a strong research element, essentially being cross-sector platforms set up for various purposes such as knowledge production and sharing, early-stage R&D and scientific demonstrations. Although such efforts will typically involve weaker societal and environmental interventions than the other partnership types, the importance of such activities should not be underestimated in bringing about sustainable urban transformations. This is because collaborations of this type provide invaluable scientific knowledge, technological prototypes and decision making tools to guide government policy making, technological progress and more aggressive interventions on urban environments and socio-economic systems from other actors. Another observation from world results concerns the lack of partnerships involving a service learning element. This indicates that there is a yet to be exploited potential for co-creative university partnerships for urban sustainability to be utilised as educational platforms at both undergraduate and graduate level. That is to say, it can be seen from the world results that co-creative partnerships for sustainability are typically being used to enhance *research* (i.e. the university's so-called second mission) as opposed to *education* (the so-called first mission).

4.3.2 Plot typology of the global sample

As an additional step towards generating descriptive statistics to provide a visual overview of the global sample, this sub-section presents the results of a typological analysis presented in Figure 4.10 below. As will be elaborated, the value of this additional analytical exercise is that two distinctive clusters of cases have been identified for closer examination in the case study component in Chapter 6.

Variables for the two axes chosen for the plot in Figure 4.10 stem from key variables identified in Analytical Framework [A] and the typology of four co-creative partnership types examined in the previous sub-section. The *x*-axis depicting the level of civic sector participation (as both core partners and key stakeholders) was chosen to illustrate the intensity of civic actors in relation to both the totality of individual cases in the global sample and the core partnership function. The two functions chosen for this end are 1) *research, demonstration or knowledge exchange* and 2) *socio-economic transformation*. The ability of these two variables to generate two contrasting groups of co-creative partnerships is due to a fundamental difference in orientation—i.e. formal research and scientific demonstrations verses practice and deep, sustained interventions on socio-economic systems.

As can be seen from Figure 4.10, the application of the above variables has generated two distinct clusters of cases. The first concentrated in the top left quadrant represents cases with a low-level of civic participation and a partnership function mostly corresponding to *research, demonstration or knowledge exchange.* (It should be noted that the larger the dot the greater the quantity of instances occupying that particular location). The large grey dot situated in the upper corner of this quadrant is reflecting seven cases that can be characterised as having a very low

[37] Data for this figure has been created by the author based on a combination of quantitative questionnaire results and qualitative data from secondary documents (and in some cases semi-structured interviews [see Appendix 2]).

level of civic participation and a strong orientation towards research and formal knowledge production and exchange. Several cases[38] from Europe plotted in this position include 2000 Watt Society Basel Pilot Region from the Swiss Federal Institutes of Technology, Energy Atlas from the Berlin Institute of Technology and Urban Laboratory for Sustainable Environment from Aalto University. From Asia cases include TUM-Create from Nanyang Technological University and Technical University of Munich and Energy and Environmental Sustainability Solutions for Megacities - E2S2 from National University of Singapore. A stronger inclination towards practice and civil sector involvement means that no cases from North America fall into this location. Key characteristics of this cluster are research-intense universities as lead institutions, typically employing technical approaches in collaboration with industry.

On the other side (bottom right) of the plot a second cluster of cases has emerged. This time they are characterised by a moderate to high level of civic sector participation and an inclination towards practice and direct societal interventions to create *socio-economic transformations.* In contrast to the top-left cluster, North American cases are numerous in this quadrant, with the medium-sized grey dot in the extreme bottom-right representing three partnerships: the Oberlin Project by Oberlin College, SEED Wayne by Wayne State University and UniverCity by Simon Fraser University. Other core characteristics of cases in this bottom right quadrant are typically less research-intense institutions as lead partners, the involvement of non-academic actors from administration and non-research functions such as real estate development and public outreach, and ambitious objectives to spur social and economic development—sometimes in socio-economic settings of post-industrial decline.

Although several other cases have emerged in positions outside of these two clusters, it can clearly be seen that the vast majority of partnerships fall into these two zones—each representing two ‘extremes’ or ‘polarities’ of the diverse universe of co-creative partnerships for sustainability. The emergence of these two sets of cases therefore warrants a more detailed analysis of motivations and influencing factors, role of partners and stakeholders and the approach and mechanisms characterising each. As will become clearer in Chapter 6, the purpose of the micro-level case study research will thus be to ‘zoom up’ on a pioneering and representative case from each of these two clusters and generate detailed, qualitative data.

[38] For details on each refer to Appendix 1.

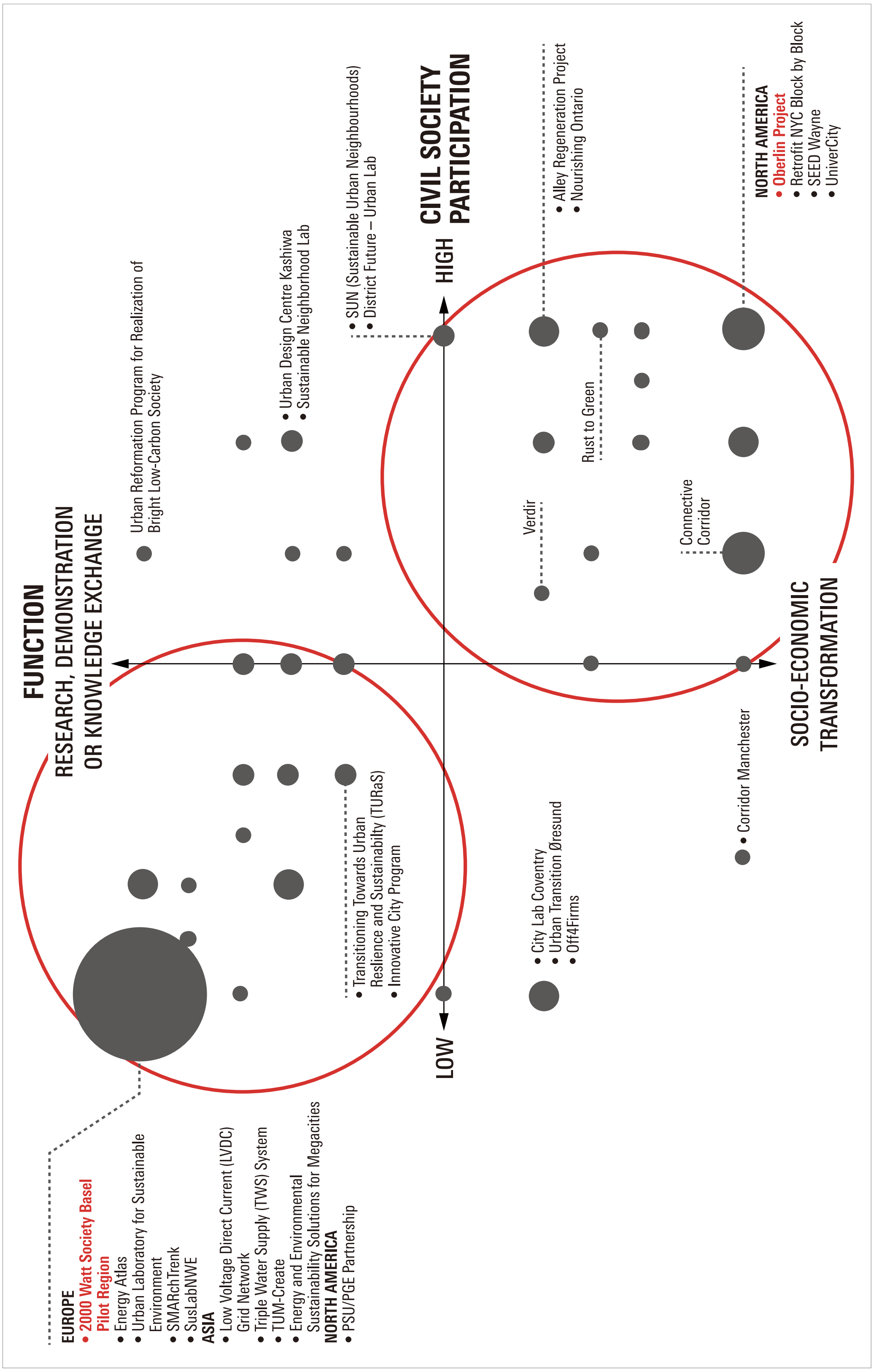

Figure 4.10 Plot typology of global sample (n=70)[39]

[39] Note that the bigger the circle the more the cases in that location. Data for this figure has been created by the author based on a combination of the first questionnaire results from Analytical Framework [A], qualitative data from secondary documents, and in some cases semi-structured interviews (see Appendix 2).

4.4 Summary and discussion of key findings

Responding to a tendency of the literature to focus on single or small sets of case studies, this chapter has sought to connect the dots between a large number of cases and provide a global overview of the emerging university function of co-creation for sustainability. It has accomplished this by providing a worldwide quantitative analysis of 70 cases sourced from industrialised nations in Europe, Asia and North America. A series of macro-level statistics was generated to identify and highlight patterns and differences across these cases using analytical tools that were developed and explained in Chapter 3.4. Data for the application of these instruments was obtained from quantitative surveys sent to key persons in each partnership (Analytical Framework [A]) and an analysis of secondary documents (the temporal and geographical analysis and the typology-based analyses).

By doing so, this chapter has thus served to sketch a portrait of the overall landscape of co-creative university partnerships for sustainable urban transformations, against which more detailed case analyses may be later compared. By the same token, it has highlighted the key attributes and defining characteristics of an emerging model of stakeholder collaboration seeking to respond to localised sustainability challenges and move beyond dominating patterns of technology transfer and university-industry collaboration. Defining characteristics of this emerging model include a focus on a specific place (mostly local/neighbourhood and city/town level) and a strong tendency to collaborate with local government and civil society. It also encompasses holistic social development objectives seeking to advance simultaneously the sustainability of multiple urban sub-systems through a wide array of societal engagement modes of which technology transfer and economic development is the least commonly used. The university function of co-creation for sustainability may hence be interpreted, in its typical manifestation, as the pursuit of a broad type of social development, involving a diverse range of approaches and internal and external actors.

More specifically, major findings to have emerged from this chapter may be summarised as set out below.

4.4.1 Geographical and temporal distribution of cases

This sub-section summarises findings related to the below research question:

1.1 *To what extent have co-creative partnerships for urban sustainability transformations emerged across academia?*

Bearing in mind that the 70 cases identified and analysed for this study represent but one ‘slice’ of an un-quantified global population, findings in this chapter have shown that co-creative partnerships for urban sustainability transformations are significantly widespread around the world. It was observed that many highly prestigious research institutions in Europe, Asia and North America are assuming roles as lead partners. Furthermore, the research strengths and missional focuses of many host institutions around the world do not correspond to the characteristics of an archetypical ‘entrepreneurial university’ (i.e. widespread university-industry linkages, active technology programmes and efforts to identify and commercialise intellectual property, coupled with strong research bases in life-sciences and engineering). The widespread geographical distribution of co-creative sustainability partnerships around the world appears to be conveying the potential for this model of societal collaboration to be adapted to a vast array of academic settings and socio-economic contexts around the world.

It was also observed temporally that the majority of cases identified for this study have emerged since 2010. This is possibly indicating that the emergence of the university's co-creative function is, on the whole, a relatively recent phenomenon and that the global population is increasing. This argument corresponds with findings from Bulkeley and Castan Broto (2012) who have concluded that the population of non-academic climate experiments around the world is also increasing, particularly since the enactment of the Kyoto Protocol in 2005. It was then argued that the function of co-creation for sustainability appears set to continue expanding and evolving into the future. This was found from a temporal analysis of project implementation periods revealing that many cases, being committed to long-term sustainability objectives, will continue indefinitely as long as necessary resources are made available.

4.4.2 Analytical Framework [A]

The following sub-sections summarise and discuss findings connected to the following research question:

1.2 *From an overall global perspective, what are the most and least common:*

- *urban sub-systems targeted?*
- *geographical scales of target areas?*
- *internal and external partners and stakeholders involved?*
- *factors motivating the formation of partnerships?*
- *mechanisms used to achieve sustainable urban transformations?*

4.4.2.1 Level one: Urban sub-systems targeted

In the world results, it was found that the three sub-sectors of *built environment* (81%), *energy heating and cooling* (74%) are the most commonly targeted sub-systems by co-creative university partnerships attempting to advance sustainability. On the other hand it was found that *solid waste (38%)* and *food, agriculture and forestry* (42%) are the least commonly targeted sub-systems—the latter being explainable by the urban focus of this study. It was highlighted that this echoes a global preoccupation with energy, established by Bulkeley and Castan Broto (2012) and Castan Broto and Bulkeley (2013) for climate experiments. The tendency to focus on the *built environment, energy heating and cooling*, and *governance and planning* in this study is also no doubted driven by a wider climate change driven awareness that the greatest GHG emissions reductions can be achieved in the energy (both demand side and production side) and building sector. Yet what has also come to light in this part of the framework is that a large majority of partnerships will target simultaneously *several* urban sub-systems—a tendency not revealed in the Castan Broto (2012) and Castan Broto and Bulkeley (2013) study. Of the ten urban sub-systems identified for this level of the framework, Figure 4.3 has shown that more than half of the cases in the global sample are attempting to advance the sustainability of five or more sub-systems at the same time. These results appear to be testifying to both a high level of ambition in regards to partnership objectives as much as an explicit focus on place and a resolve to transform interconnected societal sub-systems. This is very much in contrast to the inward and device-orientated research activities of conventional technological transfer, which as highlighted in Chapter 2, tend to be concentrated on R&D for embryonic inventions of industrial materials, genetic processes and drug creation. Regarding the factors influencing the type of urban sub-systems targeted, this is no doubt influenced primarily by partnership objectives (which are themselves dictated by the merging of local needs and socio-economic conditions and academic research agendas) and secondly, by the expertise or main field(s) of activity for the particular faculty, researchers or societal actors involved.

4.4.2.2 Level two: Geographical scale of target areas

The second level of the framework established that as an overall global trend, the overwhelming majority of partnerships in the sample are focused on either the *local/ neighbourhood level* (30%) or *city/town level* (30%). This observation corresponds with much of the discourse on sustainable development as reflected in local or city-level programmes such as Local Agenda 21, Climate Positive Development Program of the Clinton Climate Initiative, Transition Towns and various programmes of the ICLEI - Local Governments for Sustainability. In such programmes, expectations for 'on the ground' implementation and efforts toward materialising urban sustainability are directed at local and city or town levels, rather than at national or central government levels (McCormick et al., 2013). This explicit focus on a specific location and set of stakeholders is another defining characteristic of the function of co-creation for sustainability. This is in contrast to the conventional model of technology transfer where the focus is not so much on a particular place or set of stakeholders as it is on a particular device, technology or market (Mowery et al., 2004).

4.4.2.3 Level three: Internal actors

In the conventional technology transfer model, it is predominantly faculty who, in conjunction with technology transfer offices, drive the commercialisation of intellectual property through patenting, licencing or spin-off firm creation (Zhang, 2007). This tendency for *faculty and researchers* to assume a lead role in partnership formation and implementation has also come to light in the analysis of internal actors involved in co-creative sustainability partnerships. Yet it was also established in Table 4.6 that a vast majority of cases involve internal collaborations between any combination of actors such as *faculty or researchers, administration*, *students* and *bridging organisations*. This finding appears to be reflecting a non-scientific nature of certain cases. It is also conveying the valuable supporting role that actors from administration and bridging organisations can play by establishing external contacts and leveraging university resources to the goals of *faculty or researcher* led partnerships. Two implications could be extracted from these findings. Firstly, the varying areas of expertise and activities of a wide range of actors in university appear to be necessary for many partnerships to achieve their objectives. Secondly, the trend of forming partnerships with external actors to create societal transformations towards sustainability appears to be a model of stakeholder collaboration that is relevant and applicable to the activities and roles of a vast range of actors in the university.

4.4.2.4 Level four: External actors

The analysis of external actor types has revealed that in all geographical regions it is the *local or city government/public service sector* constituting the most common external partner for co-creative partnerships for urban sustainability. This trend is consistent with results from the Bulkeley and Castan Broto (2012) study, where it was observed that local municipalities were by far the most frequent leading partner of urban climate experiments. It is also reflective of the predominant focus on the *local/neighbourhood or town/city* scale highlighted in level three of the framework. These results also appear to be suggesting that whatever the nature of state or national level policy frameworks for sustainability and climate change, it is inevitably at the scale of local or regional governments where implementation must take place. The overwhelming participation of local scale authorities also contrasts with the triple-helix paradigm where government is chiefly perceived as state or national level actors, or government laboratories (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2008).

This level of the framework also brought into light another defining characteristic of the co-creative function—the participation of civil society. Although not present in all cases, some degree of participation from the civic sector was observed in all bar seven cases in Europe, four in Asia and seven in North America. This engagement of the civic sector contrasts to the conventional function of technology transfer, often viewed of as a set of 'triple-helix' relations (i.e. university-industry-government) where civil society participation is missing (Carayannis and Campbell 2010, 2011; Etzkowitz and Zhou, 2006). Civic sector involvement in co-creative university partnerships for urban sustainability is also no doubt signifying a growing awareness that so called 'non-expert' knowledge and engagement is essential to the knowledge generation and implementation process of sustainability work (Spangenberg, 2011). This is for the reason that, in addition to possessing valuable local knowledge on various issues related to local sustainability, civil society's support is a prerequisite for many partnerships around the world attempting to transform social systems, living and consumption patterns.

The global tendency to collaborate with local or regional government actors and actively seek the engagement of the civic sector is therefore a defining, structural characteristic of the emerging university function of co-creation for sustainability in relation to conventional patterns of triple-helix collaboration.

4.4.2.5 Level five: Motivations and triggers

The analysis on a range of factors triggering the formation of partnerships has revealed firstly that very few around the world have been influenced by an *entrepreneurial motivation (40%)*. This is in contrast to the conventional paradigm of technology transfer where the pursuit of income for industry, the university and inventor forms a major catalyst for commercialisation efforts (Etzkowitz et al., 2000). With the majority of cases reporting several motivating factors, the formation of co-creative partnerships for urban sustainability must therefore be explained by other interlinked reasons.

Of these, the most significant were the *scientific/scholarly motivation* (77%) and the *developmental/strategic motivation* (77%). This finding suggests that in many partnerships around the world a combination of university motivations and socio-economic and environmental conditions are heavily influencing the formation of the partnership. The *scientific/scholarly motivation* appears to be reflecting a widespread awareness across academia that engagement with external stakeholders and local environmental and societal challenges can significantly enhance research activities of individual faculty, researchers and even entire departments. On the other hand, the *developmental/strategic motivation* suggests that external socio-economic or environmental conditions and societal needs are also largely responsible for motivating university actors to take strategic measures to address localised sustainability challenges and influence local or regional development trajectories. This also appears to be conveying the realisation that as ‘anchor institutions’ (i.e. institutions literally anchored to a location with no prospect for relocation should this ever become desirable; see Birch et al., 2013), university actors and institutions are beginning to grasp the fact that their well-being and physical survival is any many ways hinged to the environmental, social and environmental sustainability of the surrounding area. Although offered only as a mere conjecture at this stage of research, the extension of this finding is that university motivations and socio-economic and environmental conditions are possibly exerting a strong influence on other framework variables (i.e. the type of partnership function assumed, sub-systems targeted, geographical scale actors involved and societal engagement modes pursued).

Lastly, a finding with policy implications is the *funding* variable (52%). This is testifying to the potential of funding programmes to coax into formation and foster the formation of cross-sector collaborations in the context of sustainable urban development. As already argued by other scholars (Dedeurwaerdere, 2013; Trencher et al., 2013a; Whitmer et al., 2010), the implications of this finding are both obvious and paramount. The scaling up of funding programmes aimed at cross-sector partnerships for sustainability would almost certainly have a significant positive effect on fostering the future formation of more co-creative university partnerships for sustainability around the world.

4.4.2.6 Level six: Societal engagement modes

A core message to emerge from application of the sixth-level of the analytical framework was the finding that co-creative partnerships are typically characterised by the simultaneous exploitation of an array of societal engagement modes. Of the six modes identified, *technology transfer and economic development* emerged as the least significant mechanism by which co-creative actors can seek to create urban transformations towards greater sustainability. This could be interpreted in many ways. Firstly, as a portrayal of the limited capacity of this societal engagement mode on its own to address place-based sustainability challenges such as energy and food security, socio-economic decline, energy efficiency and resiliency and adaptation building for climate change. Secondly, results are possibly reflecting the low relevancy of this model to the majority of university actors represented in the global sample—most of whom are from outside of fields such as the life sciences, applied engineering and computer engineering where one could expect to see more patenting and commercialisation activity. Thirdly and most importantly, the low prevalence of this channel is testifying that other forms of collaborative innovation are possible which don't necessarily rely on the assertion of IPRs and the generation of commercialisable results. Lastly, as for those partnerships employing the *technology transfer and economic development* in conjunction with other engagement modes, such cases are testifying to the potential of conventional technology transfer activities to co-exist in the wider cadre of a sustainability transformation agenda that will typically exploit other avenues simultaneously. These findings are thus demonstrating a clear possibility for university engagements with society to move beyond the narrow economic focus on technology transfer in the conventional framing of the third mission.

Knowledge management has emerged in all geographical regions as by far the most commonly exploited engagement mode by which co-creative actors pursue their objectives. The principle reason that would explain this tendency is the orientation towards research and formal knowledge production in the majority of cases. This inclination was incidentally confirmed in the typology-based analyses in Section 4.3. Another reason explaining the widespread use of this mode is no doubt linked to its importance in generating and diffusing the co-produced intelligence required to kick-start the more physical mechanisms of urban transformations towards sustainability.

A third finding meriting attention on a global level is the high prevalence of techno-centric approaches (i.e. *technical demonstrations and experiments),* particularly in Asia. On the other hand, an overall reluctance or incapacity to pursue paths of social innovation (as represented by *socio-technical experiments)* was highlighted. This global bias towards technological approaches for urban sustainability has also been observed by Castan and Broto (2013) who found that technical forms of innovation were prevalent in 76% of cases sampled. In this study, the widespread reliance on techno-centric approaches could most likely be explained by a prevalence of R&D centred research platforms headed by faculty and researchers from natural sciences and engineering. That said, with the limited capacity of chiefly technical approaches to trigger large-scale social transformations (Notter et al., 2013), it is worth noting *socio-technical experiments* as an area deserving more attention and development in future efforts to propagate the model of co-creation for sustainability.

Finally, an interesting finding to have emerged is the relative prevalence of *governance and collaborative planning* as a means by which university actors seek to advance the sustainability of a certain area, region or sub-system. It thus appears that an often described role in the literature on university sustainability partnerships (Evans and Karvonen, upcoming; Peer and Stoeglehner, 2013; Sedlaceck, 2013) and the regional engagement of higher education institutions (Arbo and Benneworth, 2007; Chatterton and Goddard, 2000) is of central importance in creating the institutional conditions for driving urban transformations towards greater sustainability. Interestingly, this study's identification of a widespread global trend of university actors playing key roles in local and regional governance structures in the cadre of urban sustainability has been overlooked by the Bulkeley and Castan and Broto study (2012). As already mentioned, this contrasting global survey only considers collaborative and experimental governance from the perspective of non-academic partnerships. The widespread tendency of university actors to engage with existing local and regional political structures and processes—or even create new governance structures—should therefore be retained as constituting another defining characteristic of the emerging function of co-creation for sustainability. Furthermore, these findings also appear to be reflecting a growing willingness for local and regional government actors to team up with academic players in the goal of carrying out experimental and self-correcting governance and policy implementation based upon scientific knowledge (Evans and Karvonen, forthcoming). Again, the relative prevalence of *governance and collaborative planning* is testifying to the potential of co-creative sustainability partnerships to facilitate a form of as a form of innovation transfer not relying on conventional patterns of IPR-based technology transfer.

4.4.2.7 Overall observation

As a unifying message of the above multi-level analysis, the university function of co-creation for sustainability has been shown to be significantly distinctive—both qualitatively and structurally—to the dominating model of technology transfer. Findings indicate that in its typical manifestation, it can be understood as the pursuit of a broad form of social, economic and environmental development (as seen from the targeting of multiple urban sub-systems) though collaborations with a broad range of internal and external actor types (including both scientific and non-scientific and often involving civil society). As also observed, co-creative partnership actors will generally exploit a wide range of societal engagement modes (of *which technology transfer and economic development* is but one avenue) in pursuit of societal transformations towards sustainability. Despite this structural breadth, co-creative partnerships were found to be very much focused on a specific location and set of stakeholders, most typically at the *local/neighbourhood* level or *city/town* level.

4.4.3 Typology-based analysis

This sub-section collates key findings related to the below research question:

> 1.3 *What different types of co-creative partnerships for urban sustainability may be found around the world?*

4.4.3.1 Geographical distribution of four partnership types

The 70 cases identified and analysed for this dissertation represent a vast array of partnership types and objectives. In response to this, Chapter 3.4.1 has suggested a typology of four types, based upon core partnership functions: 1) *research, demonstration or knowledge exchange* 2) *service-learning* 3) *physical environment transformation* and 4) *socio-economic transformation.* Of these, it was partnerships corresponding to *research, demonstration or knowledge exchange platforms* that were found to be the most common across the world and all three geographical regions. This indicates that a vast majority of the global sample contains a formal research and knowledge sharing component, mostly being cross-sector platforms set up for purposes such as early-stage R&D, knowledge sharing and scientific demonstrations. It appears therefore that the bulk of cases in the global sample are being implemented from within the context of the university's research function. Chief contributions of such partnerships to urban transformations toward sustainability therefore include scientific knowledge, decision making tools and prototypes of emerging technologies. The significance of these contributions is therefore their utility for other societal actors to guide policymaking, technological progress and more aggressive interventions on urban environments and socio-economic systems.

On the other hand, 'pure' partnerships of the other types were found to be less common. Overall, the relative lack of cases with characteristics corresponding to *socio-economic transformation projects* and *physical environment transformation projects* appears to be conveying a reluctance or incapacity for many co-creative partnerships to engage in more aggressive and sustained interventions on socio-economic, technological, political and environmental systems.

Regarding partnerships corresponding to the type *physical environment transformation project*, it was observed in Figure 4.3 that these tend to be mostly concentrated in North America. Here it was found that 13 of 27 North American cases involve interventions on the built environment, with many involving extensive real estate development of university assets. Results are therefore signalling a growing realisation in this continent regarding the transformative potential of university real estate and land assets to contribute to economic development and urban transformation in the context of sustainability. Interestingly, this potential has not yet been explored by the urban reform literature (Competitive Inner City and CEOs for Cities, 2002; Perry and Wiewel, 2005; Wiewel and Perry, 2008).

A final observation concerns the potential of exploiting co-creative university partnerships as educational platforms for either undergraduate or graduate level. In the body of literature on triple-helix and technology transfer partnerships there is an overwhelming and implicit emphasis on the research function of the university. Consequently, few scholars acknowledge the potential for societal collaborations to enhance the core university mission of education. Again in North America, it was confirmed that around a third of cases are being utilised as service learning platforms or as attempts to enhance education. One reason for this could most certainly be related to the long and established history of service learning in the US (Molnar et al., 2011). In any case, from a global perspective an unexploited potential for co-creative university partnerships for urban sustainability to be utilised as educational platforms at both undergraduate and graduate level was revealed.

4.4.3.2 Plot typology analysis

As an additional mapping exercise the 70 cases in the global sample were plotted on two axes in Table 4.10. The *x*-axis showed the degree of civic sector participation, with the *y*-axis reflecting the main function and orientation—either towards *research, demonstration or knowledge exchange,* or alternatively, towards *socio-economic transformation*. As a result, two distinct sets of clusters emerged. The first consisted of numerous cases characterised by a low-level of civil society participation and a primary function of *research, demonstration or knowledge exchange.* As a further attribute, these cases mainly belonged to research-intense institutions, particularly from Europe and Asia. On the other hand a second cluster emerged, typified by a high-degree of civic sector involvement and a chief function of *socio-economic transformation.* A secondary trait of this set was a high presence of less research-intense institutions, particularly from North America. Also, several of these partnerships are characterised by a strong involvement of non-academic actors and 'softer' university functions such as real estate development and outreach. Furthermore, several of such cases are targeted at cities experiencing severe socio-economic decline. These findings suggest that there are potentially two highly distinctive forms of co-creation for sustainability in the global sample. One would involve a strong research focus, technical approaches and interactions with industry. On the other hand, another form of co-creation for sustainability appears to be more orientated towards practice and triggering socio-economic transformations, typically with less technical approaches and in collaboration with civil society.

In this way two contrasting groups of co-creative partnerships have formed, each meriting a more detailed, qualitative scrutiny. The objective of the case study analysis in Chapter 6 will therefore be to take a pioneering case from each cluster to learn more about the two polarities of the universe of co-creative partnerships. In particular, an important goal of this eventual investigation will be to shed light on factors influencing partnership structures and objectives such as university motivations, institutional characteristics and societal conditions. Equally, it will be to learn more about the specific role of actors involved in each of these clusters, partnership functions and mechanisms, and lastly, explore the impacts of these in relation to progress towards greater sustainability.

Chapter 5
Macro-level empirical research: Drivers, barriers and impact

Purpose: To determine from a global perspective commonly encountered drivers and barriers, assessing overall effectiveness and impacts.

This chapter addresses the second research sub-objective. It complements the global-level knowledge generated by the statistical analyses of the proceeding chapter regarding key attributes of the emerging university function of co-creation for sustainability. It consists of results obtained from the application of Analytical Framework [B] (discussed in Chapter 3.4.4) to the global sample. The application of this analytical framework is carried out through an analysis of both quantitative and qualitative data results obtained from a second questionnaire. In contrast to the first, the second aimed to represent the experiences and perspectives of as many key partners and stakeholders as possible. It was therefore administered to several individuals from multiple societal sectors in each partnership.

In essence, this chapter consists of two halves. In the first, both qualitative and quantitative questionnaire results are examined to assess commonly encountered barriers and drivers affecting co-creative partnerships around the world. In the second half, quantitative results will be used to offer an overall appraisal of the performance and impacts of each case represented. Areas evaluated include partnership *synergy, function, effectiveness* and lastly, *economic*, *social*, *environmental* and *overall sustainability* impacts. It is expected that findings will provide valuable insights into the type of conditions and policies required to enhance the effectiveness of co-creative university partnerships for urban transformations towards sustainability, as well as potential impacts.

5.1 Overview of second questionnaire

This chapter seeks to answer the following specific research questions by analysing quantitative and qualitative data obtained from a second questionnaire, explained in detail below:

2.1 *What are the most significant driving factors influencing co-creative partnerships for sustainability around the world?*
2.2 *What are the most commonly encountered barriers hampering co-creative partnerships for sustainability around the world?*
2.3 *From an overall global perspective, how effective are co-creative sustainability partnerships at achieving their objectives and contributing to economic, environmental, social and sustainable development?*

5.1.1 Data collection method

In essence, the second questionnaire used to generate primary data for this chapter consisted of two halves. In the first, the array of variables identified in Section 3.4.5 were integrated into two parts. One dealing with *drivers and positive factors* and the other *barriers and negative factors*. In each section, a brief description was provided for each variable and respondents were asked to assign a score to indicate the relevance of that particular factor to their partnership (the scoring system is elaborated below). They were encouraged to respond as much as possible from the overall perspective of the entire partnership and account for all of its various activities and projects (as opposed to focusing on the individual role of that respondent). They were also provided with a space to write freely about the most significant drivers and barriers impacting the case in question. The second half of the questionnaire then asked the respondent to reflect upon the performance of the partnership and offer a self-evaluation of impacts attained so far (or likely to be attained) from an array of perspectives (project functioning and economic, societal, environmental and sustainability).

In contrast to the first questionnaire utilised in Chapter 4 that was administered uniquely to a single university actor (in most cases the project leader or co-ordinator), the second was sent to multiple partners and stakeholders in industry, government civil society, as well as to various university personnel. The aim of this was to ensure a balanced representation of perspectives and experiences from both inside and outside academia.

The questionnaire was administered electronically in WORD format over a four-month period spanning from July to October 2013. As can bee seen from Table 5.1 below, in total 192 questionnaires were sent out to 66 of the 70 cases identified for the original global sample. Any partnership for which less than 12 months had passed since its official formation was excluded from the sample (a total of 4) for the reason that it would be unreasonable to ask such partnerships to evaluate their performance to date. Questionnaires were administered to key partners and stakeholders in all of the societal sectors involved (i.e. any combination of partners from academia, industry, government and civil society). These individuals were identified mainly by an analysis of project documents and press articles, but also from a ‘snowball sampling’ technique where key project actors were asked to recommend other suitable partners and stakeholders. All respondents were first of all contacted via email or telephone to request authorisation to send the questionnaire, as well as assess their suitability to respond accurately to the questions. The WORD format questionnaire was subsequently sent only to those individuals who both consented and signalled that their knowledge of the partnership would be sufficient. In those cases where responses were not secured within approximately 10-14 days, follow up phone calls or emails were administered, with a considerable effect on boosting return rates.

As a result of the above procedure, a total of 135 responses (response rate of 70.3%) were received from 55 of the 66 cases targeted. After two responses were discarded for data quality reasons, this left 133 for integration into the final data analysis, at an average of 2.38 responses per partnership. Of these, 60 (45%) came from actors in academic institutions, 28 (21%) from government, 31 (23%) from industry and 14 (11%) from civil society. From a regional perspective, this translated to a total of 61 responses for Europe (representing 22 cases), 27 from Asia (for 13 cases) and finally, 45 from North America (representing 20 cases), as may be verified in Table 5.1 below.

Table 5.1 Details of persons contacted and responses secured

Region	Persons contacted	Surveys sent	Responses secured	Responses discarded	Responses kept
Europe	160	82	62	1	61
Asia	67	35	28	1	27
North America	145	75	45	0	45
World total	372	192	135	2	**133**

5.1.2 Data calculation method

The following quantitative survey results have been calculated as follows. Firstly, in order to prevent scores from those cases where numerous responses were secured overly exerting an influence on global results, a single mean score was created for each variable in each partnership. Each of these means was then tallied to give a mean for both the world and each of the three geographical regions, each corresponding to a certain variable in the framework. Results processing involved two different calculation methods, which are explained below.

For the first half of the questionnaire (i.e. the analysis on drivers and barriers), the relevancy of a particular variable description to the partnership in scrutiny was reflected with the following scale: *not at all relevant (0)*, *partly relevant (1)*, *relevant (2) and extremely relevant (3).* Scores obtained from differing societal sectors were then condensed into a mean score for each variable in each partnership. Each of these means was then tallied to give a world total score for each variable. This was then divided by the maximum world score possible (i.e. n x 3). This has resulted in a percentage score showing the significance of a particular variable in relation to others.

The second half of the questionnaire (that evaluating the effectiveness and impacts of each partnership) employed a different scoring system, yet a calculation method based on the same logic as above. Data was collected this time on a five-point Likert scale consisting of the options of *strongly disagree (-2), disagree (-1), not sure (0), agree (1) and strongly agree (2).* As in the first half of the questionnaire, in order to prevent multiple scores from a single partnership exerting an excessive influence on the world results, a mean score was generated for each variable in each partnership. Each of these was then tallied to give a world total score that was then divided by the n-size of the sample (i.e. 55). As an additional step to show the distribution of responses obtained, individual mean scores for the entire world sample have also been integrated into tables and figures for this section.

5.2 Application of Analytical Framework [B]

The first component of the second macro-level research seeks to determine the most commonly encountered driving and positive factors when forming co-creative partnerships for urban sustainability, securing external support and implementing ensuing activities and projects. This section of the questionnaire involved both score-based and open questions. Quantitative results are firstly listed below in Figure 5.1, with qualitative responses analysed in the preceding discussion. It should be noted that only key findings, figures and tables are presented below.

5.2.1 Quantitative results: Drivers and positive factors

To begin with the quantitative results, Figure 5.1 and Table 5.2 below reveal that the most significant driver across the world is *partnership synergy* (86%), a variable signifying when the impact and effectiveness of the partnership is increased because of the collective knowledge, strengths and resources of members from different societal sectors. *Strong leadership* (83%) has also emerged as a highly important positive factor, followed by the presence of *external funding* programmes (79%). As confirmed by Table 5.2, particularly in Europe (83%) and Asia (84%) the presence of certain funding programmes is signalled as a driving factor of paramount importance, significantly more so than in North America.

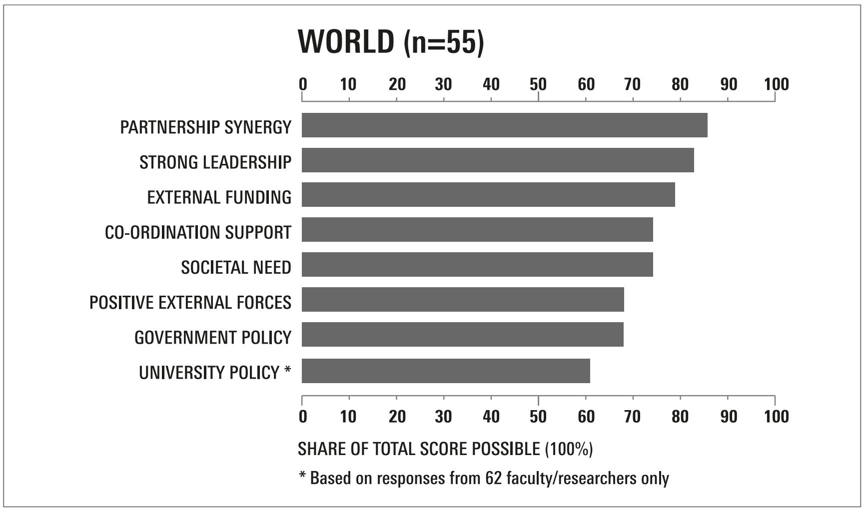

Table 5.1 World results for commonly encountered drivers and positive factors

Table 5.2 Regional comparison of drivers and positive factors (n=55)

Drivers and positive factors (% share of maximum score possible)	**Europe**	**Asia**	**N. America**	**World total**
Partnership synergy	82	84	91	86
Strong leadership	71	88	94	83
External funding	83	84	70	79
Co-ordination support	69	68	83	74
Societal 'need'	68	82	75	74
Positive external forces	64	68	73	68
Government policy	68	80	62	68
University policy (*)	62	51	67	61

** Based on responses from 62 faculty/researchers*

On the other hand, it can be confirmed in both Figure 5.1 and Table 5.2 that policy from both government and university appears to be the least significant driving force around the world for the 55 cases represented in these results. The one exception to this is the case of Asia where government policy (80%) has emerged as a significantly important driver for the formation and implementation of co-creative partnerships for urban sustainability.

5.2.2 Qualitative results: Drivers and positive factors

Questionnaire results from the various societal sectors have also provided some valuable qualitative data regarding the drivers playing an exceptionally important role in the 55 cases represented in the results. A summary of these results is as follows:

'Champions' and 'leadership' were by far the two most commonly recurring themes in open responses obtained from academia, government, industry and civil society actors around the world. Many key partners and stakeholders reported that sound leadership and individual champions in each of the participating sectors and institutions is vital to carrying out roles such as "leading, pushing and driving the collaboration", and also for "moving ideas forward". As an industry partner in Asia described, the presence of champions in cross-sector collaborations is essential to ensure that the strength, expertise and experience of each individual partner and sector is successfully harnessed and exploited. The value of influential leaders was also described by an industry respondent in the US as the capacity to mobilise leaders in other societal sectors and create and share visions.

The ability of external funding programmes to act as a decisive driving force was also repeated in several responses. One university researcher in Europe for example cited the European INTERREG funding programme as being a critical driver behind the formation of that partnership due to its specification that applicants work with external stakeholders on a regional scale for sustainable development. Other academic respondents highlighted that the prospect of obtaining funding was also helpful to secure participation and "drive action" from the private, government or civic sector.

Finally, another theme to reoccur in open-ended responses was the importance of identifying areas of mutual benefit for all partners. As a researcher in Asia described, winning the support of external stakeholders becomes easier when university actors are able to demonstrate the benefits that will ensue from another societal sector's participation in that particular project.

5.2.3 Quantitative results: Barriers and negative factors

To begin with the quantitative results, Figure 5.2 and Table 5.3 below demonstrate that *time restraints (67%)* and *funding (62%)*, followed by *lack of harmony/unity* (58%) and *communication* (55%) constitute the most significant obstacles for cross-sector university partnerships for sustainability across the world. A glance at Table 5.3 also shows that these results are largely consistent with those obtained in each geographical region. This is particularly the case for *time restraints* and *funding*, which have surfaced as two highly significant barriers in each continent. In connection to the *time restraints* barrier, this is also testifying that core partners and stakeholders will often engage in co-creative sustainability partnerships on top of existing job commitments. This means that out-of-office hours spent participating in activities such as meetings and discussion spaces, for example, is often unremunerated. The recurrence of funding issues as a significant barrier has been analysed further in Figure 5.3. Although there is not a highly significant degree of variation between the scores obtained, it can be seen that the availability of suitable funding programmes appears to be the major issue deserving attention in relation to this barrier.

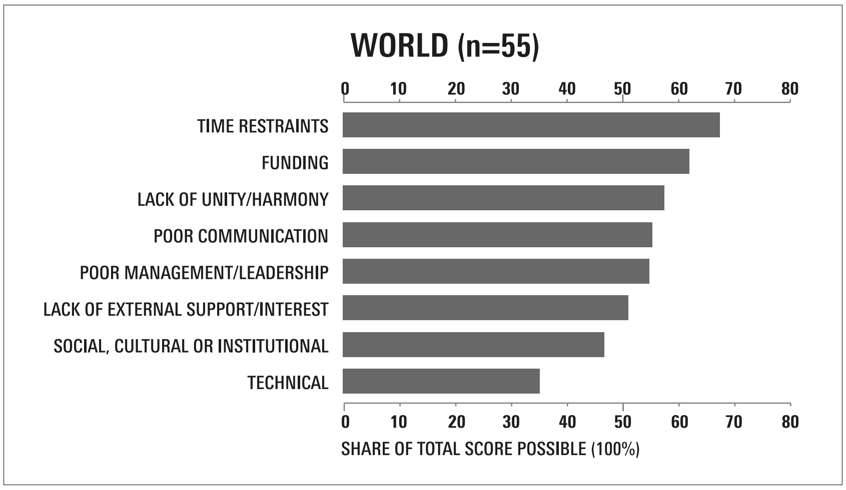

Figure 5.2 World results for commonly encountered barriers and negative factors

Table 5.3 Regional comparison for commonly encountered drivers and positive factors

Barriers and negative factors (% share of maximum score possible)	**Europe**	**Asia**	**N. America**	**World total**
Time restraints	61	69	72	67
Funding	63	65	58	62
Lack of unity/harmony	66	62	46	58
Communication difficulties	61	52	52	55
Poor management and leadership	59	57	50	55
Lack of external support and interest	54	53	48	51
Social, cultural or institutional barriers	48	44	47	47
Technical barriers	33	41	32	35

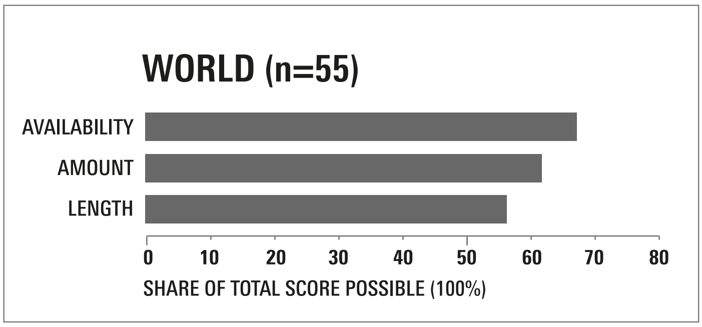

Figure 5.3 Specific funding issues

Returning back to the overall world results listed in Figure 5.2 and Table 5.3, it can be seen that *technical issues* emerge as the least significant barrier. Interestingly, this is despite the fact that a great deal of the 55 cases represented in these results involve a large component of technical innovation and research, development and efforts to demonstrate unproven or emerging technologies. It can therefore be concluded from the above findings that the most significant barriers facing co-creative efforts for urban sustainability are *human*, rather than technical in nature.

As an additional attempt to assess the various negative factors afflicting co-creative university partnerships for sustainability, questionnaires included an additional component aimed specifically at university faculty and researchers. It aimed to assess if academic incentive structures and traditional culture—with commonly reported emphasis on disciplinary scholarship and 'traditional' outputs such as publications and conferences and undervaluing of cross-departmental or cross-sector collaboration—is indeed deterring or impeding the participation of faculty and researchers around the world. As may be confirmed from results in Figure 5.4 below, traditional academic incentive structures and lack of internal interest is by no means a universal barrier. That said, a total of 26 researchers and faculty (i.e. exactly 50% of responses) have indicated that academic incentive structures and norms are proving to some extent an obstacle, rather than a driving force. Further, a total of nine individual faculty/researchers have reported these factors as a major stifling force. In connection to this finding, it is worth recalling that Figure 5.1 from the above discussion on drivers and positive forces has indicated that university or departmental policy is the least significant driver for co-creative sustainability partnerships.

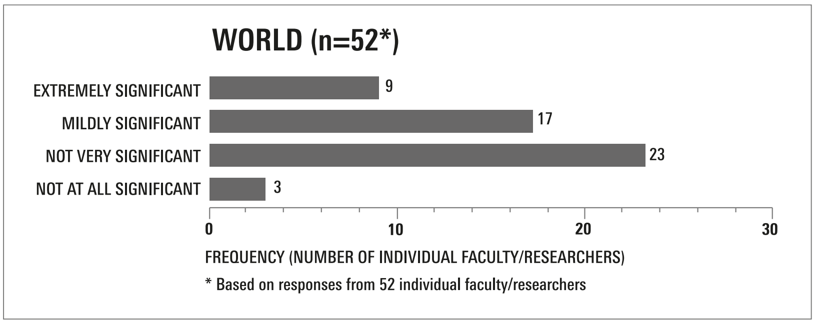

Figure 5.4 Traditional academic incentives and norms as a barrier for faculty/researchers

5.2.4 Qualitative responses: Barriers and negative factors

To move on to the qualitative responses, above-mentioned funding issues again emerged as a frequently cited barrier. It was revealed that one of the principle issues at stake in connection to the funding barrier is the loss of valuable time when project partners are forced to devote project hours to the pursuit of funding. It seems that for many partnerships, particularly those committed to long term objectives or implementation periods, the procurement of sustained funding is a constant concern. It was also reported by some that it is difficult to secure the support of key partners in the absence of necessary funding. One faculty member in Europe confided that when funding is limited, it tends to be broken down into even smaller blocks and fed to an array of smaller projects, with the societal impact of each being consequently reduced. They reported that the influence and societal reach of projects was increased once a decision was made to support less projects with a greater amount of funds. Such reports correspond with the earlier observation that the procurement of attractive or suitable funding packages is an important driver for many partnerships, both during initial formation as well as the implementation period.

The difficulties of coping with differing and operating environments of academia, local government and private enterprises also emerged as a highly common theme across many responses. There seemed to be a large consensus that priorities in local government tend to be focused on the short-term, with in general, very little planning carried out for the long term. As several faculty members in Europe pointed out, this is at odds with the long-term focus of academics dealing with sustainability. In connection to this theme of contrasting "worldviews" and priorities, distinctive decision making protocols across differing societal sectors also emerged as a key challenge. Some argued that government decision making is often lengthy and complex, with industry, on the other hand, tending to arrive at decisions much faster. Again, this is at odds with the slow and deliberate nature by which results are released from the scientific community. It was suggested by some respondents that the key to overcoming this type of obstacles is to know and respect the cultures and capacities of the differing players, and also to identify and link projects to present government priorities and success criteria.

A third theme to have recurred across the qualitative responses echoed the above finding that *lack of unity/harmony* is a significant barrier for partnerships. This seemed to be particularly the case for project goals. As a member of the business community in Europe confided, it appears that inconsistencies can arise regarding differing interpretations of project objectives. More precisely, this respondent reported that "a mismatch between the goal of the project as written in the proposal and what the different partners are considering their goal" had a hampering effect on the synergy and collective impact of the collaboration. It also seems that the unity and harmony of large-scale sustainability partnerships risks to break down not only across societal sectors, but also across different departments and disciplines in academia—as was confided by a faculty member in Asia. In relation to this point, many respondents stressed the need for effective communication and co-ordination of partners, as well as the articulation of a common vision, motivation and objective in the early formation stages. Again, it would seem that this would largely be the responsibility of the partnership leader(s), which as highlighted earlier, can play an extremely important driving role in co-creative partnerships for sustainability.

5.2.5 Results for effectiveness and impacts

The final part of the questionnaire sought to establish a global consensus on the ability of cross-sector partnerships to achieve their initial objectives, as well as their ability to generate societal, economic and environmental impacts. Key results have been collated in Table 5.5 and Figure 5.5 below, with the precise questions asked (and suggestions for indicators of economic, social and environmental indicators) compiled into Table 5.4 below.

The first part of the evaluation component asked respondents about the *synergy* of that particular partnership. It sought to gauge if the participation of different actors and societal sectors had or is having a positive effect on the partnership, and if their presence is or was necessary to achieve the project goals. As can be seen from Table 5.5, world results indicate an overwhelming consensus regarding the positive synergy that arises as a result of multi-sector cooperation, with a global mean of 1.36 and mean scores of 51 out of 55 partnerships represented[40] falling between the range of [1.00,2.00].

[40] As in the previous sections, the world mean score has been established by creating an individual mean score for each of the partnerships represented (n=55), and then dividing this by 55.

Table 5.4 Summary of partnership evaluation framework

Evaluation area	Specific question asked
Synergy	Overall, the participation of different actors and sectors (e.g. universities, government, industry and citizens) has had a positive effect on the partnership and their presence is necessary (or was necessary) to achieve the goals of the partnership.
Function	Overall, the various partners, stakeholders and sectors involved in the partnership are successfully carrying out (or have successfully carried out) their expected roles and contribution.
Effectiveness	Overall, the partnership is on track to achieving its initial objectives, or for a finished partnership, has successfully achieved its initial objectives.
Economic impacts	The partnership has made (or is on track to make) a positive impact on the target area/city/region. For example, such impacts might include: • Stimulation of economic activities • Creation of employment or a new product/business/service • Increase of industrial or business performance and efficiency • Increase of regional competitiveness and vitality
Environmental impacts	The partnership has made (or is on track to make) a positive impact on the target area/city/region. For example, such impacts might include: • Improvement of sustainability, environmental impact or resiliency of target area/city/region or business and industry activity in that area • Improvement of infrastructure and/or built or natural environment • Improved management of infrastructure and/or the built or natural environment
Societal impacts	The partnership has made (or is on track to make) a positive impact on the target area/city/region. For example, such impacts may include: • Improvement of social, political or cultural conditions • Improved liveability and quality of life • Improved public awareness or engagement in sustainability or environmental issues
Overall sustainability impacts	Overall, (in all three of the above areas: economic, environmental and societal) the partnership has made (or is on track to make) a positive impact on the sustainability of the target area/city/region.

Table 5.5 Mean and distribution of results for evaluation areas (n=55 cases)

Evaluation areas	Mean	[-2.00,-1.51]	[-1.50,-1.01]	[-1.00,-0.51]	[-0.50,-0.01]	[0.00,0.49]	[0.50,0.99]	[1.00,1.49]	[1.50,2.00]
Synergy	1.36	0	0	0	0	3	1	24	27
Function	0.85	0	0	2	0	10	9	24	10
Effectiveness	0.75	0	0	1	4	8	7	31	4
Economic	0.45	1	0	2	5	14	15	13	5
Environmental	0.82	1	0	0	0	8	12	26	8
Societal	0.81	1	0	0	0	8	13	27	6
Overall sustainability	0.91	1	0	0	0	4	8	36	5

*** Evaluation scale:** -2 = *strongly disagree*; -1 = *disagree;* 0 = *not sure*; 1 = *agree*; 2 = *strongly agree*

Despite solid faith in the power of cross-sector cooperation, Table 5.5 and Figure 5.5 also reveal that when it comes to the ability of co-creative partnerships to translate this potential into actual results, there is considerably less agreement regarding their *effectiveness*. With a global mean *of* 0.75 and mean scores for several partnerships below zero or in the minus figures, findings indicate that despite all expectations, several partnerships have been deemed to not have successfully achieved, or not be on track to achieve initial objectives. This said, mean scores for 35 of the 55 partnerships sampled fell in the ranges of [1.00,2.00], indicating overall, strong agreement regarding the ability of cross-sector sustainability initiatives to achieve stated objectives.

The next component of the self-evaluation section asked respondents from the various societal sectors to evaluate the performance (either past or on-going) of the case in question in regards to four aspects: *economic*, environmental, societal, and *sustainability* impacts (see Table 5.4 for the indicators suggested for each area). Regarding the last evaluation area of sustainability impacts, this question asked the respondent to consider the performance of the partnership from a holistic perspective, based upon the first three areas. That said, it also left them the liberty to respond from the perspective of their own personal definition of sustainability. Results for this quadruple evaluation are listed in both Table 5.5 and Figure 5.5. It can be seen from a comparison of each area that overall, the vast majority of cases have been evaluated positively in regards to environmental, social and overall sustainability impacts. Of the four evaluation areas it can be seen that the highest level of agreement is reflected in regards to *overall sustainability* impacts achieved (global mean=0.91 and individual means from 41 out of 55 partnerships falling between the range of [1.00,2.00]). It should be noted here that the indicators suggested for each of the appraisal areas in Table 5.4 were only meant as suggestions. Consequently, differing individual conceptions of sustainability have no doubt influenced the relatively high value of the global and individual mean scores for each case. Regardless however, these results confirm that the majority of actors surveyed for this study—representative of diverse perspectives from academia, industry, government and civil society—hold a positive view of the societal, environmental and overall sustainability impacts attained or likely to be attained by each case in question.

Yet when it comes to an economic perspective on the other hand, Table 5.5 and Figure 5.5 also portray much less confidence regarding the capacity of co-creative partnerships to manifest concrete economic impacts. This is conveyed by a global mean of 0.45 and the observation that 37 out of 55 cases have generated individual scores of less than 1.00 (i.e. 'I agree'). In this study, positive economic impacts were loosely suggested with indicators such as: *stimulation of economic activities, creation of employment or a new product/business/services, increase of industrial or business performance and efficiency*, and lastly, *an increase of regional competitiveness and vitality*. Although many cases in the sample are not explicitly seeking to advance economic development, the author has assumed that many cases would nevertheless manifest positive 'externalities' such as those indicators suggested above. Despite this possibility, it can be seen that in relation to environmental, societal and overall sustainability impacts, far less confidence has been expressed regarding the capacity of co-creative partnerships to contribute to economic development.

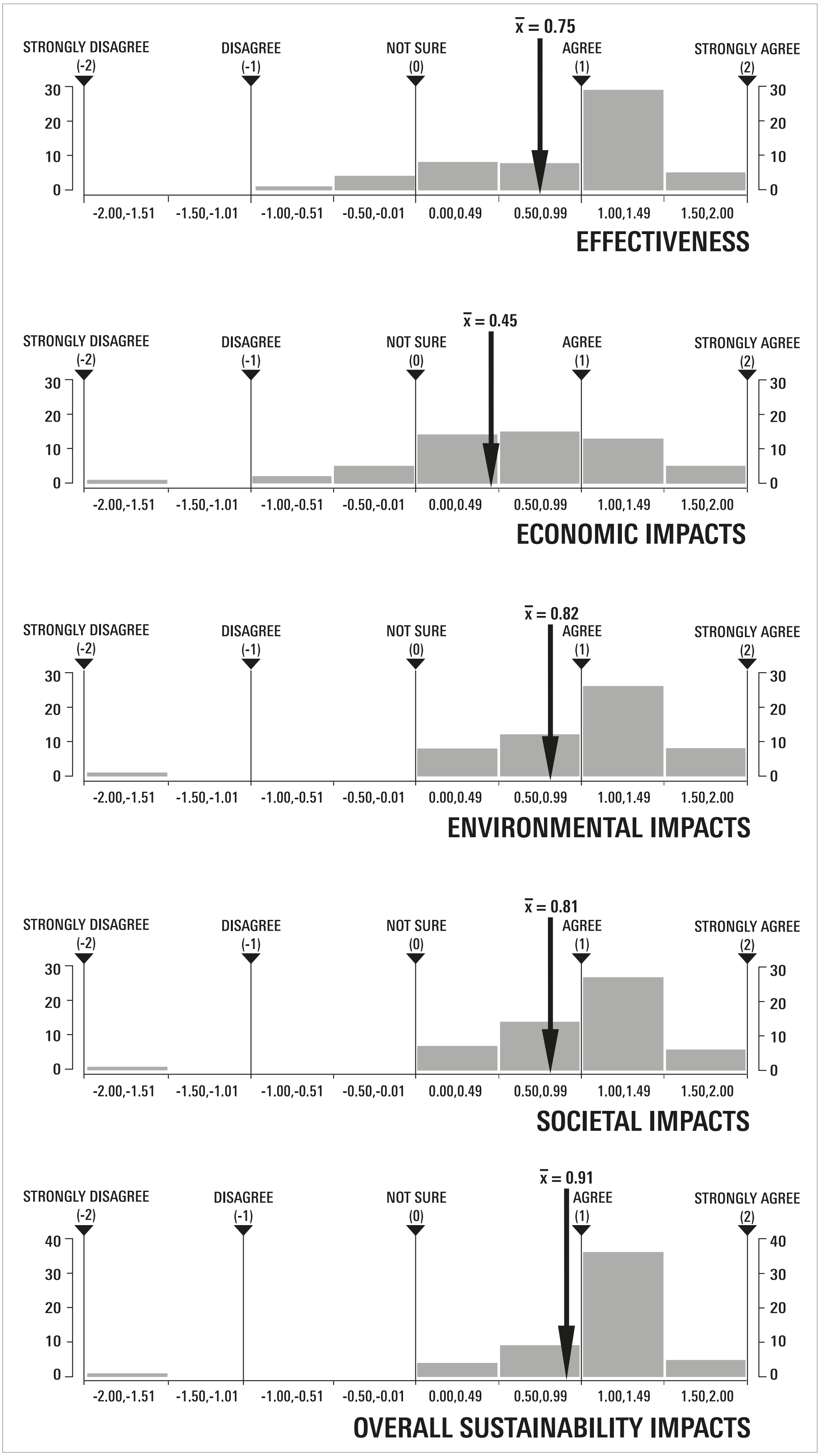

Figure 5.5 Mean and distribution of world results for impacts and effectiveness (*n*=55)

5.3 Summary and discussion of key findings

This chapter has sought to further develop the global-level empirical analysis that began in Chapter 4. Based on the assumption that university and societal actors engaging in the emerging function of co-creation for sustainability would be subject to differing pressures, expectations, obstacles and drivers than those engaging in conventional technology transfer activities, this chapter has sought to ascertain the precise nature of these factors. It firstly conducted a statistical and qualitative analysis of the type of drivers and barriers most commonly encountered in various cases around the world. Secondly, it provided a global appraisal of the effectiveness of co-creative partnerships for urban sustainability and the specific areas in which they are most likely to generate positive impacts. By doing so, this chapter has further contributed to the theoretical and empirical foundations for future scholarship in the field of cross-sector university collaborations for sustainability. It has also generated a body of knowledge that will be later exploited to suggest strategies for maximising the effectiveness of co-creative partnerships to bring about integrated societal transformations in the goal of advancing urban sustainability. Key findings and implications to have emerged from this chapter are summarised below.

5.3.1 Most important driving factors

This sub-section summarises and discusses findings related to the below research question:

> 2.1 *What are the most significant driving factors influencing co-creative partnerships for sustainability around the world?*

It has been confirmed on both a global and regional level that the most important driving factors are *synergy (86%) and strong leadership (84%)*—two factors relating to internal project dynamics. The overwhelming consensus in the sustainability literature that the impacts of societal interventions and innovation efforts can be maximised through the synergistic effect of cross-sector collaboration (Cash et al., 2003; Clarke and Holiday, 2006; Schaffer and Vollmer, 2010; Spangenberg, 2011; Talwar et al., 2011; Whitmer et al., 2010; Yarime et al., 2012) has thus been empirically demonstrated to be a true reflection of experiences of 133 co-creative actors working ‘on the ground’ around the world. Despite this overwhelming faith in the power of collective impact, it was also shown that the presence of strong individual leaders—or ‘champions’—is a decisive driving factor for co-creative sustainability efforts. Again, these are observations that correspond with the arguments of scholars such as Lozano (2006) and Zilahy and Huisingh (2009). Qualitative survey responses suggested that this was the case because strong leaders are able to enhance partnerships by: “leading, pushing and driving the collaboration”; ensuring that the strength, expertise and experience of each partner and sector is fully exploited; mustering external support and recruiting other leaders and change agents; and also, instilling a common vision and set of values amongst various partners—an essential factor in maintaining partnership synergy.

A further observation regarding core drivers was that in all three geographical regions *external funding* was a highly significant force for many partnerships (83% for Europe, 84% for Asia and 70% for North America). Some cases appear to have been ‘coaxed’ into formation by the presence of dedicated funding programmes (such as *INTERREG* in Europe for example) aimed at fostering cross-sector efforts for place-based sustainability work. Results suggest that the expansion of such funding programmes would therefore have a clear driving effect on the formation of future co-creative university efforts for sustainability. In connection to this, several qualitative responses indicated that the procurement—or *prospect* of procuring—funding was helpful in securing participation and driving action from private and government partners. These findings support arguments from Whitmer et al. (2010) that in order to encourage new experimental forms of place-based sustainability collaborations, targeted funding programmes could prove as a major driver. Finally, another important finding was that *co-ordination support* in the form of devoted project offices, managers and administrators is extremely beneficial for co-creative partnerships. This was particularly the case in North America (83%). Again, these are findings supporting arguments from Kania and Kramer (2011). This is because such 'backbone organisations' free project leaders and investigators from administrative duties, allowing them to concentrate on core co-creative activities.

On the other hand, it was also confirmed that individual *university policy* still seems on the whole an insignificant factor in relation to other drivers (61% for Europe, 51% for Asia and 67% for North America). This is most likely signalling that institutional and department-level policy can, in many settings, be modified to support co-creative actors by, for example, assisting with the preparation of project infrastructure such as offices and staff, and creating the internal conditions that would be more conducive to encouraging faculty and researchers to tie research agendas to local sustainability challenges and invest time and energy engaging with local stakeholders. In regards to this point, measures taken by frontrunner entrepreneurial universities in the US to encourage commercialisation efforts from faculty demonstrate the potential of internal university policy to foster emerging, non-traditional forms of research activities. For example, (Grimaldi et al., 2011) point out that some progressive institutions have taken formal measures such as setting up venture funds or organising business plan competitions which provide specialised entrepreneurial support to faculty such as training, cash awards and consulting services. Also worth recalling is that in the entrepreneurial university, it is supporting infrastructure such as technology transfer offices that play a key role in fostering and facilitating the identification and commercialisation of intellectual property (Etzkowitz, 2002). The development of such internal promotion mechanisms for co-creative sustainability partnerships therefore represents a key area for potential investigation and development in the future.

5.3.2 Most significant barriers

This sub-section summarises and discusses key findings related to the research question below:

> 2.2 *What are the most commonly encountered barriers hampering co-creative partnerships for sustainability around the world?*

A significant overall finding of the analysis on commonly reported barriers was that the most significant obstacles for co-creative partners are not technical, but *human* in nature. This is despite the fact that a significant number of cases in the global sample involve highly novel experimentations with emerging and unproven technologies. Incidentally, findings from Bai et al. (2010) in a survey of 30 sustainability experiments across Asia also observed that human rather than technical issues tend to be at the fore. Further, although the external factor of *external funding* emerged in the statistical analysis as the most significant barrier, a great deal of obstacles relating to internal project dynamics and issues of project management have also been reported as highly significant. For example, *time restraints* and *lack of harmony/unity* were cited by co-creative actors around the world as two highly important obstacles. Regarding the former, it became evident from qualitative responses that university actors and external partners will typically engage in co-creative activities for sustainability in addition to existing job commitments. Although not possible for all partnerships due to limited financial, physical and human resources, the need for dedicated supporting staff and backbone infrastructure such as project offices became even more evident with widespread reporting of this barrier. Regarding the *lack of unity/harmony* barrier, qualitative responses suggested that differing values and interpretations of project goals and strategies required between large numbers of stakeholders and partners tended to dilute the synergy and collective impact of the partnership. It has thus become clear that the articulation of a common vision, motivation and objective in early formation stages, in addition to effective communication and co-ordination of partners, is essential for addressing this issue.

The issue of *external funding* was further analysed. It was found that on a global level the *availability* (i.e. moderately more so than the *amount or length)* of suitable funding programmes for co-creative sustainability efforts was the most significant issue at stake. Several qualitative responses then shed further light on this finding. It was reported that when the securing of sustained funding is a constant concern, valuable time is snatched from core activities as faculty are forced to devote project hours to grant writing and so on. It was also confided that lack of financial resources tends to reduce the societal impact of projects. This occurs as limited funding blocks are broken down in the goal of supporting a large portfolio of projects. It was also reported by some that it is difficult to secure the support of key external partners in the absence of adequate funding. Such reports correspond with the earlier observation that the procurement of attractive or suitable funding packages is an important driver for many partnerships. They also confirm widespread reports in the literature that funding concerns constitute a major barrier for cross-sector sustainability initiatives (Dedeurwaerdere, 2013; Zilahy and Huisingh, 2009).

Also, an important finding from the qualitative responses was that overcoming different 'worldviews', priorities and decision making protocols between each societal sector—particularly between academia and local government—was a major challenge for several partnerships. Many responses shared the view that priorities in local government tend to be focused on the short-term, which is at odds with the long-term focus of academics dealing with sustainability. Defining projects and courses of action capable of addressing these two contrasting value systems can therefore represent a significant challenge for academic actors working with local government. Interestingly, to the author's knowledge this issue of tensions and difficulties arising from differing worldviews and cultures between local government and academia has not been sufficiently explored in the sustainability literature, which tends to widely normalise cross-sector collaborations (Fadeeva, 2004). Clearly, knowledge sharing on this topic and the development of strategies to overcome this potential obstacle are required to enhance the effectiveness of university and municipal collaborations for societal transformations in view of advancing urban sustainability.

Finally, commonly reported allegations in the literature (Crow, 2010; Dedeurwaerdere, 2013; Whitmer et al., 2011; Yarime and Tanaka, 2012; Yarime et al., 2012) that there is generally a lack of incentive in academia to engage in sustainability initiatives with external stakeholders has emerged in the results as a significant barrier in many academic settings. On the other hand, this must not be seen as a universal factor preventing faculty participation in co-creative sustainability efforts as half of faculty responses on this issue signalled that this did not prove a major barrier. This finding could be interpreted in two ways. Firstly, that in many partnerships faculty and researchers interested in engaging with external stakeholders on local or regional sustainability agendas will do so regardless of the absence of institutional incentives. Secondly, and probably just as much the case, many more progressive academic settings and departments are, contrary to common belief, actually encouraging faculty engagement with real-world sustainability agendas and external stakeholders. Incidentally, traditional academic norms and emphasis placed on conventional research outputs such as publications by reward structures have been cited by Philpott et al. (2011) as a major obstacle to the mainstreaming of entrepreneurial activities in European universities. Interestingly, this was even reported to be the case in more applied departments such as engineering and business.

5.3.3 Potential impacts of co-creative university partnerships for sustainability

This final sub-section summarises and discusses findings related to the following research question:

> 2.3 *From an overall global perspective, how effective are co-creative sustainability partnerships at achieving their objectives and contributing to economic, environmental, social and sustainable development?*

Findings related to this question firstly established an overwhelming agreement around the globe regarding the view that the presence of various societal sectors has a positive impact on a partnership's ability to pursue its objectives (i.e. *synergy*). Again, widespread views in the literature that cross-sector collaboration is necessary to tackle sustainability concerns have been confirmed here by actors 'on the ground'. Interestingly, however, results regarding the ability of the 55 partnerships represented to translate this potential to progress toward project objectives were more varied, with several cases deemed to have fallen short of expectations. Nevertheless, around two-thirds of the 55 partnerships fell in the range of [1.00,2.00] indicating, overall, a strong agreement regarding the ability of university cross-sector sustainability initiatives to attain initial objectives. These findings will thus be interpreted as solid evidence of the overall potential of co-creative university initiatives to advance urban sustainability. However the other 20 partnerships falling outside of the [1.00,2.00] range should be retained as a sobering reminder that the effectiveness of co-creative sustainability partnerships can be interpreted differently—and in some cases negatively—from the various sectors and organisations participating.

Other major findings were that despite widespread confidence that the individual partnerships represented were making positive impacts in regards to *environmental, social* and *sustainability* dimensions, on the whole there was far less confidence regarding their capacity to contribute to *economic* development. Although conventional technology transfer makes up only a small part of the fractal of co-creation for sustainability, many cases around the world are nevertheless seeking to drive economic development by exploiting other societal engagement modes identified in Chapter 3. Yet despite such attempts (and not forgetting the possibility of positive economic externalities arising from impacts attained in other areas) partnerships around the world are reporting far less success from the perspective of economic gains. This study was not able to assess the precise reasons for this failure to make significant economic impacts, despite the explicit targeting of economic systems by many partnerships. Yet these results call into question the logic of focusing upon economic development as the most desirable means of contributing to society through cross-sector collaborations. This is because results have revealed that, overall, co-creative partnerships are making far more significant impacts towards social, environmental and overall sustainable development—areas in which progress cannot easily be measured with conventional economic indicators. In connection to this overall lack of confidence (or actual success) regarding the ability of co-creative activities to contribute to economic development, it is worth recalling that many scholars (Bulut and Moschini, 2009; Washburn, 2006) are also dubious of the ability of the conventional technology transfer model to become an "engine of economic development"—as often advocated by proponents of the entrepreneurial university around the world[41].

Two speculative interpretations could be offered in regards to this point. The first is that co-creative sustainability actors around the world, being engaged in a relatively new and still emerging trend, are still learning and experimenting with differing means of advancing sustainable development, inclusive of the economic dimension. After all, success stories of university-driven economic revivals of urban areas are extremely rare. Even if citing the famous *West Philadelphia Initiatives* from the University of Pennsylvania[42], it should be recalled that this was the result of an ambitious and strategic commitment from top-level administration. That is, the ensuing economic revitalisation of the neighbouring West Philadelphia economy was the result of a decade long strategy for local purchasing, local employment, real estate development and extensive interventions on local schooling and governance (Kromer and Kerman, 2004). Secondly, questionnaire results are perhaps suggesting that expectations for cross-sector university collaborations—most of which do not receive top-level institutional support—to function as drivers of economic development should be lowered. Incentives and calls for university actors to contribute to society should be focused on those areas where co-creative partnerships are demonstrating the most success. That is, environmental, social and sustainable development; areas in which impacts and societal benefits cannot be easily understood in economic terms.

[41] One of the reasons for this is that most 'products' resulting from conventional technology transfer activities are embryonic prototypes and inventions requiring significant more time and investment before they are marketable—and therefore profitable (Thursby et al., 2001).

[42] The West Philadelphia Initiatives by the University of Pennsylvania is a well-known case of university-driven economic revitalisation of a specific location—in this case, the immediate campus neighbourhood. Drastic impacts were attained on the socio-economic fabric of the community; notably, boosting the local economy and local housing prices, decreasing crime, improving schooling opportunities and overall neighbourhood beatification (see Rodin, 2007).

Chapter 6
Micro-level empirical research: Case studies

Purpose: To build an in-depth, qualitative understanding on contrasting types of co-creative partnerships initiated by frontrunner institutions with a special regard to: motivating factors, stakeholder type and roles, partnership mechanisms, sustainability impacts attained, drivers and barriers encountered, and lastly, strengths and weakness of the approach.

This chapter addresses the third research sub-objective. It consists of two separate case studies intended to compliment the macro-level empirical research from the previous chapter: the 2000 Watt Society Basel Pilot Region programme by the Swiss Federal Institutes of Technology (ETH) domain, and the Oberlin Project by Oberlin College in the US. Both analyses build upon previous research of the author (Trencher and Yarime, 2012; Trencher et al., 2013a, 2013b).

Corresponding with Gerring's (2007, p. 51) acknowledgement of the value of choosing two "pioneering" examples of "extreme heterogeneity", these cases were chosen to represent the two polarities of co-creation for sustainability shown graphically in Figure 4.10 from Chapter 4. In this typological exercise, two clusters of cases emerged as a result of plotting the 70 cases in the global sample according to two dimensions: the level of civic involvement (i.e. high or low) on the y-axis and the type of partnership (i.e. research, demonstrations and knowledge exchange or socio-economic transformation) on the x-axis. As detailed in Section 4.3.2, the two clusters to emerge were one with a low level of civic participation and a partnership type mainly corresponding to *research, demonstrations and knowledge exchange*, with the other being those cases characterised by a high-level of civic engagement and attributes resembling a *socio-economic transformation project*. The objective of the following analysis is thus to focus on a pioneering case from each cluster and generate detailed, qualitative knowledge on:

- university and socio-economic factors influencing partnerships objectives and structure
- processes by which the partnership formed and developed
- type and role of various partners and stakeholders involved
- specific mechanisms used to achieve partnership objectives
- impacts of these mechanisms
- effect of various drivers and barriers encountered
- strengths and weakness of the overall approach and structure of partnership.

The secondary aim of this chapter is to illustrate a larger point that the function of co-creation for sustainability is in fact capable of becoming an institutional priority—or university *mission*—in vastly differing settings and contexts.

The ETH case constitutes a pioneering representation of co-creation for *innovation.* It has emerged from a research-intense public university domain in thriving socio-economic circumstances in a dense urban setting, with main external partners being local government and industry. In contrast, *the Oberlin Project* demonstrates a case of co-creation *for regeneration.* In contrast, it has developed in a semi-urban, small town setting in dire socio-economic conditions of post-industrial decline. Headed by a small liberal arts college, core partners are local government and civil society. As also described in Section 3.5.2, these two partnerships have also been chosen to ensure a balanced representation of the following points:

- differing socio-economic, linguistic, environmental, cultural and institutional contexts
- contrasting motivations, approaches and organisation
- varying stages of implementation periods (i.e. early, mid or advanced)
- representation of contrasting variables from Analytical Framework [A]
- high-level of institutional importance afforded to achieving the goals of each partnership

Table 6.1 below summarises the systematic approach used to analyse each of the two cases.

Table 6.1 Structure of case analyses

Part 1: Background and objectives
Objective: After providing a brief overview of the project structure and the socio-cultural factors shaping objectives, describe the process by which the partnership emerged and developed. **Research questions addressed:** 3.1 What sort of socio-economic factors and institutional motivations influence the type of co-creation performed? 3.2 What are the processes by which the partnership emerged and developed?
Part 2: Application of Analytical Framework [A]
Objective: To analyse the case through the six-level Analytical Framework [A] described in Chapter 3. **Research questions addressed:** 3.3 What are the defining characteristics and mechanisms driving the partnership?
Part 3: Impacts of societal engagement modes
Objective: To describe key impacts and outcomes from the perspective of societal engagement modes for co-creation. **Research questions addressed:** 3.4 What sort of outcomes and progress towards urban sustainability transformations have been attained and how were these achieved?
Part 4: Drivers and barriers
Objective: To describe drivers and key barriers, also discussing steps taken to overcome these **Research questions addressed:** 3.5 What range of factors has contributed to successful development of the partnership and implementation of various projects? 3.6 What obstacles were met and what measures were taken to overcome these?
Part 5: Strengths and limitations
Objective: To offer an overall critical appraisal of the partnership by considering its approach in regard to its objectives. **Research questions addressed:** 3.7 What are the overall strengths and limitations of the approach of the partnership?

6.1 Case 1: 2000 Watt Society Basel Pilot Region

The first part of the case study is concerned with answering the following research questions:

3.1 *What sort of socio-economic factors and institutional motivations influence the type of co-creation performed?*

3.2 *What are the processes by which the partnership emerged and developed?*

6.1.1 Part 1: Background and objectives

> If a national programme for sending man to the moon or a joint international R&D effort for nuclear energy were feasible in the 1960s, why should the vision of a 2000-watt per capita society not be possible in the future? (Jochem, 2004, p. 10)

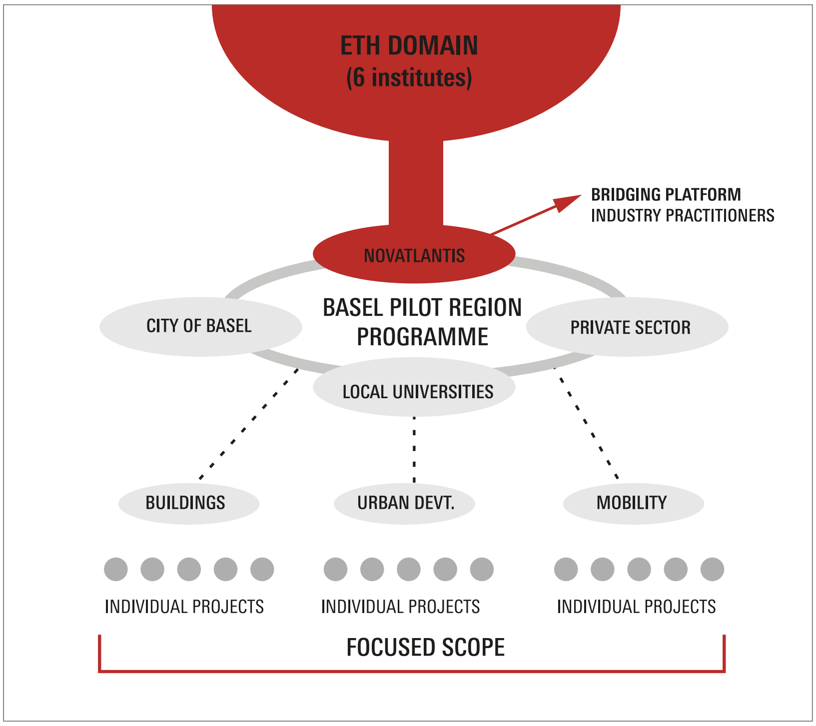

Figure 6.1 Structure of Basel Pilot Region

6.1.1.1 Overview

The 2000 Watt Society Basel Pilot Region was formed in 2001 and takes technologies emerging out of the six institutes of the ETH domain[43] and integrates them into real-world implementation and demonstration projects in the City of Basel, Switzerland (population 193,000). The objective is to showcase solutions to accelerate progress towards the long-term target of a '2000-watt society' (explained later) with a chiefly technical approach. As depicted above in Figure 6.1, the partnership may be conceived as a triple-helix set of relations between *academia,* comprising of

[43] The ETH domain consists of six institutes: Swiss Federal Institute of Technology Zurich (ETH Zurich), Swiss Federal Institute of Technology Lausanne (EPFL), Paul Scherrer Institute (PSI), Swiss Federal Laboratories for Materials Science and Technology (EMPA), Swiss Federal Institute of Aquatic Science and Technology (EAWAG) and Swiss Federal Institute of Forest, Snow and Landscape Research (WSL)

the six institutes of the ETH domain (facilitated through the platform of Novatlantis run by industry practitioners) and the University of Applied Sciences and Arts in Basel (FHNW); *government,* comprising of planners at the City of Basel and *industry,* consisting of local utilities, enterprises, construction companies and building owners. The partnership consists of three focus areas: mobility, buildings and urban development.

6.1.1.2 Socio-economic factors, institutional motivations and objectives

The array of factors influencing partnership objectives, type and structure have been summarised into Figure 6.2 below. The focus on societal conditions and institutional motivations has been shaped from the earlier observation in Chapter 4.3.6 that these two factors were reported as the two most significant across the global sample in relation to other motivations.

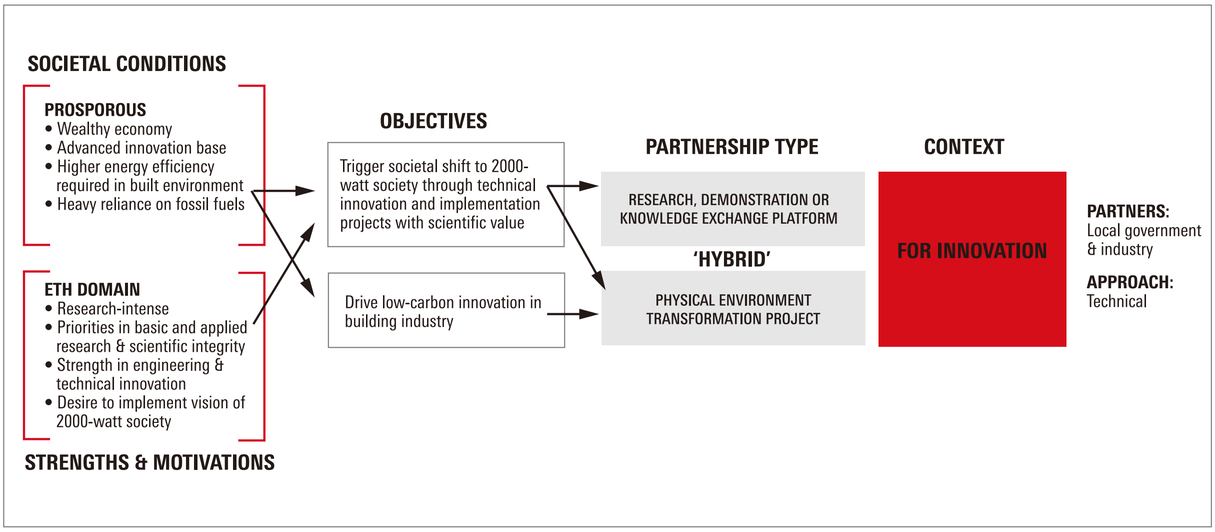

Figure 6.2 Factors influencing objectives and partnership structure (Basel Pilot Region)

As can be seen from Figure 6.2, the objectives of the partnership (which essentially mirror the partnership type) have been heavily shaped by societal conditions on one hand, and on the other institutional strengths and motivations. Overall, the socio-economic conditions of Basel (as is the case in the rest of Switzerland) can be characterised as prosperous, bolstered by an advanced innovation base from large global players in life sciences, agro-business, chemicals and nanotechnology. Table 6.2 below compiles key statistics for Basel, which also reveal that the city is typified by a small surface area and high population density. That said, at the turn of the millennium Basel and the rest of Switzerland in general was hampered by concerns about an aged and often poorly energy efficient building stock and overreliance on fossil fuels (Lienin et al., 2004). In such a setting, sustainability challenges such as energy and climate change were regarded chiefly from a technical perspective and seen as a strategic opportunity to decrease fossil fuel importations, strengthen the economy, increase manufacturing efficiency and further technological innovation (Jochem, 2004). On the other hand, Figure 6.1 also portrays ETH-side factors motivating the formation of the bridging platform of Novatlantis and the subsequently established pilot region. With the ETH domain characterised as a research-intense institution with strengths in basic science, engineering and technical innovation, measures taken to implement the vision of the 2000-watt society were thus heavily influenced by the need to ensure scientific integrity and research value (Lienin et al., 2004).

The merging of these societal and institutional factors has thus shaped two core objectives and the 'hybrid' nature of the partnership. Objectives are thus: 1) take research results and emerging technologies out of the ETH domain to drive a societal shift towards a 2000-watt society and co-create implementation projects with scientific value, and 2) drive low-carbon innovation in the building industry. These twin objectives have thus shaped the hybrid nature of the partnership, which may be classified as a partnership functioning simultaneously as a *research, demonstration or knowledge exchange platform* and *physical environment transformation project.* As also shown in Figure 6.2, this model of co-creation is taking place in a context of *innovation* due to the chiefly technical approach (driven mainly by the research function of the university) and the engagement with local government and industry. This interpretation of the pilot region corresponds with that of Lienin et al. (2004, p. 4) who explain that the Basel Pilot Region programme "can be considered a large-scale and long-term field test of the impact of technology on sustainable development in a developed economy like Switzerland".

Table 6.2 Key statistics for Basel (Source: Berger et al., 2011; Switzerland Global Enterprise, 2012; Swiss Confederation, 2013)

Population	193,396 (Basel City in 2011)
Land area	23.9 km2 (Basel City)
Median household income	Swiss average 83,472 CHF in 2012 (equiv. $US 91,990)[44]
Unemployment rate	3.65% (Basel City 2012)
Economic conditions	Prosperous. Strong business centre, presence of multi-national corporations and dynamic innovation base in life sciences, agro-business, chemicals and nanotechnology.
Carbon emissions	5.5 tonnes 2010 (City of Basel) 5.0 tonnes 2010 (Swiss average)
Primary energy demand	Approx. 4000-watts per capita[45] (Basel City in 2010) (Swiss average 6500-watts)

6.1.1.3 Emergence and development of partnership

The roots of the 2000 Watt Society Basel Pilot Region reach back to the vision of a 2000-watt per capita society that had emerged from within the ETH domain during the early 1990's (Imboden et al., 1992; Kesselring and Winter, 1994). The aim of this low-carbon masterplan for the future was to reduce over several decades the mean of the permanent flux of power in industrialised nations to around 2000 watts per citizen, a target corresponding to the current world average (Morosini, 2010). Achieving this would entail not only electricity consumption, but all sources of primary energy, equating to roughly 17,000 kWh (Morrow and Morrow, 2008), 63 GJ or 1.5 tonnes of oil equivalent per person per year. The conception of the 2000-watt society was intended as a dual response to climate change and mounting energy security concerns. In the context of

[44] Based on 1 CHF = 1.10205 US on November 25, 2013.

[45] This figure is based on all fossil fuel based energy consumption (electricity, heat and fuels) in Basel City from transport, residences, buildings and industry. This does not include energy consumption in the form of imported products, which are also estimated to constitute around 4000-watts per capita (Berger et al., 2011)

Switzerland, this vision necessitates slashing by two-thirds the current yearly energy consumption by around mid-century (Jochem et al, 2004). Also at the heart of the 2000-watt vision is the resolve to mitigate climate change by slashing per capita GHG emissions to 1-tonne of CO2e.

In 1998 the ETH board formally promoted this vision by stating publically its support and integrating the 2000-watt society into the *Sustainability Strategy for the ETH Domain*[46] (Marechal et al., 2005). This top-level approval was in fact indicative of enthusiasm from the President of ETH Zurich at the time (Alexander Zehnder), the President of the ETH Council and the Presidents of two other ETH institutes[47] regarding concrete measures that would be taken to promote a low-carbon transformation of Switzerland in pursuit of the 2000-watt goal (Spreng, 2013). At a time when the term ‘sustainability’ was still shrouded in ambiguity and debates continued over differing definitions, the concept of a 2000-watt society won support from the top of the ETH domain due to its simplicity and objectiveness as a “criteria for sustainability” (Spreng, 2013).

Steps were then taken to translate the initially scientific vision of a 2000-watt society into an implementation project. Dieter Imboden, a prominent professor who had been a fervent advocate of the 2000-watt society throughout the 1990’s, was charged with directing the *Sustainability Strategy for the ETH Zurich* (Stulz, 2013). With formal support from the ETH board—which represents all six institutes of the ETH domain—funds were allocated to the Imboden-led steering committee for the setting up of research projects with industry in the goal of diffusing knowledge required for the implementation of a 2000-watt society. These initial attempts to set the stage for a low-carbon transformation of Switzerland were warmly received by both industry and media and did much to lay the initial groundwork for future efforts to forge industry and government sustainability collaborations from ETH. However, these scientifically focused initial research projects fell short of expectations and were unable to generate the momentum and socio-technical innovation required to spark the societal and industrial transformations required to trigger a significant transition towards a 2000-watt society (Spreng, 2013; Stulz, 2013). The ETH board then made the decision in the year 2000 to recruit a practitioner from industry—Roland Stulz—a prominent architect and leading partner at the time of one of the largest engineering firms in Switzerland. With an allocation of 400,000 CHF in ETH-funding for an initial period of 10-years, Stulz directed the establishment of Novatlantis, a bridging organisation set up to accelerate the national transition to a low-carbon society. The mission of the Novatlantis platform was initially broad, and was simply that of taking “the findings and results of recent research within the ETH domain” and applying them to “projects designed to promote sustainable development in major urban settlements.” (Novatlantis, 2013). This was to be done in a trans-disciplinary manner in partnership with government and industry. The ETH domain ensured its stake in projects by forming a steering committee with representatives from all six institutions of ETH, as well as a member from the ETH board itself. By taking the measures just described above, as well as communicating these avidly to society, ETH thus established itself as a frontrunner transformative university where one of the priorities—or missions—become that of bringing about societal transformations in view of realising a 2000-watt society.

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[46] See: Board of Swiss Institutes of Technology (ETH-Rat) 1998. 2000-watt society: Swiss Model Sustainability Strategy for the ETH Domain (in German). Wirtschaftsplattform ETH Zurich.
[47] Swiss Federal Institute of Technology Lausanne (EPFL) and the Paul Scherrer Institute (PSI).

Although Novatlantis was to later initiate several other sustainability projects including the formation of the International Sustainable Campus Network[48] (ISCN), it was the 2000-watt society that become the core 'product' upon which this platform focused its resources (Stulz, 2012a). An initial feasibility study was arranged with a team of ETH researchers on the steps that would be required to attain a 2000-watt per capita society (Jochem et al., 2002). Two years later, Novatlantis facilitated the publishing of a white paper containing the final blue-print for a 2000-watt transformation of Switzerland (Jochem, 2004). Three vital and seemingly contradictory assumptions were laid out in these English language reports widely targeting both national and foreign governments, industry and science foundations. Firstly, that the realisation a 2000-watt per capita society in Switzerland by the year 2050 was technically possible, but would require massive improvements in energy efficiency. It was proposed that this be achieved by reducing losses occurring in transformation chains from primary energy to final energy services and drastically overhauling the major consumers of energy in the Swiss economy; namely, buildings, transport and industry (Marechal et al., 2005). Secondly, in what could also be interpreted as a subscription to the myth that endless economic growth is both possible and desirable, the authors assumed that domestic economic activities in 2050 would have increased by around 70%. This was in spite of the fact the population of Switzerland was projected to remain relatively stable. Finally, the third assumption was that all of this would be "technically feasible without reducing the level of comfort" attained by society so far (Jochem, 2004, p. 3). Other defining characteristics also built into the vision include the call to reduce GHG emissions (principally CO2) to 1-tonne per capita (Morosini, 2010) with a shift to renewable energy sources that would constitute 75% of the total 2000 watts. In this sense, the blueprint for a 2000-watt per capita society also had its core IPCC climate science and the ultimate objective of keeping post-industrial temperature rises to below two degrees (City of Basel and Novatlantis, 2013; Spreng, 2013). In tandem with scores of papers that would later flow out of the ETH domain, these two landmark studies thus served to win public and political support for the 2000-watt society within Switzerland. They also formed the scientific and intellectual framework that would inform Novatlantis efforts to translate this knowledge into action.

In parallel to this wider effort from within ETH to communicate to Switzerland and the rest of the world the feasibility and desirability of achieving a 2000-watt society, Novatlantis began looking for a test site where scientific knowledge could be converted into real-world implementation projects for sustainable development. The 2000 Watt Society Basel Pilot Region Programme consequently emerged in 2001 as the first research project from Novatlantis. Its aim was to translate to a city-level discussions previously focused on a national scale, and also to facilitate a series of innovative technical experiments and demonstrations in the fields of mobility, buildings and urban development. Their purpose would be to drive a wider societal transformation towards the 2000-watt per capita target. The City of Basel (population 186,000) was chosen after it responded favourably to a Novatlantis proposition to which it stipulated that any project be focused on application rather than research (Stulz, 2012a). The Basel Pilot Region was thus born as a Novatlantis mediated alliance between the ETH domain, the City of Basel (Department of Building) and two local universities. It was intended as an umbrella for a series of sustainability

[48] Formed in 2007, the ISCN is a network of global research universities united around the theme of sustainability. Its mission is described as: "to provide a global forum to support leading colleges, universities, and corporate campuses in the exchange of information, ideas, and best practices for achieving sustainable campus operations and integrating sustainability in research and teaching." See URL: http://international-sustainable-campus-network.org/about

projects that would be fed the latest research results from the ETH domain, and implemented with the aid of the City and private enterprises. The City of Basel later helped to finance the project with 1.5 million CHF for a 10-year period.

Concerning the processes by which the alliance has since developed and prospered, project ideas for the 2000-watt society Basel Pilot Region programme were initially sourced from a series of stakeholder workshops. Here the 'demand side' of City administrators were brought together with the 'supply side' of ETH scientists and FHNW professors to collaboratively envision numerous projects, of which approximately six have since materialised (Stulz, 2012a). Projects have thus been created in both a 'push' (ideas originating from ETH) and 'pull' (ideas from the public sector) manner (CCEM, 2011), with Novatlantis committed to ensuring that 'pull' remains a significant force. Once approved by the Novatlantis steering committee and ETH board, individual projects were then granted ETH seed-funds. The scale of the initial ETH funds set aside for the pilot region was 400,000 CHF over 10 years. Projects then sought their own private partners, created their own steering committees and pursued additional funding from industry and government sponsors. This external funding also meant that government and industry stakeholders were able to ensure that the research design and execution responded to their needs and areas of interest (Lienin et al., 2004).

With the above-described stakeholder workshops leading to the first series of implementation projects and establishing the initial momentum for the pilot region programme, Novatlantis and various core members have also worked hard at 'marketing' aspects (Stulz, 2013) to further propel the partnership and boost public acceptance and visibility levels. For example, on top of numerous conference and meeting presentations conducted across Switzerland during the first few years by Novatlantis and various ETH domain actors, much energy has been invested into rendering visible the emerging results and planned projects on a national and international-level through a vast array of mediums. These include both academic and non-academic publications aimed at the general public, international exhibitions such as Smarter Living by ThinkSwiss and various Swiss embassies, press releases, dedicated Internet sites from both Novatlantis[49] and Basel City[50], in addition to annual forums where results from all building and mobility experiments are reported to industry stakeholders.

[49] See URL: http://www.novatlantis.ch
[50] See URL: http://www.2000-watt.bs.ch

6.1.2 Part 2: Application of Analytical Framework [A]

With a background discussion now in place, this sub-section will now proceed to respond to the following research question:

> 3.3 *What are the defining characteristics and mechanisms driving the partnership?*

To this end, a decision has been made to apply Analytical Framework [A] (developed in Chapter 3) in the same manner as Chapter 4. This will hence enable a closer analysis of the following characteristics:

1. urban sub-systems targeted by the collaboration
2. scale of the geographical area(s) targeted
3. main *internal* actors involved
4. main *external* actors involved
5. motivating factor(s) behind the formation of the partnership
6. various engagement mode(s) used to purse the partnership's objectives

As with both analyses in this chapter, quantitative data for the application of this framework has been sourced through a score-based questionnaire[51], the results of which are summarised in the following sub-sections. (The relevance of each variable is shown as: *high*=two bars, *medium*=one bar and *nil*=blank, with each relevancy level corresponding to questionnaire[52] scores of 2,1 and 0 respectively). In addition, the following discussion also uses qualitative data obtained from interviews with key members in the Basel Pilot Region programme and professors at ETH Zurich, in addition to various secondary data such as documents and publications.

6.1.2.1 Level 1: Societal sub-systems targeted

Since its formation in 2001, the Basel Pilot Region programme has continued to focus its efforts in three fields: mobility, buildings and urban development (Novatlantis, 2013). When applying Analytical Framework [A], these categories are reflected as follows by questionnaire responses:

Table 6.3 Level-one results

Societal sub-system targeted (what?)	Relevance level*
Built environment	■ ■
Transportation	■ ■
Energy, heating or cooling	■ ■
Economy, employment and industrial production	■
Natural environment or green spaces	■
Food, agriculture and forestry	
Water	■
Solid waste	
Governance and planning	■
Human and social systems	■

* Two bars = high relevancy, one = medium and none = nil.

As can be seen from above, the core focus of the Basel Pilot Region programme is in the three areas of *built environment, transportation* and *energy and heating/cooling.*

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[51] This was completed by Roland Stulz the founder and managing director of Novatlantis from 2001-2011.

[52] See Appendix 3.

For the sub-sector of the *built environment,* although the Basel Pilot Region programme targets mainly private residential and commercial buildings, the building stock of the Basel administration has also been the target of several sustainable reformations. The specific aim of this focus is to drive energy efficient and socio-ecologically sustainable building practices for both renovation and new construction, in a process extending from construction to final usage. In connection to this building component, as the vision of the 2000-watt society is ultimately an energy strategy pushing for deployment of renewable resources (Morosini, 2010), the sub-sector of *energy* has naturally been signalled to be of high relevance. The specific focus here is on demand-side energy usage (heating, cooling and lighting etc.) in new and existing buildings, but also extends to on-site energy production such as solar and geo-thermal. Concerning the *transportation* sub-sector, with car traffic identified as a major source of CO2 emissions and consumer of roughly 20% of fossil fuel consumption in Switzerland, a major focus of the pilot region is also upon developing, demonstrating and testing sustainable individual transport solutions (Lienin et al., 2005). Various mobility projects are currently targeted at car fleets owned by industry, taxi companies and the City of Basel municipality.

Other urban sub-systems such as *water*, *solid waste*, *human and social systems* and *governance and planning* have also been reported as being partly targeted (i.e. medium relevance scores). Regarding the first two, *water* and *solid waste* have emerged due to their relationship to sustainable building projects seeking to reduce water consumption and generation of solid waste. The *solid waste* category has also emerged in connection to a project in the transportation sub-sector involving the City of Basel's street-sweeper vehicle fleet. *Human and social systems* has also been identified as a partly targeted area of the pilot region. This is principally for the reason that scientific testing and commercial implementation projects in construction and planning have sought to provide the physical environment and infrastructure for the fostering of sustainable lifestyles. In addition, activities in the Basel pilot region have been avidly reported to the civic sector in order to boost public awareness in the quest to curb energy consumption pathways and realise a 2000-watt society. Lastly, the sub-sector of *governance and planning* has also been identified as having some relevance to the pilot region. This is indicative of one of the key targets and end users of knowledge produced in the context of the 2000-watt society—government decision makers—(Jochem, 2004) whose energy policies and building regulations have played a key role in transforming the building sector.

6.1.2.2 Level 2: Geographical scale of target area

Responses obtained for the second level of the framework (the geographical scale of target area) are as follows:

Table 6.4 Level-two results

Scale of target area (where?)	Relevance level
Local/neighbourhood level	▬
City/town level	▬ ▬
Regional level	▬
National level	▬ ▬
Trans-border level	

These results are indicating that the pilot region programme has a dual focus of both a *city/town level* and a *national level.* That is to say, the City of Basel is intended on one hand to function as a local testing and demonstration site, and then on the other as a driver of a wider national transition towards the 2000-watt society. Regarding the *city/town level,* mobility demonstration and pilot projects have taken place at several locations across the city over the last decade, in addition to roughly 30 pilot buildings and urban development projects scattered all over the city in areas such as Gundeldinger Feld, Erlenmatt and Dreispitzareal (City of Basel and Novatlantis, 2013). Concerning the high relevance of the *national level* for pilot region programme activities, this is principally for the reason that the vision of 2000-watt society was initially intended as a transformation project to be implemented on a national scale (Jochem et al., 2002). Consequently, the interplay of ambitions to drive socio-technical transformations in pursuit of materialising sustainable development on both of these two levels is a key characteristic of the pilot region.

6.1.2.3 Level 3: *Internal* actors

Regarding the university actors involved in the Basel Pilot Region, responses obtained for this layer are as follows:

Table 6.5 Level-three results

Internal actors (who?)	Relevance level
Faculty/researchers	▬ ▬
Administration	▬
Students	
Bridging organisations	▬ ▬

These responses indicate that the main internal actors from the perspective of ETH are *faculty/researchers* from the various institutes of the ETH domain, and the *bridging organisation* Novatlantis. Using these categories, Table 6.6 overleaf provides a non-exhaustive analysis of several of the major internal actors involved in the pilot region over the last decade.

Regarding the role of *faculty/researchers,* various scientists, professors and researchers from ETH Zurich, Paul Scherrer Institute (PSI) and the Swiss Federal Laboratories for Materials Science and Technology (EMPA) are major internal contributors to the pilot region activities. Overall, two major roles are discernable here. The first concerns project creation, management and steering, with several professors and scientists from ETH Zurich and PSI being members of the Novatlantis sub-committee. The second role is that of contributing research results, conducting R&D, field demonstrations and implementation projects. It is in this role that actors from EMPA and PSI have been particularly active, especially in the field of mobility. Here, several demonstration projects (explained in Section 6.1.2.6) have been implemented over the last decade under the banner of ‘Experimental Space Mobility’ (Lienin et al., 2004; 2005). Here the role of *faculty/researchers* has been that of carrying out both basic and applied research and then applying these results to demonstration projects where emerging technologies from the ETH domain in fields such as LNG and hydrogen-fuel cell vehicles are showcased in Basel. It has also been that of managing the various projects, working with industrial partners to solve technical problems, gathering data and test results and then, finally, ensuring that all of this is feed back into future research activities (Martin, 2013). In tandem with Novatlantis, participating ETH scientists and professors have also played a major part in communicating the results of pilot region projects to industry and government stakeholders in annual mobility forums.

The ETH *administration* has also played a role in the pilot region, even if only indirectly. First of all, by providing a formal recognition of implementation activities for the pilot region they have allowed the Novatlantis platform to function as a representative of the entire ETH domain, thereby boosting considerably the social credibility of the pilot region (Lienin et al., 2004). Secondly, they have provided 400,000 Swiss francs of funding to the Novatlantis platform for the first 10-year period of 2000-2010. Thirdly, the ETH board has ensured that its interests are served in the pilot region by also serving as a member of the Novatlantis steering committee, which convenes bi-annually. The ETH board, which was initially concerned about the scientific integrity of implementation focused projects, has thus played a quality control role via the steering committee. They have done this by screening various projects proposed by the pilot region actors to assess suitability for the granting of seed-funds (Lienin et al., 2004).

Regarding the final category of *bridging organisations,* although the Novatlantis platform is essentially a cross-institutional project and not a physical headquarters for the pilot region, by mostly functioning as the national co-ordinator and initiator of the pilot region Novatlantis is essentially assuming the role of a *bridging organisation* (Lienin et al., 2004). That is to say, over the past decade its most basic role has been that of linking various ETH researchers and scientists on the one hand with actors from the City of Basel and industry on the other. It should be highlighted now that this central role has been reduced over the past few years to a scientific advisory and quality assurance role, with the overall steering and co-ordination of the pilot region programme now transferred to the City of Basel Office for Environment and Energy and University of Applied Science FHNW in Basel (see Section 6.3.3).

Table 6.6 Key internal actors in Basel Pilot Region

Name	Affiliation/position	Chief role assumed
Faculty/Researchers		
Prof. Dieter Imboden	ETH Zurich (Department of Environmental Sciences)	• Major promoter of 2000-watt society • Founder of Novatlantis • Founder of initial 2000-watt society pilot projects
Prof. Alexander Wokaun	ETH Zürich (Institute for Chemical and Bioengineering & Energy Science Centre) Paul Scherrer Institute (PSI)	• Scientific management of Mobility group • Project creation for Mobility group • Scientific research for 2000-watt society • Member of Novatlantis sub-committee
Dr. Philipp Dietrich	Paul Scherrer Institute (PSI)	• R&D and field-testing for mobility group • Member of Novatlantis sub-committee
Dr. Christian Bach	Swiss Federal Laboratories for Materials Science and Technology (EMPA)	• R&D and field-testing for mobility group
Dr. Patrik Soltic	Swiss Federal Laboratories for Materials Science and Technology (EMPA)	• R&D and field-testing for mobility group
Administration		
Dr. Kurt Baltensperger	ETH Board	• Provision of official ETH approval to pilot region • Member of Novatlantis sub-committee • Quality control, steering of pilot region • Provider of initial funding to Novatlantis (CF 400,000 ten-years)
Bridging organisations		
Roland Stulz	Novatlantis	• Executive Director of Novatlantis 2000-2011 • Founder and overall leader of Basel Pilot Region programme
Urs Elber	Novatlantis	• Executive Director of Novatlantis 2012-to present • Scientific advisory to pilot region

6.1.2.4 Level 4: External actors

Regarding the external actors constituting the core members of the Basel Pilot Region programme, responses obtained for this layer of the framework are:

Table 6.7 Level-four results

External partners/stakeholders (who?)	Relevance level
Local/regional government	■ ■
State/national government	■
Civic society	
Other academic institutions	■ ■
Large or multi-national corporations	■ ■
Small-medium enterprises	■ ■

As can be seen, core partners consist of a triple-helix set of relations with the three sectors of government, academia and private industry. Using these categories, Table 6.8 below provides a non-exhaustive analysis of the major roles performed by each of these sectors over the last decade.

To begin with participation from *local government/public service sector,* this consists of city planners and policy makers from the Department of Building, the Department of Economy, Society and Environment and the Office of Energy and the Environment from the City of Basel, which is an official partner for the pilot region. For the majority of the first decade of the pilot region the role of these local government actors was to enable pilot projects by providing hard resources in the form of funding car pools and buildings for various pilot and demonstration projects, in addition to soft contributions such as legal and administrative assistance (Stulz, 2012a) and the alignment of policies such as building codes, energy policies and fiscal incentives to principles of the 2000-watt society (Martin, 2013).

For *other academic institutions*, although the University of Basel specialising in the humanities and medicine is an official pilot region partner, the bulk of local co-ordination activities are assumed by the Institute of Energy in Building at the University of Applied Sciences Northwestern Switzerland (FHNW) (Stulz, 2012a). As a specialist in construction and energy use in buildings, FHNW professors play a major role by coordinating a portfolio of building projects under the title of 'P+D Buildings'. However, the responsibility of this institute also extends to that of acting as the local coordinator for all three legs of the pilot region: mobility (Experimental Space Mobility), buildings (P+D Buildings) and urban development. More concretely, this entails day-to-day communications with the various actors and project members as well as organising events and steering board meetings for the individual project committees (Binz, 2013). On a more technical level, FHNW professors have played a large part in driving more sustainable building and urban development practices in Basel. They have done this serving as consultants to architects, identifying suitable private sector construction projects for insertion into the pilot region (Geissler, 2013), organising and judging architectural competitions for retrofit and urban development projects, contributing to the creation of the 'Minergie®-P' building standard (Binz, 2013), and working to establish more stringent building codes in Basel (all of these activities will be elaborated in Section 6.1.3).

Table 6.8 Major external stakeholders and partners

Name	Chief role assumed
Local government	
City of Basel (Office for Environment and Energy)	*(Period 2002-2012)* • Provision of funding, legal and administrative assistance • Provision of test-sites such as government buildings and car fleets • Implementation of building codes, energy policies and fiscal incentives *(Period 2012 to present)* • Overall national coordinator of pilot region in addition to previous roles
National government	
Swiss Federal Office of Energy	• Integration of 2000-watt goal into national energy strategy • Promotion of 2000-watt target at national level
Other academic institutions	
University of Applied Sciences Northwestern Switzerland (FHNW)	*Period 2002-2012* • Local coordinator of pilot region • Manager of P+D Buildings pilot and demonstration programme • Provision of technical expertise for energy in building • Provision of consultancy services to industry *Period 2012 to present* • Overall national coordinator of pilot region in addition to previous roles
Large corporations	
Industrielle Werke Basel (Electricity, water, gas and heat utility in Basel)	• Provision of car fleets to mobility projects
Urban developers and construction companies	• Integration of 2000-watt building principles into large-scale urban development projects • Provision of technical feedback to university actors
Bucher Schörling and Proton Motors	• Collaborative R&D (technical assistance and funding) • Absorption of new technologies
Small-medium enterprises	
SustainServ (sustainability consultancy)	• Project management for mobility group • Strategic advice for pilot region
Various architects and building owners	• Integration of 2000-watt building principles into individual pilot and demonstration building projects • Provision of technical feedback to university actors

For industry participation, the active involvement of *large or multi-national corporations* (high relevancy) and s*mall-medium enterprises* (high relevancy) may be explained as follows. Firstly, a private sustainability consulting firm called Sustainserv plays an active role in project management for the mobility component, as well as playing a key role in the overall management and steering of the pilot region. On the stakeholder side, both *large or multi-national corporations* and s*mall-medium enterprises* are involved in enabling implementation and demonstration projects in mobility, building and urban development. For mobility, various car fleet operators such as taxi companies and Industrielle Werke Basel (IWB)—the electricity, water, gas and heat utility in Basel—are actively participating as the 'customer' side of various mobility projects. For building and urban development, a vast array of private investors, buildings owners, developers and architects have been enticed to integrate energy efficiency and sustainable building principles from the 2000-watt society. In addition, Swiss automobile manufacturers such as Bucher Schörling and Proton Motors have been heavily involved with R&D activities related to the mobility component of the pilot region. Their role has been that of technical advisory, funding and subsequent absorption of new knowledge and technologies.

Lastly, *national government* (Swiss Federal Office of Energy) participates in the pilot region as a stakeholder rather than a core partner, with the major role being the uptaking of local experiences for informing the national energy strategy.

6.1.2.5 Level 5: Motivating factors

Concerning the reasons behind the formation of the Basel Pilot Region, the main initiator Roland Stulz has indicated the following responses:

Table 6.9 Level-five results

Motivational factors (who?)	Relevance level
Missional	▬ ▬
Funding	▬
Scientific/scholarly	▬
Social contribution/community relations	▬
Developmental/strategic	▬ ▬
Entrepreneurial	▬ ▬

Table 6.9 above shows that the emergence of the pilot region can be explained by a variety of factors. The *missional* type of motivation has been given a high relevancy score, indicating that the Novatlantis platform was established for the exclusive purpose of forming multi-actor partnerships and implementing localised solutions for various sustainability issues. The emergence of the 2000 Watt Society Pilot Region programme was therefore a natural consequence of Novatlantis attempting to fulfil this mission and create a ‘product’ and identity for the newly established platform (Stulz, 2012a). As for the *developmental/strategic* motivation, this is reflecting a motivation at the roots of the pilot region to influence developmental trajectories of not only Basel, but also Switzerland. It can also be seen that at the origins of the initiative was the hope that some of the projects would have commercial utility for the partners involved, hence a high relevancy score for the *entrepreneurial* type of motivation. On the other hand, it can be seen that although projects conducted in the pilot region would also be required to hold research value for the scientists from ETH, for Stulz the industry practitioner who initiated the programme, the individual focus was more so on implementation rather than on scientific research. This is reflected by a medium relevancy level assigned to the *scientific/scholarly* motivation. In the first few years during the establishment of the pilot region, such contrasting orientations and motivations (i.e. research verses implementation) constituted a key area of tension for the various scientific, industry and government actors brought together (such tensions are discussed in Section 6.1.4.2).

6.1.2.6 Level 6: Societal engagement modes

The final level in the analytical framework concerns the societal engagement modes by which the Basel Pilot Region attempts to achieve partnership objectives. Responses obtained are listed in Table 6.10. It should be pointed out that due to the sheer volume of activities taking place in the framework of the pilot region, the following analysis is by not intended as exhaustive. Rather it seeks to summarise some of the more prominent and relevant initiatives for each mode of engagement.

Table 6.10 Level-six results

Societal engagement modes (how?)	**Relevance level**
Knowledge management	■ ■
Governance and planning	■ ■
Technical demonstrations and experiments	■ ■
Technology transfer or economic development	■
Reform of built or natural environment	■ ■
Socio-technical experiments	

- *Knowledge management*
  The end-users of knowledge produced in the context of implementation efforts for the 2000-watt society are decision makers in government, industry and scientific organisations (Jochem, 2004). To transfer key knowledge to these users, both written reports and forums are used as key communication vehicles. Regarding reports first of all, in addition to the initial feasibility study (Jochem et al., 2002) and subsequent white paper (Jochem, 2004) pitched at both a national and international audience, other more technical reports have also been produced in the context of the Basel Pilot Region. A recent example is a report *Energy Optimisation in the City of Basel* (Berger et al., 2011) produced by a large team of industry, government and university actors from both ETH and FHNW. This report deals with the suitability of individual locations in the Basel City for renewable energy production such as solar, wind and biomass. It is targeted chiefly at decision makers and technicians in both Basel administration and local industry (Binz, 2013). Another example of an attempt to transfer the results of the pilot region experiences to relevant stakeholders is a series of reports that have emerged from the mobility component. Authored by a team of ETH domain scientists and industry experts, some of these publications[53] deal with acceptance levels regarding LNG, biogas and electrical vehicles. Chiefly targeted at government and industry decision makers and fleet managers, they draw heavily upon data obtained from focus groups, survey-based acceptance studies and the results from the pilot region mobility experiments themselves.

  In parallel to efforts to disperse this ‘codified’ knowledge, Novatlantis and FHNW have also worked to transfer lessons from the pilot regions via annual forums which, initially concentrating upon building projects, have now expanded to encompass the mobility component. Targeted at diverse stakeholders such as building and car-fleet owners, private investors, real estate developers and government officials, annual forums are currently organised in Basel, Geneva and Zurich.

- *Governance and planning*
  Another area of activity in the Basel Pilot Region programme pertains to *governance and planning,* which is signified by a high relevance score. This engagement mode is closely overlapped with *knowledge management* activities described above and is mostly carried

[53] See for example: Kasemir, B. et al., 2004. Gas im tank: Duft in der luft? Novatlantis, Zurich; Lienin, S. et al., 2007. Repräsentative Marktumfrage zu Erdgas- und Biogasfahrzeugen, Novatlantis, Zurich.

out in connection to buildings and construction in the aim of changing industry practice through the reform of building industry governance frameworks. To accomplish this, two courses of action have taken place. Firstly on a city-level, Basel Pilot Region actors have worked with several departments of the City of Basel (especially from the Department of Building, the Department of Economy, Society and Environment and the Office of Energy and the Environment) to reform building codes regarding energy efficiency and sustainability requirements for new construction and urban development (elaborated in Section 6.1.3). On a national level, Novatlantis actors have sought to use building industry governance frameworks such as guidelines from the Swiss Society of Engineers and Architects (SIA) to foster building practices principles incorporating principles of the 2000-watt society.

- *Technical demonstrations and experiments*
  As shown by a high relevancy level, *technical demonstrations and experiments* represent a core part of activities in the Basel Pilot Region. Over the past decade the core of these has been focused in the field of personal mobility (Experimental Space Mobility programme)—a platform intended to demonstration low-carbon car fleet solutions for individual passenger transport. Scientific goals of these demonstrations are to evaluate not only technical aspects such as performance, emissions and wear and tear, but also social dimensions such as public acceptance, affordability, legal requirements and economic and commercialisation aspects. The wider societal objective of this mobility component is to inspire replication of low-carbon fleet technologies from other government and industry decision makers. Demonstrations involve three sets of technologies. This triple focus emerged from initial consultation workshops with stakeholder groups from the ETH domain, industry and government in Basel revealing that projects in mobility must not be focused solely on long-term fuel solutions such as hydrogen and electricity, but also on bridging solutions such as natural gas (Lienin et al., 2005). Based upon these societal needs, car fleet demonstrations involve a short term (natural gas), mid-term (biogas and EVs) and long term (hydrogen fuel cells) focus. The logic behind this is that in the long-term, hydrogen-powered vehicles will most likely be the choice for sustainable transport. However as a bridge to this still non-mainstream technology, it is believed that natural gas and biogas offer immediate potential to significantly reduce GHG emissions (Lienin et al., 2004).

- *Technology transfer & economic development*
  As may be confirmed from a medium relevancy score for this variable, revenue generation through identification and commercialisation of IP is not a major focus of the Basel Pilot Region, as is economic development. Instead, this platform for scientific and industrial innovation should be understood as an open-ended collaboration model committed to free flow of data and results to all interested stakeholders. This stance regarding the assertion of IPRs appears to be influenced by two factors. The first is the sentiment that the ETH domain is a publically financed institution and that its responsibility is to ensure the greatest societal impacts of technical innovation as possible (Bach, 2013). The second is that some of the mobility related R&D projects in the pilot region are funded by industry, with expectations that research results are passed freely back to stakeholder companies. In this way, technology transfer to industry

is an inevitable ‘by-product’ of cross-sector cooperation and this will be outlined in Section 6.1.3.

- *Reform of built or natural environment*
  A prerequisite for the realisation of a 2000 watt per capita society is a highly energy efficient or even passive building stock (Jochem, 2004). Therefore, in tandem with the scientific mobility experiments just described above, another focus of the pilot region programme is on the ‘less scientific’ task of fostering sustainable building innovation and decarbonising the building and urban development cycle in Basel. This has been pursued in two ways. Firstly, the fostering of sustainable urban development through architectural competitions and secondly the fostering of architectural and building-energy innovation through government subsidies and incentives. The key actors involved in these areas have been Novatlantis and faculty from the FHNW, the local university of applied sciences in Basel.

  Concerning the first strategy, Novatlantis and FHNW have worked with the City to integrate sustainable urban development and building practices into industry behaviour through architectural competitions. For example, land owned by the City has been identified for development and then pitched to the private sector, who through competition guidelines, is requested to integrate sustainable building practices. With Novatlantis and FHNW actors also on the judging panel, tenders are subsequently awarded to the development proposal best confirming to the demands of a 2000-watt society. Specifically, criteria used to shape sustainable urban planning and construction include: i) high material and energy efficiency ii) use of renewable energy iii) ecologically responsible facilities and building operation and iv) promotion measures for new forms of lifestyle and entrepreneurship (Fischer, 2009) in addition to v) responsible water management and vi) integration of sustainable mobility options (Novatlantis, 2004).

  The final method consists of a demonstration building programme (*P+D programme*). City subsidies are used to entice private owners, architects and developers to utilise already initiated, individual building projects as flagship pilot or demonstration projects for the 2000-watt society Pilot Region. This programme has a dual focus on both new construction and renovation projects. Faculty at FHNW firstly seek to identify suitable projects by screening building permit applications submitted to the City, in particular those already indicating a commitment to sustainability. Architects and owners are then contacted and offered a financial incentive for raising the sustainability performance of the building to that of a previously unattained level. Specific requirements consist of at least a Minergie®-P standard (or even zero-energy), together with a minimal use of materials and a future orientated design with innovative features. It should be noted that the City subsidiaries do not always suffice to cover all additional costs incurred (Martin, 2013). Nevertheless, owners and developers in the city are financially enticed to integrate higher levels of sustainability into projects, in the hope that they will serve as models for replication and drivers of sustainable building innovation (Geissler, 2013a).

6.1.3 Part 3: Impacts of societal engagement modes

The second part of the case analysis seeks to answer the following research question. This will be done through the theoretical lens of the societal engagement modes of co-creation just outlined above.

> 3.4 *What sort of outcomes and progress towards urban sustainability transformations have been attained and how were these achieved?*

It should be noted again that the activities and impacts dealt with below are far from exhaustive. The aim is more so to demonstrate key results to have emerged through activities corresponding to the numerous societal engagement modes exploited.

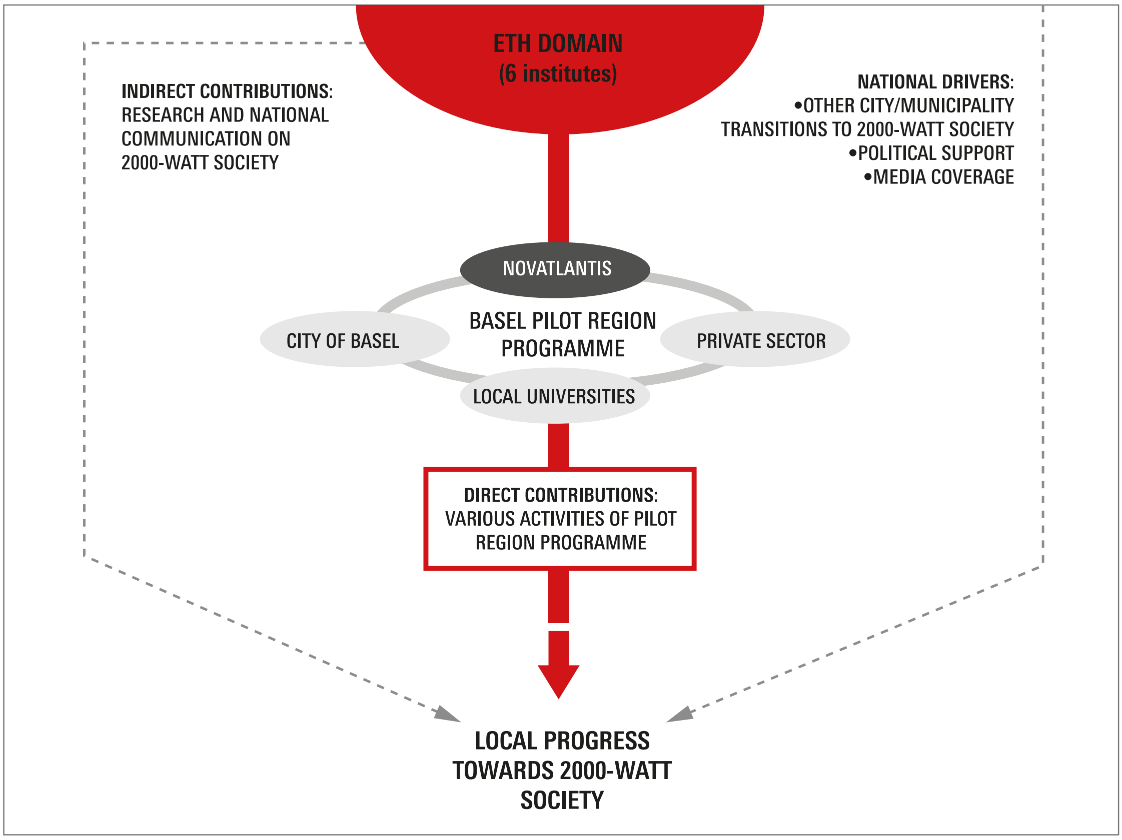

Figure 6.3 Positive externalities influencing local impacts of the pilot region

Before proceeding however, a 'disclaimer' merits prior attention. That is, the greatest difficulty in identifying impacts upon urban sustainability in the pilot region concern the difficulty in establishing cause-and-effect linkages. There are principally two reasons for this. The first, and the most significant, concerns the array of macro-level external factors influencing government and private sector behaviour, particularly in building and urban development projects in the City of Basel. These 'positive externalities' are depicted above in Figure 6.3. As may be seen from the top half of the figure, since the late 1990's much communication and research results on the 2000-watt society (such as journal articles, reports, conferences and media appearances) are flowing out of the ETH domain and into Swiss society independent of Novatlantis and the pilot region. This has had a substantial effect on boosting awareness of the 2000-watt society vision in the public, private and government sector. On top of this, other externalities from the national-level are affecting local pilot region activities in Basel. These include the uptake of 2000-watt society knowledge by other cities and cantons across Switzerland as well as national political support and media coverage. The sustainability impacts achieved by projects in the Basel Pilot Region programme therefore need to be viewed from the perspective of this greater nation-wide transition. The second reason why it is difficult to attribute sustainably results of the pilot region programme towards university actors in particular, is that Novatlantis, ETH and FHNW actors have at times, merely created the conditions and sought to *foster* sustainability innovation, leaving actual *implementation* to the private and government sector. This is particularly the case for the building and urban development components of the programme.

6.1.3.1 Knowledge management

Key achievements pertaining to *knowledge management* are summarised in Table 6.11. As listed, a core result attained by this mode of societal engagement has been the successful translation of a scientific and universal concept to a city-level (Puntener, 2013). It has already been discussed in the background of this chapter that the notion of a 2000-watt (and 1-tonne CO2) society began as a scientific vision, dating back to the early 1990's in the ETH domain (see Imboden et al., 1992; Kesselring and Winter, 1994). However what this global vision lacked was a local dimension. Creating and implementing this has therefore been one of the core achievements of the Basel Pilot Region.

The decade-long process of knowledge management initially begun with a series of stakeholder workshops where scientific knowledge pertaining to the concept of a 2000-watt society and energy efficiency was translated to government and industry stakeholders by Novatlantis and ETH actors. These activities focused upon identifying possible applications of this concept in real-world industry and government projects (Binz, 2013). This initial application has generated a knowledge base and critical mass of experiences in building, urban development and mobility that has been shared through annual forums in building and mobility, in addition to various publications. The end result of these interlinked and ongoing activities has been a significant uptake of energy efficient building practices and a mainstreaming of the 2000-watt methodology in industry and government, not just in Basel, but all across Switzerland (Stulz, 2012). As seen in Table 6.11, actors from ETH and FHNW have played a key role in this process by producing and contributing to technical reports as well as communicating and translating scientific knowledge to stakeholders at workshops and public forums. Novatlantis actors have also played a key role in the knowledge diffusion process by integrating principles of the 2000-watt methodology into national construction guidelines for the Swiss Society of Engineers and Architects (SIA, 2010) (elaborated below).

6.1.3.2 Governance and planning

Key achievements pertaining to *governance and planning* are firstly the significant decarbonisation of building sector behaviour through reform of governance frameworks, and secondly the institutionalisation of the 2000-watt target and pilot region activities into City policy.

To begin with results of reforming the governance of building industry behaviour, a major outcome on the local level has been the strengthening of local building codes in alignment with energy efficiency targets of the 2000-watt society. As a result of City legislation being adjusted to facilitate progress towards the 2000-watt target, all new private buildings in Basel are now required to satisfy energy performance corresponding to the Minergie® rating. This international label demands extremely low levels of energy consumption and heat loss by integrating high-performance insulation, double or triple-glazed windows, natural mechanisms to warm outside air used for heating, airtight building shells and highly energy efficient lighting and electrical appliances (City of Basel, Minergie). This roughly equates to buildings that are around 5 times more energy efficient than traditional constructions, requiring no more than 3 litres/m^2 of fuel for space heating annually (Mitchell, 2012). On top of this obligation, all new public buildings in Basel must now confirm to Minergie®-P standards (annual fuel consumption of 1 litre/m2 for space heating), which roughly equates to the German standard of a 'passive house' (City of Basel, Erlanmatt). This even stricter international rating of Minergie®-P has been heavily shaped from the Basel Pilot Region experiences (Binz, 2013; City of Basel, Minergie) and now serves as a significant tool for mainstreaming and standardising 2000-watt society compliant buildings in Basel and across Switzerland. Meeting this rating also demands the use of top end energy efficiency classification (A, A+, A++ etc.) for electrical appliances, as well as onsite energy production in order to satisfy the almost zero-emission standards. Consequently, introduction of the Minergie®-P rating into building code obligations for new public buildings (and many developments on public land) has had the effect of spurring innovation in onsite energy production with photovoltaics and geothermal (Geissler, 2013a).

On a national level, scientific-based theoretical knowledge on a 2000-watt society, in tandem with practical experiences from the pilot region, have also been integrated to building industry governance frameworks from the Swiss Society of Engineers and Architects (SIA). This has included both the integration of 2000-watt principles into construction and engineering guidelines—i.e. the *Energy Efficiency Roadmap* (SIA, 2010)—and the creation of a planning tool (SIA 2040 Energy Efficiency Path) for measuring energy efficiency off the plans. Regarding the latter, this tool serves to predict energy efficiency for residential buildings, offices and schools and takes into account construction, operation and associated transport usage. This governance tools also includes an Excel-tool for preliminary planning phases and has been greatly used in the Basel Pilot Region to drive sustainable building innovation. Concretely, integration of scientific ETH knowledge on the 2000-watt society into SIA frameworks was achieved largely by the industry practitioner at the head of Novatlantis (2000-2010), who also served as President of the SIA building commission. Once again, a major outcome of these governance framework reforms has been their bridging and translation capacity to directly apply and mainstream 2000-watt scientific knowledge to real-world building industry projects.

In addition to the above-described efforts to influence industry behaviour and governance, another major achievement of this engagement mode is the securing of long-term political support and adoption of the 2000-watt vision as a guiding principle for long-term sustainability planning. This has taken place by the government of Basel integrating the 2000-watt and 1-tonne CO2 target into the City 2009-2013 legislative plan (Government of the Canton of Basel-Stadt, 2010). Within this document, the City has also signalled its commitment to the activities and priority areas of the pilot region by stating its ambition to set an example in low-emission buildings (both new construction and renovation) and mobility. In addition, the City of Basel has also formally stated its resolve to continue progress towards realisation a 2000-watt and 1-tonne CO2 per capita society in key documents such as the already mentioned energy optimisation study for the City of Basel (Berger et al., 2011). Although attainment of this target still requires at least another half-century of energy efficiency improvements, additional long-term government strategies are currently being drawn up to increase electric vehicle adoption and further renewable energy creation in the City (Berger et al., 2011).

6.1.3.3 Technical demonstrations and experiments

Results ensuing execution of this societal engagement mode will be interpreted from the field of mobility. Since its inception in 2002, the Experimental Space Mobility programme has implemented five long-term demonstration and pilot projects with varying stakeholders; notably IWF, the City of Basel and various fleet operators such as taxi companies (City of Basel and Novatlantis, 2013). As also mentioned above, these various projects have been designed to demonstrate sustainable transport solutions for the short term (natural gas), mid-term (biogas) and long term (hydrogen fuel cells), but also encompass an electric vehicle element. It should be noted that the five projects summarised in Table 6.11 are more than just simple technical field tests. They are instead a series of interconnected demonstrations showcasing exportable, low-carbon car fleet and socio-technical systems in the aim of facilitating replication by other stakeholders across Basel and Switzerland.

Of these five individual projects, the hy.muve hydrogen fuel cell driven sweet sweeper is the landmark achievement. This is due to its pioneering nature[54] and relevance to the vision of a 2000-watt society, which has specified hydrogen fuel-cell technology as a means of drastically lowering CO2 emissions in the transport sector (Jochem, 2004). This long-term testing framework has since enabled long-term field-testing of both technical and social dimensions. This took place in Basel over six months in 2009 (City of Basel, Hy.muve). Regarding the former, the introduction of the hy.muve vehicle in to the sweet sweeper fleet of the City of Basel allowed insight into fuel and cost efficiency, and technical performance regarding aging and durability of the fuel cell system (Schlienger et al., 2010). As a major finding, it was learnt that the hy.muve vehicle can potentially result in 50% less energy consumption (tank-to-wheel) when compared to the conventional diesel-powered type (City of Basel, Hy.muve). CO2 reductions are dependant on the technology used to produce the hydrogen. However, even in the case of natural gas-sourced hydrogen, the hy.muve vehicle has demonstrate that CO2 emissions can be reduced by 30% (well to wheel) in comparison to conventional diesel combustion (EMPA, hy.muve). On top of this, the hydrogen testing and demonstration platform has also generated scientific knowledge pertaining to more social dimensions. This has ensued the successful demonstration of hydrogen technology as part of complete social system—comprising of drivers, fleet owners and a fuelling station, in addition to a reform of City legal frameworks to permit the public operation of hydrogen technology (Bach, 2013)[55].

As for demonstration projects dealing with LNG and biogas, since 2006 approximately 19 taxi companies have been each equipped with several LNG and biogas powered vehicles in a programme originally aiming to place ‘100 environmentally friendly taxis’ on the streets of greater Basel. ETH researchers and consulting company Sustainserv conducted passenger acceptance studies, which revealed high levels of customer and operator satisfaction (Lienin et al., 2007). Despite funding from the City of Basel and Federal Office of Energy, the target of 100 taxis was

[54] According to the City of Basel (City of Basel, hy.muve), this was the first public hydrogen-driven vehicle to be tested in the world, in this way.

[55] According to Bach (2013), City legal regulations had to be reformed in order to allow the long-term operation of a hydrogen powered vehicle, together with supporting infrastructure such as fuelling stations.

not reached, although the ‘environmentally friendly’ marked taxis continue to operate today (Martin, 2013). Other experiments with mid-term solutions have involved a fleet of several EV’s that are currently being trialled in the City’s own car fleet as well as in a regional car sharing programme (City of Basel and Novatlantis, 2013). Lessons from these projects have been compiled into a brochure and online decision making tools for commercial fleet managers and also diffused to industry and government stakeholders through annual mobility forums across Switzerland.

As shown also in Table 6.11, actors from the scientific areas of the ETH domain such as EMPA and PSI have played a very central role in technical demonstrations and experiments connected to mobility. This has included R&D, overall scientific direction of implementation projects and the subsequent monitoring, data collection, analysis and reporting of results.

6.1.3.4 Technology transfer or economic development

It was mentioned earlier that the conventional technology transfer model, which seeks to generate revenue through the commercialisation of scientific research, does not reflect well the nature of activities in the Basel Pilot Region. That said, there are efforts to ensure that the fruits of collaborative innovation projects are transferred to industry stakeholders, and then potentially used as a means of spurring economic development.

One mass of efforts concerns the above described hy.muve vehicle. Technology such as fuel-cells and the hydrogen-driven powertrain was firstly developed at Swiss Federal Laboratories for Materials Science and Technology (EMPA) and Paul Scherrer Institute (PSI) in conjunction with Swiss automobile manufacturers Bucher Schörling, Proton Motor and other industrial partners. After the above described R&D and field-testing programme with the municipality in Basel, research activities are now moving towards commercialisation and diffusion. The project has thus evolved to a research platform for socio-economic studies investigating the acceptance of hydrogen technology and its market potential and cost-effectiveness. These results will be used to develop a marketing strategy for hydrogen-driven vehicles in Switzerland and will be shared with a wide audience of automobile manufacturers and industrial stakeholders through forums (Bach, 2013; EMPA, hy.muve). The aim of this will be contribute to the formation of a potential hydrogen vehicle related industry in Switzerland. In addition, production of a second ‘hy.muve 2’ is underway. In this extension of the first project, technology tested in the first hy.muve project is in the process of being further developed by the Swiss company Bucher Schörling. A series of new vehicles will thus be manufactured, this time to test a mixture of both natural gas and natural gas derived hydrogen (Bach, 2013).

6.1.3.5 Reform of built or natural environment

Section 6.1.3.2 has described impacts ensuring a combination of *governance and planning* measures to decarbonise the building cycle in Basel through the reform of building industry governance frameworks with tools such as Minergie®, Minergie®-P and guidelines from the Swiss Society of Engineers and Architects. In addition to this, another major outcome has been the fostering of innovation in low-carbon and ecological construction techniques in both single buildings and large-scale urban development. This has been carried out in two ways: 1) through the above-described P+D programme and 2) though architectural competitions and the awarding of urban development rights to tenders best respecting the demands of a 2000-watt society.

In total, five large-scale urban development projects in the Basel area have been led to incorporate sustainability—and especially 2000-watt society principles—into planning and construction. An early achievement for the pilot region was the 2006 redevelopment of Gundeldinger Feld in central Basel. Here, a disused engineering factory was refurbished into a private residential area for 65 tenancy agreements in 16 buildings. Sustainability measures such as water saving fittings, 370m^2 of onsite photovoltaics, conversion of area into a car-free site and ecological building materials have since allowed the now finished project to serve as an initial beacon of progress toward a 2000-watt society. Since then, pilot region efforts to foster sustainable urban development have turned to new and larger scale projects. A current landmark initiative taking place is Erlanmatt, a 19-hectare redevelopment of a former freight yard of Deutsche Railway, where construction began in 2013. The site will serve as a mixed-use district containing commercial and residential buildings (570 dwellings on four sites), shopping facilities, restaurants, schools and parklands. The winning architects of the public tender for the site have been led to abide by strict and legally binding sustainability criteria in the planning and construction process. These 2000-watt society guidelines have specifically required energy efficient heating systems and building interiors. For example, a minimum of 10% of floor space in the development had to conform to Minergie®-P-Eco standards (Cornaro et al., 2007), with the remainder of the buildings satisfying Minergie® requirements. Features of the site include firstly district heating and hot water, in addition to provision of 100% renewable heating from local utility IWB, which will be boosted with on-site solar production. EV charging infrastructures for cars and e-bicycles have also been integrated into the plans that have qualified the site for a '2000-Watt Site' label—only the second in Switzerland—from the Energistadt Label Commission (2000-Watt Gesselschaft, 2013). Novatlantis, ETH and FHNW actors contributed to these two projects through an array of roles. These included serving on the jury for the architectural tenders, consulting with architects and engineers and transferring the 2000-watt society methodology (such as the above-described SIA Efficiency Path) to the City of Basel to enable measuring of energy performance during initial planning stages.

Regarding efforts to foster 2000-watt society compliant innovation in individual buildings, the earlier-described P+D programme has succeeded in realising to date approximately 30 demonstration/pilot buildings across the City of Basel (Novatlantis and City of Basel, 2013). To give but one example, the IWB Customer Centre was a construction project for the local Basel energy utility, who is also a major stakeholder in the Pilot Region and a provider of car fleets to the mobility programme. The downtown customer centre was completed in 2008, with a pioneering achievement of being the first Minergie®-P compliant commercial building in Basel. Heating demand was reduced to 14.9 kWh/m2/year through features such as an airtight building shell, triple and even quadruple window glazing, heat recovery and a gas-fired heat pump (City of Basel and Novatlantis, 2013; City of Basel, IWB Customer Centre). Candidates for such demonstration buildings were identified by FHNW faculty, who scanned building permit applications for suitable opportunities to persuade architects to adopt more ambitious building innovation. Funds were provided to offset some of the additional costs for the developer from the City of Basel. The value of these publically subsidised private sector projects is that they serve as functioning and living 2000-watt society branded projects to foster learning and imitation across industry and deepen public awareness of cross-sector efforts to achieve the 2000-watt vision (Geissler, 2013a).

Not just limited to energy efficiency, the sustainable transformation of the building and urban development sector in the above-described manner has also fostered uptake of other key areas of the 2000-watt society. These include on-site renewable energy production, sustainable material and resource use, responsible building usage and the fostering of sustainable entrepreneurship (Fischer, 2009). The significance of these qualities, in addition to gains made in building energy efficiency, is that much of this infrastructure will be standing and consuming energy in several decades time (Jochem, 2004).

6.1.3.6 Collective impact of co-creative engagement modes

The analysis to this point has identified a series of outcomes towards greater urban sustainability through the lens of various societal engagement modes characterising the co-creative model of stakeholder collaboration. What is more important than this slightly reductionist appraisal, however, is the *sum* of these outcomes and the collective impact of the various activities unfolding through the pilot region framework. These are listed also in Table 6.11.

As can be seen, a key overall outcome of the 2000 Watt Society Basel Pilot Region is the harnessing and synergising of scientific research activities, government policy and industry projects into an action-focused innovation and governance framework. Before the emergence of the pilot region, the sustainability related activities of the various societal players were taking place independent of each other, with the collective impact of this potential nexus of innovation unexploited. Yet the formation of the pilot region programme has provided the opportunity for these differing sectors to come together, identify areas of common interest and mutually design and execute projects with a greater societal impact than could have occurred separately. As a result, for more than a decade the City of Basel has functioned as a successful model of an urban laboratory allowing experimentation between emerging technologies and living, social systems.

Importantly, the pilot region has created mutual value for all parties. It has enabled university actors to learn from real world situations and gain valuable knowledge from the field that could never be obtained in a laboratory (Bach, 2013). It has also permitted university actors to align research activities with the needs of industry and government, thereby increasing the societal value of research (Geissler, 2013b). For the City of Basel, value was created by gaining access to scientific expertise from ETH and FHNW and using this as a knowledge base to shape public policy and strategies to accelerate progress towards existing sustainability commitments, which by influence, have also served to inform policy of other cities and cantons around Switzerland. For industry players such as construction and building stakeholders, they have benefited from the branding of a ‘2000-watt society’, subsidies from the City of Basel to offset extra costs incurred when building for higher energy efficiency, and access to scientific expertise from FHNW and ETH. It appears that the mutual value created in this manner has been a vital factor in maintaining commitments and the synergistic alignment of activities from each sector. Further, the target of a 2000-watt and 1-tonne CO_2 society has provided these three societal sectors with a common vision, language and above all, a measurable and science-based criteria for sustainability.

Table 6.11 Summary of key impacts in 2000 Watt Society Basel Pilot Region

Engagement mode	University/Novatlantis role	Key achievements
Knowledge management	• Contribution to and production of technical papers and reports • Public communication and translation of scientific knowledge	• Translation of global and national-level scientific concept (i.e. 2000-watt society) to city-level, with concrete implementation projects. • Significant contribution to political and public mainstreaming and acceptance of vision of 2000-watt society. • Sharing of experiences and fostering of replication from wider national audience and decision-makers in government and industry.
Governance and planning	• Core leadership and recruiting of stakeholders • Collaborative policy planning • Contribution towards Minergie®-P label • Translation of scientific knowledge into industry guidelines	• Successful transformation of building industry behaviour through reform of industry governance frameworks. • 2000-watt methodology integrated into national guidelines and planning tools for Swiss Society of Engineers and Architects (SIA). • Successful institutionalisation of 2000-watt based criteria into City building codes (Minergie® mandatory for new private buildings and Minergie®-P for public). • Securing of mid-term political commitment: integration of 2000-watt goal and pilot region focus on sustainable building and mobility into 2009-2013 legislative plan. • Securing of long-term political commitment: attainment of 2000-watt objective by around 2075.
Technical demonstrations and experiments	• R&D • Scientific direction • Monitoring, data collection and analysis • Publications and communication of results	• Five long-term private and government fleet demonstrations implemented. Practical and scientific understanding generated on interaction of new technologies with human systems: 1) LNG and biogas 'Environmentally Friendly Taxis', 2002-2011 2) Clean Engine Vehicle, 2004-2007 (LNG and low emissions) 3) Near Zero Emission Vehicle Clean Engine Vehicle, 2004-2007 (featuring ceramic foam gas catalyst) 4) 'Hy.muve' hydrogen fuel-cell street sweeper, 2009-2012 5) 'E-mobility Basel' project, 2010-2013. (EV private fleets and car sharing).
Technology transfer or economic development	• Communication of results through industry forums and collaborative R&D.	• Hy.muve technology transferred to industry sponsor for serial production of next prototype—without patenting on ETH side. • Evolution of hy.muve project to a socio-economic investigation platform to contribute to development of hydrogen technology market.
Reform of built or natural environment	• Identification of suitable pilot projects • Technical consulting and advisory • Judging of architectural competitions	• Engagement of major players in building and urban construction sector—a major source of GHG emissions across Europe. • Realisation of approximately 30 demonstration/pilot buildings and five large-scale urban development projects as functioning '2000-watt society' branded projects.
Overall	• Instigator of pilot region and overall leader and scientific advisor • Creator and translator of 2000-watt vision	• Binding of scientific research activities, government policy and industry projects into action-focused innovation framework for sustainability. • Creation of successful 'urban laboratory' model, continuing for over a decade. • Instilment of a common vision, language and criteria to differing actors working towards urban sustainability.

6.1.4 Part 4: Drivers and barriers

The fourth section aims to discuss key drivers, in addition to barriers encountered and steps taken to overcome these. It will thus address the following specific research questions:

3.5 *What range of factors has contributed to successful development of the partnership and implementation of various projects?*
3.6 *What obstacles have been met and what measures were taken to overcome these?*

6.1.4.1 Drivers

To begin with the various factors propelling the development of the pilot region and success of projects implemented, the most notable driver concerns the steadfast commitment to pursuing sustainable development from the City of Basel and its citizens. As pointed out by Lienin et al. (2005), this receptiveness to environmental issues and energy saving measures in fact precedes the establishment of the pilot region and can be traced back to the "Schweizerhalle" industrial accident, which severely contaminated the river Rhine in 1986. Since then, it is argued, both civic and administrative sectors of the City have demonstrated a remarkably high level of environmental awareness. This is reflected in pioneering energy policies date backing to the 1984 Energy Conservation Act (EnergieSpar Gesetz) and the 1998 Energy Act[56]. This pre-existing commitment to pursuing sustainability through aggressive City policies has recently culminated into the integration of the 2000-watt vision into the 2009-2013 legislative plan of Basel[57], which is itself a reflection of public opinion. As a result, the City is now legally bound to the continued scaling up of renewable energy and energy efficiency projects, sustainable transport, buildings and urban development (City of Basel, 2000 Watt Society).

Another decisive driving force behind the pilot region programme concerns the mainstreaming of the 2000-watt vision in Switzerland and its infiltration into national energy policy and development trajectories. As described in the introduction of this chapter, the concept of a 2000-watt per capita world is the product of highly influential scientific circles in ETH Zurich. Since its inception, it has been enthusiastically promoted to the media by proponents such as Professor Dieter Imboden (Spreng, 2013) where it has triggered intense scientific and political debate across the nation. Needless to say that the pro-2000-watt forces have effectively won against critics in many highly influential arenas in Swiss society. For example, as early as 2002 the Swiss Federal Council[58] promoted the 2000-watt vision in a strategy paper on sustainable development. It declared: "The scenario of a «2000-watt society» serves as a conception guiding energy and climate protection policy" (Swiss Federal Council, 2002, p. 24). Federal Councillor Moritz Leuenberger later described it as "a goal toward which the Federal Council will be working over the next couple of decades." (quoted in Morrow and Morrow, 2008, p. 32). This top-level support has also been translated into various scenarios, programmes and proposals to Parliament by the Federal Office of Energy, who in principle, targets all endeavours to the 2000-watt goal (Spreng,

[56] To give a summary of this latter, the Act consists of four pillars: legal provisions such as the building codes described earlier and the requirement that the local electricity provider IWB purchase a share of renewable energy; a promotional tax since 1984 added to local energy bills, resulting in an annual revenue of around 10 million CHF that is directed to subsidies for energy saving renovation and renewable energy projects; an incentive tax as a second surcharge on energy bills to offset the decreasing energy prices during the mid 1990's and encourage energy conservation; and finally, a solar power exchange where the provider IWB is required to purchase annually an additional 2000 kWp from locally solar-generated electricity (Basel).

[57] See URL: http://www.regierungsrat.bs.ch/legislaturplan-2009-2013.pdf

[58] The Swiss Federal Council is a seven-member executive council forming the federal government and serving as the collective head of state.

2013). Coupled with countless papers and reports that have emerged from differing branches of the ETH domain over the last decade or more, this combination of political and scientific support for the 2000-watt per capita society has resulted in a significant mainstreaming of this vision in Switzerland. As a consequence, '2000-watts' has since become a highly visible component of the Swiss vocabulary. The propagation of this concept has in effect created a 'decarbonisation race' as numerous villages and towns across Switzerland—also including Zurich and Geneva—are now literally competing with each on the path towards the materialisation of a 2000-watt society (Stulz, 2012a).

Finally, another significant driver consists of the 'dual accountancy' of the Novatlantis platform towards ETH actors on one side and project partners and key stakeholders on the other. This objective of maintaining a 'power balance' has been designed into the very structure of the programme. As argued by Lienin et al. (2004), this has over the years been essential to the success of the pilot region programme by ensuring that projects in the pilot region serve the interests of all parties. That is, the dual obligation of Novatlantis has meant that pilot projects be designed with needs for scientific credibility and research value from ETH, yet with relevancy, legitimacy and implementation value for the external partners. This set of dual responsibilities has also been described as 'push' and 'pull' forces (CCEM, 2011) which lead to the initial co-design of projects during a series of workshops held at the turn of the millennium between actors from ETH, the City administration and industry (Stulz, 2012a). For the first ten years the ETH domain ensured that projects were scientifically credible by screening all applications before granting seed funds. Then, as the three fields of mobility, buildings and urban development subsequently formed their own steering committees, co-financers such as the City of Basel and industry were then able to ensure that individual projects served their practical needs and areas of interest. Finally, the mobility component in particular has strived to incorporate public opinion into the overall design of the programme in order to ensure that it remained legitimate from the perspective of citizens. This was attained by focus group sessions aimed at gauging civic sector attitudes towards LNG (short-term), biogas (mid-term) and hydrogen (long-term) solutions for individual transport (Lienin et al., 2004). These workshops resulted in the understanding that the elements of biogas and hydrogen, which were perceived as having large environmental benefits, were essential if the mobility projects were to be seen as legitimate from the citizen perspective. This was even though the planning of hydrogen projects were not so enthusiastically received by industry or the City of Basel due to the overwhelmingly long-term focus.

6.1.4.2 Barriers

Regarding major barriers encountered and steps taken to overcome these, the start-up phase for both the Novatlantis platform and the pilot region was reported as the most challenging. The below discussion will therefore focus upon this initial formation period stretching of the first few years of the new millennium.

At the origins of Novatlantis, many challenges were encountered that were largely institutional in nature, with resistance to an orientation towards implementation initially encountered from certain scientific and administrative sectors of the ETH domain (Stulz, 2012a). Reflections on this same period from Lienin et al. (2004) shed further light on this. As explained, the issue of 'credibility' was a major issue at the outset as differing cultures of basic and applied sciences struggled to reach a consensus within the ETH domain regarding the overall focus of the pilot region programme. The strong inclination towards implementation from the industry practitioner-led pilot region programme was not seen as ‘scientific’ by some internal critics (Stulz, 2012a). Coupled with academic incentive systems prioritising traditional research outputs such as publications and conferences presentations, the undervaluing of implementation projects with external stakeholders created difficulties in winning internal interest and participation from faculty in the ETH domain. Institutional resistance and demands for scientific credibility was to some extent overcome by obliging researchers and project managers working with Novatlantis to publish project results in peer-reviewed, academic journals. As a further step, it was also deemed that any project set up under the pilot region must be first of all approved by the Novatlantis steering committee consisting of ETH faculty, scientists administrators and Novatlantis managers before the granting of any seed money. This was seen as an essential step in ensuring the scientific quality and credibility of implementation projects in the Basel pilot region. These ‘safety measures’ subsequently permitted the ETH domain to be able to confidently communicate to Swiss society its involvement in an applied programme as one of its core activities (Lienin et al., 2004).

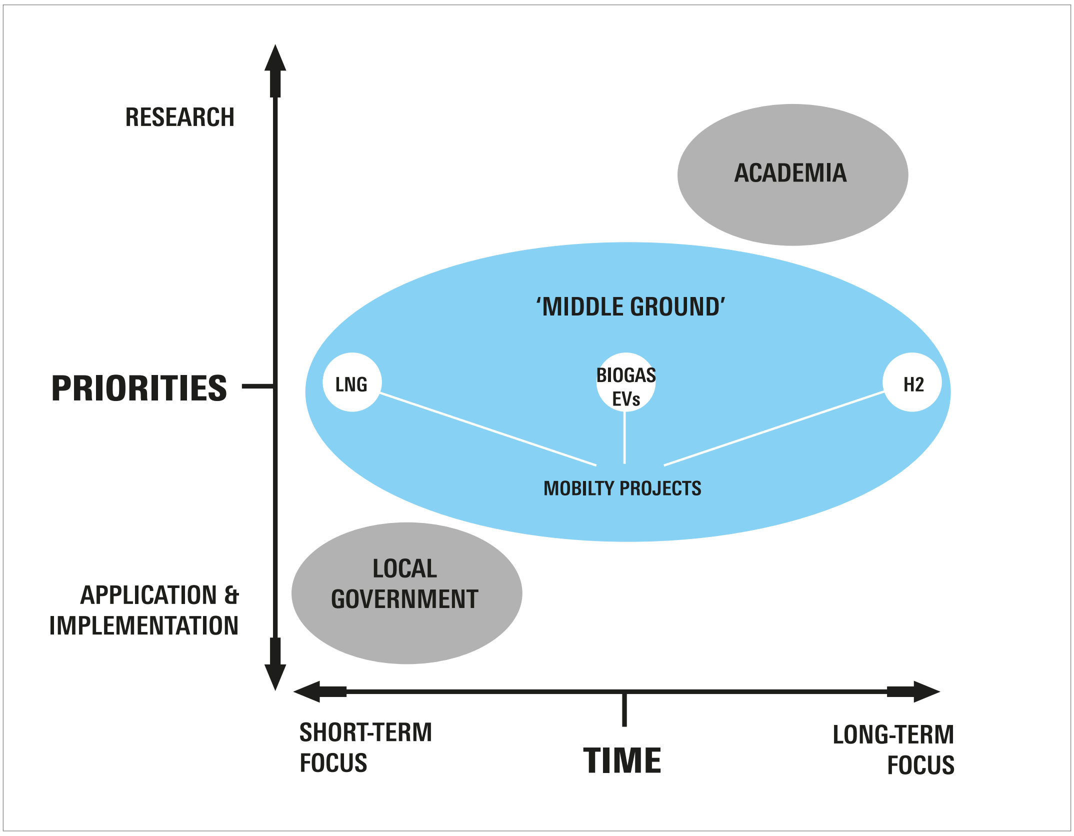

Figure 6.4 Opposing ‘worldviews’ of academia and local government (Source: After Binz, 2013).

A second period of barriers was reported by Binz (2013) regarding potential polarities that can occur between norms and priorities in academia on one hand, and the reality and constraints of day-to-day implementation activities in city municipalities on the other. These polarities are illustrated in Figure 6.4 below. This diagram depicts the situation when actors from Novatlantis, ETH, FHNW and city planners first met to discuss the direction and focus of the yet to be decided pilot region at the turn of the millennium. Participants from academia and local government soon realised that they were from “two different planets” (Binz, 2013) when they encountered difficulties in aligning the starkly contrasting paradigms within which both operated. On one end of the scale, city planners worked in a world of time, budget and political restraints. This meant that their projects were focused on application and implementation and typically focused on the short-term. On the other hand, scientists and faculty from ETH and FHNW had more so priorities in scientific research agendas guided by an extremely long-term vision of a 2000-watt society (for which a realisation year had been fixed anywhere from the year 2050 to 2150). Binz (2013) explains that although these two contrasting ‘worldviews’ produced stimulating discussions, polarities prevented any concrete projects proposals for one or two years. This gulf was eventually overcome with time and persistence. This was in a large-part due to the above-described ‘dual accountancy’ and mediating role of Novatlantis, which eventually facilitated the co-design of projects falling into the ‘middle ground’ and serving the distinct interests of both parties. For example, as already mentioned in regards to the mobility component, after several workshops with both City planners and civic sector representatives, a triple-pronged approach was formed. This would subsequently lead to the generation of solutions for the short (LNG), medium (electric) and long-term (hydrogen); a portfolio containing both research and implementation value (Lienin et al., 2004). In the same vein, the demonstration building programme was also shaped to fall into the middle ground. It would deliver rapid results for already planned commercial projects whilst facilitating incremental progress towards ambitious, long-term energy targets of 2000-watts and 1-tonne-CO_2. The creation of mutual benefits for both academic and local government parties has hence occurred by balancing long-term sustainability agendas and demands for research value and scientific integrity on one hand, with needs for short to mid-term implementation projects on the other.

6.1.5 Part 5: Appraisal of strengths and limitations

This fifth and final part is given to offering an critical appraisal of the partnership by considering its approach in regard to its objectives. It will thus respond to the following research question:

3.7 *What are the overall strengths and limitations of the approach of the partnership?*

6.1.5.1 Strengths

A core strength of the Basel Pilot Region programme lies in its adoption of a research-based vision of a 2000-watt society. The simplicity of this yardstick has also allowed the differing partners and stakeholders participating in pilot region activities to share a common language, target and vision. Further, the integration of the 2000-watt scenario as the guiding principle for the various projects designed and implemented in the pilot region has also aided the securing of stakeholder support due to its functioning as an objective measurement of sustainability. This is a significant success factor when considering that there are still contesting notions of what sustainable development is and how it should be measured (Spreng, 2013). Novatlantis and ETH have also worked hard to lay the groundwork for boosting social acceptance of this goal. This was done by firstly demonstrating the technical and political feasibility of this target through the publication of a white book (Jochem et al, 2004) of which the results were communicated avidly to government and industry stakeholders. With this common language and methodology at its core, the Basel Pilot Region programme has then focused its activities on the building/urban development and mobility sectors. This has served to set up the programme for potentially large sustainability gains as both of these sectors are major emitters of GHG emissions in Switzerland. For example, transport (road traffic) makes up for around a third of GHG emissions (FOEN, 2013), with buildings accounting for around 50% of final energy consumption, mostly from operations and heating (Jochem et al., 2002).

Another forte of the 2000 Watt Society Basel Pilot Region programme lies in the recruitment of industry experts to head the Novatlantis platform and direct the translation of scientific knowledge into implementation projects. By making the decision to place an industry practitioner (a prominent architect and engineer as opposed to an academic) at the head of the Novatlantis bridging platform, the ETH domain has in effect imported industry knowledge, experience and contacts. This has facilitated the conversion of scientific theory into concrete industry projects capable of responding to demands for scientific robustness and research value from the ETH domain and stakeholder needs for relevancy to industry and government activities. Further, the wealth of connections possessed by the industry recruits at Novatlantis has enabled the rapid engagement of major construction players in Basel and Switzerland and the leverage of high-profile industry projects as test beds for theoretical knowledge on energy efficiency. By the same token, these intense links with industry have also facilitated the diffusion of 2000-watt principles into governance frameworks for the building industry such as SIA guidelines (*Energy Efficiency Roadmap*), energy performance measurement tools (SIA 2040 Energy Efficiency Path) and the creation of labels such as Minergie®-P.

6.1.5.2 Limitations

A major limitation of the Novatlantis and ETH attempt to trigger a societal transformation towards 2000-watts and 1-tonne-CO2 stems from the absence of civil society and social innovation in the partnership. As a result, the overwhelming presence of technical approaches and actors in the partnership has meant that the partnership has so far been unable to secure the engagement of the lifestyle sector. This paradoxical approach of attempting a social transformation project with only technical experts and technical means has been criticised by Morosini (2012, p. 66) who asserts that "in Switzerland most communication on the 2000-watt society focuses on watts, not on society. Technological change is to the fore, not social change." Attention is being brought here to the 'rebound effect' (Jenkins et al., 2011; Nature, 2011) where gains in energy efficiency are potentially offset by growth in overall energy consumption. This phenomenon may be driven by factors such as increased flooring area in buildings. In the case in Switzerland, per capita living space has doubled from 23m^2 in 1955 to 46m^2 in 2005 (City of Zurich, 2008), with an increase of 23.5% over the last 20 years[59]. A rebound can also arise from the stimulation of economic activities. This occurs as financial savings from reduced energy are directed towards purchasing other energy consuming goods and services[60]. In the event of a 100% rebound, which has already occurred in energy consumption for flooring and lighting in Swiss buildings (Spreng, 2013), one possible consequence is heeded by Morosini (2013) who contends: "without a social revolution any transformation towards better energy efficiency will be useless".

The need to engage the lifestyle sector has also been re-affirmed more recently with findings from an ETH and EMPA study on the ecological footprint of 3369 residents across Switzerland (Notter et al., 2013). With energy intensive Western lifestyles creating a situation where only 2% of participants were able to satisfy the requirements of a 2000-watt society[61], the authors emphasised the need for the adoption of a 'sufficient lifestyle' and "abstinence from excessive consumption" across a much larger part of society. The sobering conclusion of the study was that "[e]nergy consumption in the near future of less than 2000-watts is realistic only when assuming a pronounced technological increase in efficiency combined with a smart sufficiency strategy" (Notter et al., 2013, p. 4019). To achieve such a strategy, the authors bring attention to the notion that people have to be "*educated* and *governed* in order to develop a more sustainable lifestyle based on sufficiency" (emphasis added, p. 4015). The limitations of a predominantly technical approach to energy efficiency in buildings without a wider engagement of lifestyles and consumption have not been completely overlooked by actors in the pilot region. Along with programme leaders in Novatlantis and the City of Basel (City of Basel and Novatlantis, 2013; Stulz, 2012b, 2013), there is a growing acknowledgement across Switzerland in general surrounding the concept of 'sufficiency' and the need to tackle the lifestyle sector through civic engagement (City of Zurich, 2011).

The problem however is two-fold. Firstly, the idea of promoting 'sufficiency' and restraint of excessive consumption clashes with the central promise of the 2000-watt vision: that the 2000-watt target is "technically feasible" and will not require any compromise in "the level of comfort" currently enjoyed by Western society (Jochem, 2004, p. 3). Secondly, to admit the inadequacy of this promise would be to wrestle with one of the greatest assumptions at the heart of modern political discourse—that endless growth is both possible and desirable—and thereby expose the partnership to the risk of political rejection. Due to the sheer complexity and gravity of this problematic which is at the same time social, technical and *intellectual*, the inclusion of living patterns and social systems in the 2000 Watt Society Basel Pilot Region remains as the missing link. This is even so in the new four-year strategy just hatched out for the period 2013-2016.

[59] Unpublished data from Spreng (2013).

[60] Energy consumption arising from the production of goods and services is factored into calculations for the 2000-watt society (see Berger et al., 2011).

[61] Note that this study is not part of the official 2000-watt Society Basel Pilot Region Programme.

From another perspective, the pilot region programme is contending with other shortfalls in its attempt to trigger a decarbonisation of the building stock of Basel and wider Switzerland. The most significant is the fact that new construction activities only concern a minority of the existing building stock in Basel and the rest of Switzerland. This means that in the short to mid-term, retrofitting techniques capable of achieving the same results in energy performance as new construction projects are required to continue progress towards the 2000-watt society. With only several retrofitting projects present in the pilot region (the most significant being the re-development of Gundeldinger Feld district) the demonstration and up-scaling of sustainable retrofitting materials and techniques remains an unsolved challenge (Stulz, 2012b) and a key area of focus in the next four years of the pilot region (2013-2017). In addition, a second limitation concerns the absence of a framework and monitoring system to verify that energy performance measured ‘off-the plans’ was actually achieved in the final construction (Geissler, 2013). This argument is based on the observation that some of the pilot and demonstration buildings fostered through the P+D programme have actually fallen short of initial expectations in regard to energy performance. What is therefore needed is a systematic monitoring system of the demonstration building portfolio to compile and diffuse energy performance results and lessons to other industry and government practitioners.

6.2 Case 2: The Oberlin Project

As in the first case study from Switzerland, part one of this second case analysis is concerned with addressing the following research questions:

3.1 *What sort of socio-economic factors and institutional motivations influence the type of co-creation performed?*
3.2 *What are the processes by which the partnership emerged and developed?*

6.2.1 Part 1: Background and objectives

> The era of cheap fossil fuels is over. The era of rapid climate change is upon us. We live in an economically challenged region. Given those three facts, there is no question that we should do such things. However, there is a question of how we should go about doing them. We can be reactionary and do them as a series of disjointed, one-off, overly expensive ad hoc responses to external crises, supply interruptions, and volatile prices. Or we can envision and create an integrated, well-thought-out system in which the parts reinforce the resilience and prosperity of the entire region. The latter choice is the Oberlin Project. (Orr, 2011b, p. 19)

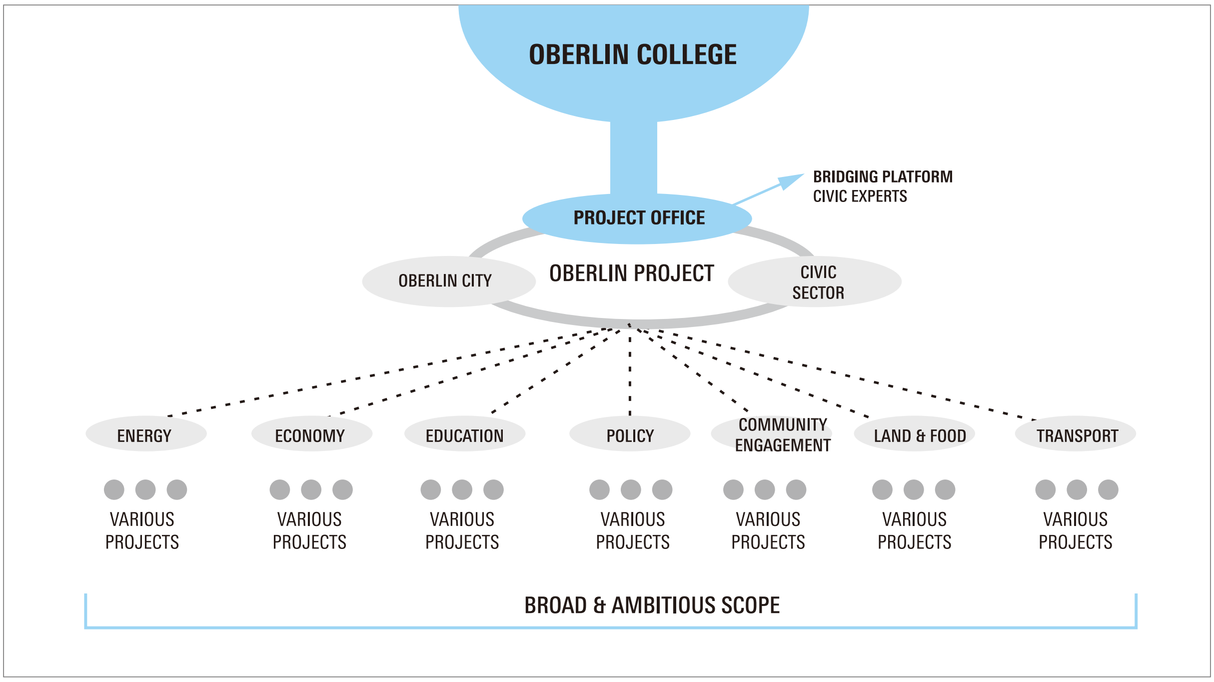

Figure 6.5 Structure of the Oberlin Project

6.2.1.1 Overview

The Oberlin Project is an ambitious attempt by Oberlin College to regenerate and transform the socio-economic conditions and environmental resiliency and sustainability of Oberlin, a semi-rural town in the US state of Ohio (population 8,000). The ultimate objective is to create an exportable model of post-fossil fuel revival and prosperity. The collaboration is an official alliance between Oberlin College and the City of Oberlin. Yet on the ground the Oberlin Project is a bottom-up, grass-roots social transformation project involving large numbers of stakeholders from local and regional civic groups, schools and many local citizens. The Project is the brainchild of David Orr, Paul Sears Distinguished Professor of Environmental Studies and Politics at Oberlin College, who could also be credited as being one of the forefathers of the academic sustainability movement[62]. At the Project's origins lie a resolve to simultaneously address interlinked and converging crises of climate change, peak oil and economic decline (Orr; 2011b). Together with an overwhelmingly social-innovation approach, the Oberlin Project is also characterised by a comprehensive and ambitious resolve to simultaneously advance the sustainability of multiple urban sub-systems such as energy, economy, education, policy, community engagement, land and food and transport (as shown above in Figure 6.5).

6.1.1.2 Socio-economic factors, institutional motivations and objectives

The numerous factors influencing partnership objectives, type and structure have been summarised into Figure 6.5 below. As already emphasised in the earlier ETH case, the focus on societal conditions and institutional motivations stems from the earlier observation in Chapter 4.3.6 that these have emerged as the two most significant motivating factors for the formation of co-creative partnerships in the global sample.

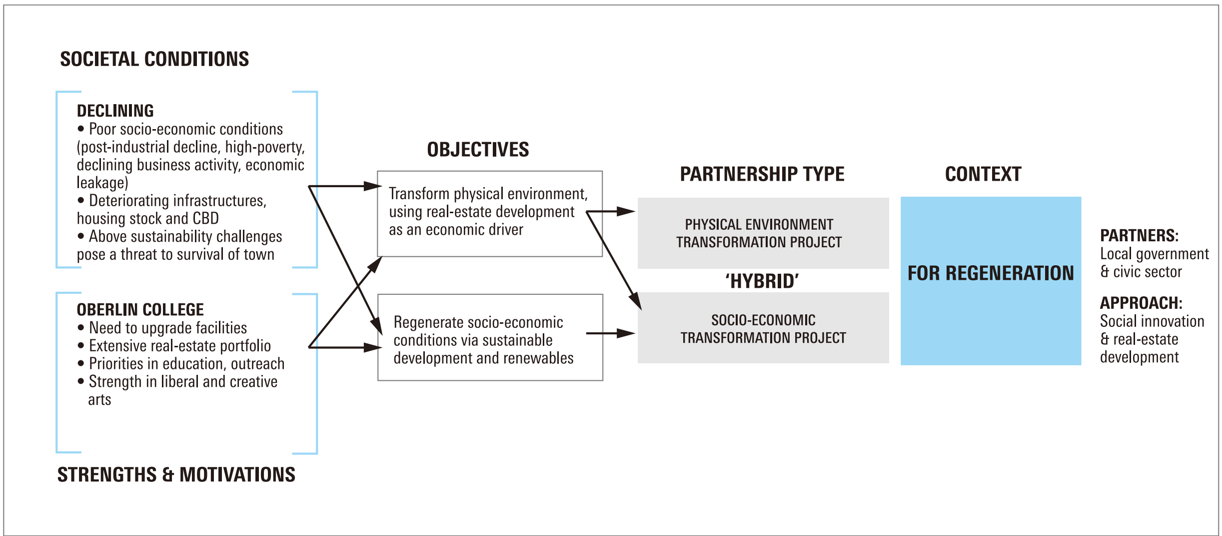

Figure 6.6 Factors influencing objectives and partnership structure (Oberlin Project)

Figure 6.6 depicts the Oberlin Project as an example of co-creation in the context of *regeneration.* Again, a converging of societal conditions and College motivations have shaped objectives, which have in turn influenced the core functioning of the partnership, and ultimately, the partners recruited and the overall approach taken. As may also be verified in Table 6.12, the town of Oberlin's embedment in the heart of the US 'Rust Belt'[63] means that it is characterised by socio-economic and built environment conditions of severe decline. In reflection of these dire social conditions are indicators such as a 24% poverty rate (City of Oberlin, 2013) and median household incomes substantially below the US average of $51,017. The detracting economy has also forced the City government to draw upon reserve funds for the last few years in order to

[62] This could be argued from Orrs' publications on the potential of higher education institutions to address the global ecological crisis, which date back to 1991 (See Orr, 2004).

[63] The 'Rust Belt' signifies a strip of cities stretching across the north-eastern corner of the US. This region is experiencing severe socio-economic decline due to the dwindling economic importance played by steel and heavy manufacturing industries in the wake of a transition to a post-industrial economy (Vey, 2007).

meet minimal annual budget requirements (Burgess, 2013). Seen from an energy perspective, the region is equally poor. Ohioan households spend nearly US$4,800 annually on heat, power and gasoline, amounting to ten-percent of middle-income household budgets. The sum of this is billions of dollars leaking out of the state each year in exchange for imported fossil fuels such as coal and oil (Woodrum, 2013b). As shown in Figure 6.6, one of the overriding objectives of the Oberlin Project is hence that of combatting this decline in social and economic prosperity by advancing sustainable development and self-sufficiency in renewable energy (Orr, 2013a). Also of importance is the resolve to address other sustainability issues such as climate change and potential extreme weather events, concerns about over-reliance on fossil fuels and low levels of local agricultural consumption. In conjunction with the above-described economic conditions, this array of factors were perceived as potential threats to the physical survival of Oberlin and have thus shaped the partnership's functioning as a *socio-economic transformation project.*

The other set of motivating factors to be considered concern the College's desire to improve the aging downtown environment and improve socio-economic conditions. As a prestigious liberal arts school with core activities more so in education rather than research, Oberlin College is also motivated by a desire to boost its capacity to attract top-rate students and faculty by improving facilities and the downtown environment. This motivation is linked to the other core partnership functioning as a *physical environment transformation project*. As depicted, this is shaped by the objective of transforming the physical environment through real estate development—an approach also intended to compliment the twin objective of regenerating socio-economic conditions. The absence of a core partnership function of *research, demonstration and knowledge exchange* means that in contrast to the ETH case, for the Oberlin Project the production of formalised knowledge through academic research is more so a means than an end.

Table 6.12 Key statistics for Oberlin (Source: Bishaw, 2011; City of Oberlin, DeNavas-Walt et al., 2013; US Census Bureau, 2013; World Bank, 2013)

Population	8,286 in 2010 (73% white, 14.8% African American)
Median household income	$47,334 in 2010 (US average $51,017)
Household energy expenditures	$4,800 (State of Ohio) (heat, power, gasoline)
Poverty level	24% of population in 2010 (US average 15.9%, Ohioan average 16.4% in 2011)
Economic conditions	Declining. As a Rust Belt city, Oberlin is suffering from high rates of unemployment and a detracting local economy in light of a post-industrial transition.
Carbon emissions	17.4 tonnes CO2e in 2007 (US average 19.3 tonnes in 2007)
Power mix	68% coal, 10.5% hydro in 2011

6.1.1.3 Emergence and development of partnership

The origins of the project reach back to 2007, to a vision from David Orr, a professor at Oberlin College. Orr had previously demonstrated to the world a fully functioning microcosm of sustainability with the realisation of the Adam Joseph Lewis Center for Environmental Studies at Oberlin College, the first authentically green building in American higher education (Orr, 2011b). Also the product of an array of personal motivations, the Oberlin Project was intended as an extension of this initial success where the objective was “not to build a building but to change how people think” (Orr, 2013a). Orr, who holds a position as Special Advisor to the President, met with the new College President in 2007 and conveyed his vision, which was initially focused on the re-development of a downtown block into a ‘Green Arts District’ (see *reform of built or natural environment* in Section 6.2.1.6). This was intended as a carbon-neutral neighbourhood development to bring together the creative arts and natural sciences and begin a ‘conversation’ about sustainability (Orr, 2009b). Out of this meeting emerged the shared awareness that the development needs of the College and town could be culminated into one large project (Goldstein, 2011), with assets and resources of the College utilised as an economic driver. After a team of consultants was hired to draft a feasibility study for the Green Arts District, Orr’s next point of contact was the newly arrived City manager. The manager voiced his desire for the pursuit of an even broader development agenda—one encompassing a greater geographical area and more inclusive portion of the population (Norenberg, 2013). The field of focus hence expanded from a single city block to a scheme to ‘green’ the entire city (Orr, 2013a). In this way, an alliance emerged between David Orr, the College president Marvin Krislov and the City manager Eric Norenberg. Orr then introduced the still developing concept of the Oberlin Project to the College’s Board of Trustees in the spring of 2008. An accord was then obtained for a further set of feasibility studies that was conducted by BNIM Architects (Goldstein, 2011).

In this collaboration with BNIM Architects, the idea of signing onto the Clinton Foundation Climate Positive Development Programme surfaced and was eventually realised. This decision would later bind both the College and the entire City of Oberlin to the pursuit of climate neutrality. The initial proposal document (Orr, 2009b) for the Oberlin Project was prepared with input from the College President and City manager and then circulated to the Board of Trustees and senior staff, from where no objections emerged (Orr, 2013a). This document has served as the initial roadmap for the simultaneous pursuit of six objectives, which were later expressed as follows (Orr, 2011b):

1. The development of a 13-acre downtown block into a Green Arts District (at LEED Platinum level for neighbourhood development) to function as a driver for community economic revitalisation.
2. A transformation of the local economy involving the creation of business ventures in energy efficiency, solar deployment and local resources such as food and forestry products and services; the expansion of existing local businesses; and the spurring of local investing to spread wealth throughout the City and increase economic resilience.
3. The creation of a climate positive town by shifting the City and College to renewables, improving efficiency and drastically reducing carbon emissions.
4. The establishment of a 20,000-acre green belt for stimulating the local economy and supplying local foods, forestry and bio-fuel products, in addition to carbon sequestration services.

5. The creation of a sustainability educational alliance with local schools and colleges to boost the sustainability literacy of the next generation.
6. The replication of the project at varying scales and different regions across the US.

The Project encompasses some explicit metrics, some of which have been summarised below:

Table 6.13 Summary of key targets for Oberlin Project (Data: City of Oberlin, 2013; Masi, 2012; Orr, 2009b; World Bank, 2013)

Area	Current situation	Target(s)	Method
Local food consumption	6% of total	70% (2030)	• Increase local demand and consumption • Extend growing seasons • Reconfigure food networks
Carbon emissions	17.4 tonnes CO2e in 2007 (US average 19.3 tonnes in 2007)	For City of Oberlin* - 50% (2015) - 75% (2030) - Below 100% (2050) - Base year=2007	• Switch to renewables • Increase energy efficiency • Carbon sequestration
Greenbelt network for agriculture, carbon and forestry services	Area under consideration: 1.7 million acres across 6 counties. This includes: • 58,000 acres of publically protected land • 12,000 acres of privately protected land	20,000 acres of public and private land secured into a network around Oberlin.	• Mobilise local landowners into network • Carbon credit scheme • Drive demand for local products

* Oberlin College has fixed itself the goal of reaching climate neutrality by the year 2025.

The Project was originally conceived for implementation over seven years; the first two for feasibility studies and planning, and the latter for construction and implementation. Initial estimates for the entire project were put at $US140 million, with $US55 for the first phase in a total of four (Orr, 2009b). Funds were to be sourced from a combination of private investments, state and federal support, tax credits, philanthropy and savings generated from improvements in energy, materials and water efficiency. This original planning document (Orr, 2009b) was then used to apply for funding grants and mobilise key actors in the community, many of whom Orr had already contacted during the drafting process.

The Oberlin Project was formally announced at the 10-year anniversary of the Adam Joseph Lewis Center (AJLC) in late 2010. At this ceremony the College president and City manager both signed an individual Memorandum Of Understanding with the Clinton Foundation Climate Positive Programme (CPDP). This gesture committed both the College and the City to separate climate neutrality goals; the year 2025 for the College and 2050 for the City. Although this public act was merely revealing previously established sustainability commitments for the City and College, the signing of the Oberlin president as both a lead partner and endorser of the Oberlin Project also signified that the goals of the Oberlin Project had become a top-level institutional priority for the College.

The next major step in the development of the Oberlin Project was the obtainment of funding from several foundations such as the Kresge Foundation, the Cleveland Foundation, the GUND Foundation and the Joyce Foundation, all of which resulted in the securing of a budget in the mid to high hundreds of thousands of dollars (US$)[64]. This was then used to rent a downtown office and employ four full-time staff, who as well as taking charge of the day-to-day operations and management of the project, would also be involved in implementation activities. The Oberlin Project thus became a fully operational and staffed initiative in 2011 (City of Oberlin, 2013). With the office given a lifespan of between four to six years, the Oberlin Project was intended to serve as a catalytic—as opposed to *permanent*—strategy to kick-start a long-term social transformation project (Orr, 2013a). The project was conceived to eventually function as a self-organising and mutually reinforcing series of de-centralised sustainability initiatives for which ownership would eventually be assumed by the City and community, as well as become institutionalised in the form of policy and legislation (Orr, 2013a; Pearson, 2013).

[64] The exact figure has been signalled as confidential by the Oberlin Project office.

6.2.2 Part 2: Application of Analytical Framework [A]

With a background discussion now in place, this sub-section will now proceed to apply Analytical Framework [A] developed in Chapter 3 to respond to the following research question:

> 3.3 *What are the defining characteristics and mechanisms driving the partnership?*

As also done in the first case from Switzerland, this will be used to analyse in more detail the following characteristics:

1. urban sub-systems targeted
2. scale of the geographical area(s) targeted
3. main *internal* actors involved
4. main *external* actors involved
5. motivating factor(s) behind the formation of the partnership
6. societal engagement modes used to purse partnership objectives

As was the case in the application of this framework in Chapter 4, data has been sourced principally through a score-based questionnaire[65] of which the results are displayed sequentially in the discussion below. (Similar to the ETH case, the relevance of a particular variable is shown as: *high*=two bars, *medium*=one bar and *nil*=blank). In addition, the following discussion also uses data obtained from interviews with key partnership members and stakeholders, in addition to various secondary data sources such as documents and publications.

6.2.2.1 Level 1: Societal sub-systems targeted

The striking feature of the Oberlin Project lies in its holistic and ambitious resolve to drive sustainable development in all of the inter-connected sub-systems of the urban environment and surrounding rural areas. This is depicted in the phrase 'full-spectrum sustainability', a process in which "each of the parts supports the resilience and prosperity of the whole" (Orr, 2013b, p. 290). This commitment to joining "the many strands of sustainability into an integrated response" (Orr and Cohen, 2013, p. 1) is reflected quantitatively in the following questionnaire responses. With high relevancy scores obtained for all variables, the Oberlin Project can be understood as having the ambitious resolve to advance the sustainability of literally all major sub-systems comprising the town and surrounding regions of Oberlin. These are explained below:

Table 6.14 Level-one results

Societal sub-system targeted (what?)	**Relevance level***
Built environment	▬ ▬
Transportation	▬ ▬
Energy, heating or cooling	▬ ▬
Economy, employment and industrial production	▬ ▬
Natural environment or green spaces	▬ ▬
Governance and planning	▬ ▬
Human and social systems	▬ ▬

* Two bars = high relevancy, one = medium and none = nil.

[65] This was completed by Kristin Braziunus, communications director for the Oberlin Project, with input also from David Orr.

- *Built environment*
  The Oberlin Project is seeking to drive sustainable development in both commercial buildings and residential housing. Regarding the former, the physical core of the Oberlin Project will eventually become the extensive renovation and redevelopment of a 13-acre downtown city block. Envisioned as a 'Green Arts District', this urban reformation effort will combine cutting-edge sustainable building design with the creative arts. Consisting of both renovations and new construction, the project will strive to attain a LEED Platinum rating for neighbourhood development. On top of these efforts, another key area of activity of the Oberlin Project is efforts to increase the energy efficiency of the local residential housing stock through weatherisation and retrofitting (City of Oberlin, 2013).

- *Transportation*
  Decarbonisation of the transportation sector is another key focus of the Oberlin Project. As a member of Climate Positive Development Program (CPDP), the City of Oberlin is required to build a strategy to eventually attain net-negative emissions in this sector. Efforts in this area are co-ordinated by a transportation sub-committee. At present, transportation accounts for 15% (23,887 tonnes) of community-wide GHG emissions (City of Oberlin, 2013), with the majority of this resulting from private automobile transport. Yet this share will drastically increase in the coming years as the City is in the process of transitioning to an almost carbon-free electricity mix (Pearson, 2013). At present, the goal is to reduce transportation-related carbon emissions by 1.5% each year, resulting in reductions of 5% by 2015, 30% by 2030, and 60% by 2050 (City of Oberlin, 2013). With the majority of Oberlin commutations lasting less than 10 minutes, the key strategy to achieving this consists of developing policies to discourage private car use and encourage other modes of transport such as public, bicycle and car-sharing.

- *Energy, heating or cooling*
  With a long-term goal of achieving climate neutrality in Oberlin, the decarbonisation of energy production and consumption is a core issue for the Oberlin Project. Concretely, this involves efforts targeted firstly at the production side (by shifting the old municipal electrical power mix from fossil fuels to renewables) and then on the demand side, by shifting space heating in commercial and residential buildings—currently responsible for 15% of GHG emissions—from LNG to renewable sources (City of Oberlin, 2013). Lastly, energy efficiency in private and public buildings is simultaneously being pursued via insulation fit-outs and lighting upgrades, in addition to expanding renewable energy production such as solar in the community.

- *Economy, employment and industrial production*
  Orr (2013a) describes the overarching goal of the Oberlin Project as a catalytic scheme to transform and regenerate the local economy. The logic here is that the buying power of the College, in conjunction with the construction of the Green Arts District will be harnessed to stimulate local consumption, employment, and therefore the overall economy. Some concrete goals have been fixed in this regard. Firstly, to increase overall revenues of local businesses, whilst increasing new job creation (The Oberlin Project). The fostering of new business ventures, in addition to plans to lure existing businesses to

a future green innovation business park will be a key tool in pursuing these objectives. Secondly, there is also a resolve to decrease financial leakage out of Oberlin by promoting local investment and purchasing and bringing residents and businesses to cut costs through energy efficiency measures.

- *Natural environment or green spaces*
  Another core aim of the Oberlin Project is to identify and create a 20,000-acre network of protected land around Oberlin for the purposes of agriculture, conservation, forestry, carbon sequestration and bio-fuels (Orr, 2009b; Western Reserve Land Conservancy, 2012). It is envisioned that this could be enabled by mobilising existing farmers into a local consumption network. This would be economically supported through spurring local consumption and the creation of new ventures to drive projects such as a local carbon offset market and projects and support afforestation and sustainable agricultural practices (Adelman, 2013). Transformations of the natural environment such as afforestation and forestry will also be a key way of producing local timber and bio-fuels (Orr, 2011a).

- *Water*
  As may be observed in the design of the Adam Joseph Lewis Centre housing the Department of Environmental Studies in Oberlin College, the transformation of water consumption to more sustainable patterns has long been a pre-occupation of Orr. Naturally, this objective forms a key focus in the Oberlin Project (Braziunas, 2013). The commitment to sustainable water usage can be seen in several areas. Firstly, the Green Arts District will feature an 'Eco-Machine' as the centrepiece of a natural biological systems water recycling system to purify waste water using plants, wetlands and natural organisms. This technology will form the next development in a system featured in the Adam Joseph Lewis Center at the College. Secondly, water conversation will be promoted throughout Oberlin, as is already occurring in the College, through deployment of the 'environmental dashboard' technology (see Section 6.2.3.3). This seeks to educate residents and building users on the local hydro cycle by providing live animations on volumes currently consumed and treated. Guidelines for sustainable water usage have also been incorporated into a ten-point plan for the City of Oberlin, which calls for a transition to sustainable water treatment.

- *Food, agriculture and forestry*
  The Oberlin Project has fixed itself the ambitious goal of transforming the local food and agricultural system to attain 70% food self-sufficiency by the year 2030 (City of Oberlin, 2013). The motive behind this goal is to increase the sustainability and resiliency of the town, as well as stimulating the local economy. Pursuit of this goal is currently pursued by two working groups: Land and Agriculture Resources and Local Foods Utilisation. Concretely, it is envisioned that this objective could be achieved by: mobilising farmers in a 20,000-acre green belt around the City and six neighbouring counties to re-direct agricultural products to local markets, spurring local consumption, fostering local food entrepreneurship and extending growing seasons of produce through use of greenhouses and so on (Adelman, 2013).

- *Solid waste*
  In order to attain climate neutrality under the Climate Positive Development Program, Oberlin is also required to tackle the solid waste sector, currently responsible for 1,622 tonnes of CO2e (0.9%) of local emissions (City of Oberlin, 2013). The eventual transition to a zero waste society will be pursued through the strengthening of recycling both residential and industrial waste, in addition to diverting landfill waste via composting. The solid waste sector has also been a target of the energy strategy for the Oberlin Project. By 2015, the City will source 59% of local electricity production from landfill gas energy generation at the local Lorain County landfill (Dupee, 2013).

- *Governance and planning*
  The transformation of local governance and planning structures so that "sustainability becomes the default setting for all decision making" (Orr, 2013) is also a central aim of the Oberlin Project. Efforts to enhance the sustainability of local governance and planning are taking place through various means. Concretely, this includes affecting local decision making through lobbying to City Council and transferring knowledge in the form of best practices and policy recommendations to the City (see knowledge management in Level 5 of this section). The goal of this is to ensure that sustainability goals are institutionalised into City legislation (Orr, 2013, Braziunus, 2013).

- *Human and social systems*
  As a large-scale, social transformation project, *human and social systems* of Oberlin are inevitably a principal target of the Project. This can be sensed on many levels, but most particularly from the strong involvement of the civic sector in various initiatives and activities, in addition to an ongoing commitment to public outreach and education. The Project includes a *Community Engagement* committee whose core mission is to secure the support and participation of local citizens regarding Project goals and initiatives. A specific focus of this committee is to ensure that all sectors of the community are represented—including those in poorer and disadvantaged neighbourhoods.

6.2.2.2 Level 2: Geographical scale of target area

Responses obtained for the second level of the framework are as follows:

Table 6.15 Level-two results

Scale of target area (where?)	Relevance level
Local/neighbourhood level	■ ■
City/town level	■ ■
Regional level	■ ■
National level	■ ■
Trans-border level	■ ■

These may be interpreted as follows. Firstly, with the upcoming Green Arts District constituting a single city block, a significant share of Oberlin Project activities are currently focused on the *local/neighbourhood level* and heart of the central business district. That said, the Project is also seeking to drive sustainable development across the entire City in order to attain citywide climate neutrality—inclusive of its 8000 residents. Then, looking past the confines of the City, the *regional level* also applies as much of the focus on transportation and local food and agriculture is on the state level. At this scale, collaborations are being forged with neighbouring counties whilst Oberlin Project actors lobby for policy reform at a state level. Lastly, many activities in the broader cadre of the Oberlin Project are also being enacted on a *national level*. This is for the reason that the Project is aiming to transfer local experiences to the national stage and replicate the project in various cities and regions across the US. This is being carried out in cooperation with other cities, educational institutions, military bases and industry (Orr and Cohen, 2013).

6.2.2.3 Level 3: *Internal* actors

Concerning the type of internal university actors involved, responses obtained for the Oberlin Project are as follows:

Table 6.16 Level-three results

Internal actors (who?)	Relevance level
Faculty/researchers	■ ■
Administration	■ ■
Students	■
Bridging organisations	■ ■

Responses are indicating that the core internal actors are chiefly *faculty/researchers*, *administration* and *bridging organisations* (in this case the sustainability office), with some participation from *students*. Using these categories, Table 6.17 below provides a non-exhaustive analysis of the precise roles performed by each of these categories, in addition to key individuals or organisations.

To begin with the role of *faculty/researchers*, the most notable here is that of the core leadership, assumed by Professor Orr. In addition, Orr's other functions encompass fund-raising, recruiting and mobilising of key stakeholders, and finally, promoting and communicating experiences on both a national and international level. In addition, several other faculty are engaged in differing roles and intensities. For example, one faculty member acts as a co-chair of the Energy Planning committee, performing a dual role of both leadership and implementation of various residential energy efficiency upgrade projects. Lastly, other faculty are involved for the purposes of using the Oberlin Project as an educational and research platform, in addition to providing technical and strategic advice by participating in the core planning committee.

Various actors from the College *administration* also play an active role in the Project. First and foremostly, as a lead partner in the Project, the College president assumes a role in executive planning and official endorsement for high-level decisions requiring the College's official commitment (e.g. committing the College to the Climate Positive Development Programme). For other administration actors from the College, a common function appears to be that of aligning existing functions and operations with objectives of the Oberlin Project, in addition to playing a key role in decision making by participating in the core planning committee.

Table 6.17 Key internal actors in the Oberlin Project

Name	Affiliation/Position	Chief role assumed
Faculty/Researchers		
Prof. David Orr	Department of Environmental Studies Special advisor to the President	• Founder of project • Core leadership and executive decision making (executive director) • Fundraising • National promotion of Project
Ass. Prof. John Peterson	Department of Environmental Studies	• Strategic advisory • Development of 'environmental dashboards' • Use of Project as education and research platform
Ass. Prof. Rumi Shammin	Department of Environmental Studies	• Technical advisory • Use of Project as education and research platform
Prof. Cindy Frantz	Department of Psychology	• Chair of energy planning group • Grassroots work to promote residential energy efficiency • Use of Project as education and research platform
Administration		
Marvin Krislov	President of Oberlin College	• Core leadership, executive decision making and official endorsement
Tita Reed Sandra Hodge	Special assistant to the President for community and government relations	• Seat on core planning committee • Liaison to College administration • Official endorsement
Committee of Environmental Sustainability	Comprising of faculty, administration and students	• High-level decision making • Alignment of College policy and operations with goals of Oberlin Project and commitment to CPDP
Ron Watts	Vice President for Finance	• Financial decision making
Students		
Undergraduate students	Various departments, especially Department of Environmental Studies	• Participate directly in Oberlin Project via internships • Contribute to project knowledge base via community-based research • Contribute to implementation efforts via student-led College initiatives.
Bridging organisations		
Office of Sustainability	Director of sustainability	• Co-chair of transport committee • Co-ordination of College sustainability efforts towards carbon neutrality • Identification and implementation of mutual projects between College and Oberlin Project

As for *student* participation, many are given the opportunity to participate directly in the day-to - day running of the Project via internships at the Oberlin Project office, with others contributing via the provision of course related research results (Adelman, 2013). Another role may be observed where existing student initiatives such as carbon offset funds, for example, serve as proofs of concept before being integrated and up-scaled into the framework of the Project. It should be noted that student participation will most likely increase in the coming years. This will occur as various initiatives gather momentum and attract more faculty and student interest towards the utilisation of the Oberlin Project as a platform for learning and research (Adelman, 2013).

Finally, the Office of Sustainability (who serves as a *bridging organisation* with its commitment to community, local and national outreach and collaboration) is a key actor in the Project. Staff members from here serve as a co-chair of the transport committee and also as a liaison to the College administration.

6.2.2.4 Level 4: External actors

Regarding the external actors constituting the principle stakeholders and partners in the Oberlin Project, responses obtained for this layer of the framework are listed below in Table 6.18. As an overall observation, core partners and stakeholders in the Oberlin Project consist mainly of the three sectors of *local government, civic groups* and *other academic institutions*. In particular, a defining characteristic of the Oberlin Project is a deep and highly diverse involvement of civic actors. Results are also reflecting moderate participation from *large or multi-national corporations* and *small-medium enterprises.* Using these categories, Table 6.19 below provides a non-exhaustive analysis of the various roles assumed by these sectors, with a more detailed discussion following below.

Table 6.18 Level-four results

External partners/stakeholders (who?)	Relevance level
Local or city government/public service	▬ ▬
State/national government	
Civic society	▬ ▬
Other academic institutions	▬ ▬
Large or multi-national corporations	▬
Small-medium enterprises	▬

The high-relevance of *local or city government/public service sector* is due to the City of Oberlin's status as an official partner. More specifically, the City manager assumes a role of leadership and decision making, and also seeks to align City policy and operations with the various goals of the Oberlin Project. The City Council, consisting of six elected community representatives and a City mayor, serve as the official decision making body within the City. Policy recommendations emerging from the Oberlin Project are officially advocated and debated through this council. Lastly, the director of the City owned power utility (OMLP) also plays a key role by serving as a chair of Energy Planning committee and working to balance the long-term strategies of the power utility with the objectives of the Oberlin Project.

A deep and highly diverse participation of *civic society* is a defining attribute of the Oberlin Project. As summarised in Table 6.19, civic involvement extends from local development agencies and NPOs, to think tanks, local experts and community leaders such as members of churches, businesses and educational systems. In essence, three key roles are performed by civic actors.

The first is knowledge provision. This is provided in the form of either commissioned research or direct participation in committee meetings and other gatherings. The second is to conceive and implement various initiatives conforming with Project objectives. A final role is to promote wider community engagement by linking existing community efforts to the Oberlin Project and fostering wider citizen support throughout the City.

For *other academic institutions*, key stakeholders include the local K-12 school system and vocational colleges. The function here is not research but more so to engage educational resources to the theme of sustainability and decarbonise day to day operations (Adelman, 2013). More concretely, this involves the execution of energy efficiency measures on facilities and experimentation with various pedagogical approaches to integrating sustainability into curriculums. This engagement of the local education system is a key objective of the Project, which strives to increase the sustainability literacy of all local school and college students (Orr, 2011b).

With the Oberlin Project being predominantly a grass-roots social transformation project in a small town lacking the industrial presence of larger cities, the participation of *large or multi-national corporations* is naturally limited. That said, the firm BNIM Architects has been playing an active role through the conception, design and engineering of the Green Arts District, in addition to serving on the advisory committee for the Oberlin Project core planning group.

This observation also applies to *small-medium enterprises,* whose participation in the Project so far has not been prominent. Yet this too will no doubt change as the economic development function of the Oberlin Project gathers momentum in the coming months by working with local SMEs on energy efficiency upgrades, as well as fostering new business ventures and attracting existing green companies to the City. In the same vein, the role of local and regional private landowners and farmers will also become more and more significant in the future. This will occur as presently planned finance mechanisms are implemented to enable the land acquisition and agricultural, forestry and carbon sequestration projects envisioned as part of the 20,000 green belt scheme and 70% shift to local food.

Table 6.19 Major external partners and stakeholders

Sector	Chief role assumed
Local government	
City manager (Eric Norenberg)	• Core leadership and high-level decision making • Alignment of City policy and operations with vision of Oberlin Project and carbon neutrality goals.
City Council (seven members)	• Official endorsement via policy adoption • Representation of community interests
Oberlin Municipal Light and Power System (OMLP)	• Management of City energy portfolio • Alignment of operations with Oberlin Project and carbon neutrality objectives • Chair of Energy Planning Committee
Administration heads	• Integration of sustainability and carbon neutrality objectives into City operations
Civic sector	
Policy Matters Ohio (think tank)	• Expert consultancy and research • Policy recommendations
Western Reserve Land Conservancy (NPO)	• Local expertise, consultancy and research
POWER (NPO)	• Community engagement of underserved population • Implementation of residential energy efficiency projects
Local experts	• Provision of local knowledge and expertise • Provision of connections and fostering of local engagement • Representation of community interests • Participation in and initiation of various sustainability initiatives
Other academic institutions	
Lorraine County Community College	• Integration of sustainability into curriculum and operations
Lorrain County Joint Vocational School	• Same as above
Local K-12 school system	• Same as above
Large corporations	
BNIM Architects	• Design and engineering of Green Arts District
Small-medium enterprises	
Private land owners and farmers	• Provision of local foods and natural resources • Participation in carbon financing and adaptation of sustainable agriculture methods
Local business	• Participation in and initiation of various sustainability initiatives

6.2.2.5 Level 5: Motivating factors

In regard to the factors triggering the formation of the Oberlin Project, the initiator David Orr has provided the following responses to the framework:

Table 6.20 Level-five results

Motivational factors (who?)	Relevance level
Missional	
Funding	
Scientific/scholarly	
Social contribution/community relations	
Developmental/strategic	■■
Entrepreneurial	

As can be seen from above, the only variable bearing any relevance to the formation of the Oberlin Project is the *developmental/strategic* motivation. That is to say, the emergence of the Project can be explained purely and simply as a 'survival reflex'. It has emerged from the resolve of "creating a response in a rapidly changing climate" (Orr, 2013) and a 'black swan'[66] world of completely unanticipated crises such as peak oil, terrorism and Fukushima like disasters (Orr, 2011c). The Oberlin Project was also envisioned by its founder Orr as a holistic, systematic and aggressive strategy that would "join the many strands of sustainability into an integrated response" (Orr and Cohen, 2013), as opposed to initiating "a series of ad-hoc responses" (Orr, 2013). Yet in addition to this desire to ensure the physical survival of the town by increasing its self-sufficiency and resiliency to black swan events, as described in *developmental/strategic* variable in (Trencher et al., 2013a), the concept of 'enlightened self-interest' from Dixen and Roche (2005) is also of high relevance to the motivations behind the formation of the Oberlin Project. For example, Orr (2011b) has described the need to upgrade the College facilities and increase the attractiveness of the town to ensure the College's continued capacity to attract top-level faculty and students (2011c).

Regarding other possible motivating factors, *funding* has been described as a "means to an end" rather than a primary motivation (Orr, 2013). As for the remaining variables—in particular the *scientific/scholarly* motivation—their irrelevancy to the Oberlin Project is expressed by Orr as "the academic tendency of turning things into research projects so you can add one more line to your CV does not apply here at all". Rather, the Oberlin Project is all about an attempt to "go about the hard business of transforming this little city" (Orr, 2013).

6.2.1.6 Level 6: Societal engagement modes

Results for the societal engagement modes by which the Oberlin Project attempts to achieve its objectives are listed below in Table 6.21. As can be seen, responses reveal that each and every engagement mode strongly describes the type of activities and mechanisms of the Oberlin Project. As such, another distinguishing characteristic of the Oberlin Projects is its comprehensiveness use of a wide array of approaches to pursue objectives. The significant volume and breadth of these activities is also a natural, quantitative reflection of level one where it was also demonstrated that the Project is attempting to drive sustainable development in all ten urban sub-systems identified for Analytical Framework [A]. The Oberlin Project's holistic utilisation

[66] Orr (2011c) describes 'black swan' events as unanticipated rare events, like the birth of a black swan in flock of white. The use of this term is appropriated from Taleb (2010).

of all societal engagement modes identified in co-creative partnerships is hence a logical consequence of this commitment to pursuing ‘full-spectrum sustainability’ (FFS).

Table 6.21 Level-six results

Societal engagement modes (how?)	Relevance level
Knowledge management	▬ ▬
Governance and planning	▬ ▬
Technical demonstrations and experiments	▬ ▬
Technology transfer or economic development	▬ ▬
Reform of built or natural environment	▬ ▬
Socio-technical experiments	▬ ▬

The following discussion seeks to summarise some of the more prominent and relevant activities and projects occurring in each mode of engagement. It should be pointed out that due to the sheer volume of initiatives taking place, the following analysis is not intended as exhaustive.

- *Knowledge management*
  The creation, processing and dispersion of knowledge is playing a key role in triggering Oberlin’s shift to sustainability. This is because a chief method by which the Oberlin Project seeks to generate change is to fuse outside examples of best practice with local expertise and knowledge and use this as a basis for shaping policy and legislative reform in the City (Woodrum, 2013). The ultimate aim of this approach is to render permanent (i.e. in the form of policy and legislation) the shifting of priorities in public, private and civic spheres towards sustainability and to create a situation where “sustainability becomes the default setting” by which all decisions are made in the community (Orr, 2013). To accomplish this, the Project is sourcing knowledge from both *internal* and *external* bodies. Internal providers of knowledge include local experts from Oberlin—both individuals and NPOs—in various areas such as energy efficiency, local food, land use, agriculture and economic development. External experts and providers of knowledge include regional think tanks and national energy consultants. Once mobilised and documented, Oberlin Project actors then seek to translate and share this knowledge to decision makers from the City council and the community. The ultimate aim of such activities is to ensure that knowledge produced in the context of the Oberlin Project is converted to actual projects and City policy (Braziunas, 2013).

- *Governance and planning*
  As mentioned above, a major objective of the Oberlin Project is a transformation of the priorities affecting government planning and the institutionalisation of sustainability so that it becomes the guiding principle for community decision making (Orr, 2013). A key means by which this is pursued is via the societal engagement mode of *governance and planning.* This encompasses activities such as the mobilisation of local leaders, creation of discussion spaces and informal decision making frameworks, collaborative policy making with Oberlin City and lobbying and advocacy at local, regional and state government.

  Regarding the first approach, Project initiator Orr focused initial efforts on identifying and mobilising key stakeholders and important decision makers in the community (such as the head of the local power utility and the superintendent of the local K-12 school system) and then to create discussion spaces and decision making bodies outside of existing political frameworks. Through both formal and informal meetings, Orr and Oberlin Project actors have then worked to present the vision and goals of the Project to community leaders and identify areas where community resources could be harnessed to the goal of driving a societal transformation towards sustainability and carbon neutrality.

On top of these efforts, another core strategy in this engagement mode has been the shaping of policy for local and regional government. This has involved the mobilisation of local knowledge and external best practices into policy recommendations. These are then transferred to key decision makers in the local and regional governments by actors from the project office participating on city committees and commissions. As employees of both the College and the City of Oberlin, civil actors in the Oberlin Project office have been able to influence directly the process and outcomes of policy making in the City government. This collaborative planning and policy drafting approach has also been accompanied by lobbing and advocacy at the regional and state-wide level, especially with regard to regional transport policies (Woodman, 2013).

- *Technical demonstrations and experiments*
  The Oberlin Project is looking to foster innovative and unproven technologies and function as a living laboratory for their demonstration and testing. One key area in progress involves the creation, trial and deployment of 'environmental dashboards' and other forms of feedback technology. The environmental dashboard project essentially consists of television monitors providing real-time socio-technical feedback in a visual form for water and electricity consumption at both a building and regional level. Data is gathered from hundreds of sensors placed throughout buildings and community infrastructure. These dashboards have been created through a collaboration between Oberlin College born venture Lucid Design Group and College faculty, in partnership with the City and a local NPO. The technology is based upon principles from natural systems that self-regulate via dynamic feedback (Peterson, 2012). The initiative seeks to build upon an earlier project where glowing orbs were developed to educate building users on real-time usage of water and electricity. The key target of the environmental dashboard project includes local decision makers, students and residents. One core aim of these demonstrations and trials of this technology is to educate building users and citizens by helping them to 'see the chains of causality' in the intention of fostering reductions in water and electricity consumption (Frantz, 2013). 'Bio-regional' feedback is provided via a web-based platform[67] generating live animations on levels of water availability, usage and treatment, and energy production and consumption.

- *Technology transfer and economic development*
  Although Oberlin College lacks the engineering or research base of larger institutions, as mentioned above a key focus of the Oberlin Project is the transformation of the local economy into a "sustainability and new technology innovation district" (The Oberlin Project). For College and Oberlin Project actors, this implies a role of economic development (rather than conventional technology transfer) and efforts to build a prosperous post-fossil fuel economy in wake of post-industrial contraction. Specific

[67] See URL http://www.oberlindashboard.org

strategies are to combat socio-economic decline by increasing total revenues of the local retail/service businesses sector and increase new job generation. This strategy involves three prongs. One is to attract established green businesses to the area through the establishment of a ‘Green Business Park’. A key ‘bait’ here is the recent decarbonisation of the municipality owed electricity mix. It is hoped that this could allow local businesses and services to markets themselves regionally and nationally as ‘green’ and ‘carbon free’. Secondly, Project members are seeking to foster the creation of new business ventures by creating support mechanisms such as local purchasing policies (Braziunas, 2012) and increasing the demand for locally made or grown products. Such nurturing strategies are focused on the areas of energy efficiency (demand-side management), solar deployment and provision of local resources such as food, timber and agricultural products. Finally, a third technique for driving economic development is that of bringing local businesses to reduce energy consumption and adopt more sustainable business practices, in the goal of reducing energy-related expenditures (Frederick, 2013). This is also justified by the need to stop economic leakage out of the area in the form of fossil fuel expenditures. It was mentioned above that Ohioan households spend nearly US$4,800 annually on heat, power, and gasoline; equating to approximately 10% of middle-income household budgets. A final strategy to drive economic development is the use of College real estate development (i.e. the below-explained Green Arts District) to function as an economic driver through employment creation and consumption of local resources.

- *Reform of built or natural environment*
  Efforts to transform the built or natural environment in and around town form an integral part of the Oberlin Project. Regarding reformation of the built environment, the physical manifestation of the Oberlin transformation will be the downtown development of a 13-acre ‘Green Arts District’ adjacent to Tappan Square in front of the College. This development will fuse the arts and sciences, as well as College creative art and housing facilities, with public venues such as a hotel, restaurants, bars and a conference centre (BNIM, 2013). This College-led development of the Green Arts District encompasses both new construction and renovation of existing buildings. It is envisioned that this block eventually attain carbon neutrality, zero-discharge of water and sewerage the standard of LEED Platinum for neighbourhood development. Energy will be generated with solar photovoltaic panels, geothermal, biogas from onsite waste and bio-mass for space heating. Renovations of existing buildings in the Green Arts District include the LEED gold upgrade of College facilities such as the Allen Memorial Art Museum and the acquisition and LEED silver upgrade of the local Apollo Theatre. Concerning new construction, this is scheduled to begin during 2014 and is currently focused on transforming the existing Oberlin Inn into a LEED platinum certified accommodation facility. The full realisation of the Green Arts District has been designed to unfold over three stages and ten years (BNIM, 2013) at a total price tag of US$73.5 million, US$78 million and US$80 million respectively. Funding for the construction projects is being sourced principally from private donations and grants (Orr, 2013), but also from state and federal grants, tax credits and corporate and private grants (Oberlin College and Conservatory, 2011). It should be outlined that it is particularly College actors playing a key role in the realisation of the Green Arts District. Some of the key roles assumed include the initial conception and societal communication of the vision (Orr, 2009b),

fundraising efforts (Orr and college administration), design of functionality and contribution to architectural design (various faculty and college architects) and finally, project management and supervision of construction.

As for initiatives to reform the natural environment, in addition to re-creating natural systems such as wetlands in the Green Arts District, efforts in this area are concentrated on the acquisition of a 20,000-acre green belt. Still in the planning stages, Orr and Oberlin project actors are working with local NPO Western Reserve Land Conservancy and local farmers to identify and mobilise a patchwork of private and public land around the City of Oberlin (Adelman, 2013). This will be set aside for the express purpose of supplying food, timber and bio-fuel products to Oberlin (Orr, 2011b). In addition, this belt will also provide services such as carbon sequestration involving both afforestation and reforming agricultural practices such as tilling and crop rotation. This latter role is especially important as Oberlin will be required to offset carbon emissions in the future in order to attain a climate neutral—and ultimately *positive*—status (City of Oberlin, 2013).

- *Socio-technical experiments*
  Social innovation constitutes a large part of initiatives taken to transform the various social, cultural, environmental and economic systems of Oberlin. At present, a large proportion of activities falling into the category of *socio-technical experiments* consist of efforts to re-configure the local agricultural sector. This transformation process extends from production, distribution, consumption all the way through to waste treatment. The ultimate aim is to achieve a 70% localisation of the entire food chain over the next 20 years (Orr, 2011b). Specific strategies that are being trialled include efforts to expand local consumption through awareness raising and attempts to introduce sustainable greenhouse technologies to extend the growing season of summer produce. On top of this, other efforts involve the creation of entrepreneurial opportunities and infrastructure for local agricultural products and services. Concretely, this includes the promotion and up-scaling of the local farmer's market, the creation of a local food hub (for storage, distribution, processing and marketing of local foods) and a waste-to-food energy hub (for converting organic waste to inputs for local agriculture).

  In addition to these efforts to re-configure flows of local agricultural products and services, other initiatives involving social innovation include experiments with local carbon funds for carbon sequestration, also designed to stimulate local economic investment.

6.2.3 Part 3: Impacts of societal engagement modes

As in the first analysis of the 2000 Watt Society Basel Pilot Region, the second part of this examination of the Oberlin Project will seek to answer the following question. This will be done through the theoretical lens of the six societal engagement modes just outlined above.

> 3.4 *What sort of outcomes and progress towards an urban sustainability transformation have been attained and how were these achieved?*

Due to the huge volume of activities taking place in the Oberlin Project, the following discussion is intended only to provide a snapshot of the more prominent impacts emerging so far. These are collated into Table 6.22 below and then discussed in more detail below:

6.2.3.1 Knowledge management

The mobilising of knowledge from both within and outside of Oberlin has resulted in a series of reports and white papers on an array of themes pertaining to energy, economic development and urban sustainability. The College's role in regards to these knowledge creation activities has been the shaping of research agendas, fund-raising and subsequent allocation of these funds to finance the external studies. Findings from these publications are serving two purposes. Firstly, they are forming the intellectual framework and intelligence to guide the various activities in each of the specific areas of focus in the Oberlin Project. Secondly, they serve as shapers of policy and legislative reform within the City as findings are translated and shared with key stakeholders in the local government (Braziunas, 2012).

To cite some key examples of knowledge creation informing action and policy, a series of reports and studies in specific areas such as local potential and job opportunities for wind and solar power; residential energy efficiency; strategies and policy options for sustainable energy, transport and local green investment; and technical studies on local food and agricultural systems have all served to inform the drafting of the City of Oberlin's Climate Action Plan (City of Oberlin, 2013). This document serves to paint the roadmap by which the City of Oberlin may achieve climate neutrality (and positivity) and shift towards a post-fossil fuel, sustainable and resilient economy. It was prepared under the supervision of a climate action committee of 17 City, College and community members, of which more than half are involved with the Oberlin Project. College faculty were also able to contribute to the creation of the knowledge base for this document via the establishment of a GHG emissions inventory for 2007 (the base year for future emission reductions). With staff from the Oberlin Project Office also involved in the actual drafting of Climate Plan document, many of the findings from the various reports and white papers commissioned in the context of the Oberlin Project have thus been integrated into City climate policy (Braziunas, 2013).

Regarding progress made towards other core Project metrics (e.g. 70% shift to local food and acquirement of a 20,000 acre greenbelt), the knowledge-base for these highly ambitious socio-cultural and environmental transformations has been largely formed. The first key document forming this base is the *Land Resource Identification Plan* by local NPO Western Reserve Land Conservancy (2012). Contained in this mostly GIS analysis-driven study is key local data encompassing a six-county area such as an appraisal of the conservation value of both natural areas and working agricultural land, in addition to the suitability of specific areas for sustainable forestry, biofuel, wind energy and solar energy production projects. The second key document is that produced by local sustainable food expert Masi (2013) who, as well as supplying technical knowledge, also brings to the Project a wealth of buyer and grower connections. Key recommendations to emerge from the study are the creation of a local food hub (for storage, distribution, processing and marketing for locally produced foods), a waste-to-food energy hub (for converting organic waste to inputs for local agriculture), the expansion of urban agriculture and a large-scale education effort regarding the local food cycle. Efforts are currently underway to implement these findings. A food-hub is currently being set up in neighbouring Lorain (Adelman, 2013) and a series of year-round greenhouses for extending the growing season of local produce with waste heat from the Lorain County Landfill gas generator is currently in development (Braziunas, 2013). When realised, the greenhouse project is expected to produce up to 50 new employment opportunities.

6.2.3.2 Governance and planning

Overall, the most concrete societal impacts to have emerged from the Oberlin Project have come about as a result of *governance and planning* activities. Key achievements are discussed below:

The first accomplishment attributable to *governance and planning* activities concerns the mobilisation of local leaders and stakeholders into an action-focused planning and governance structure[68]. This has been assembled in holistic pursuit of sustainability in interlinked areas such as economic development, energy, food/agriculture/forestry, education, transport and community engagement. Informed by a vision of 'full-spectrum sustainability' and socio-economic regeneration, at the highest level this governance framework involves a formal partnership between the College President and the City Manager. At an operational level the governance and planning framework unites College actors such as faculty, administration and the sustainability office with influential community leaders and stakeholders. Concerning the significance of this commitment to full-spectrum sustainability, Orr (2011c) points out that until now, attempts to co-create sustainability had been reductionist, with ad-hoc approaches to individually pursuing sustainable agriculture, renewables, green buildings and so on. Therefore, the novelty of the Oberlin Project lies in its resolve to tie all of these separate dimensions of sustainability together into an integrated strategy for community revival and transformation.

Another major outcome ensuing *governance and planning* activities is the fostering of a community consensus bringing both the City of Oberlin and Oberlin College to enter into a legally-binding commitment to pursue climate neutrality and sustainable development through the Clinton Foundation Climate Positive Development Programme (CPDP). With the City now evolved from 'candidate' to official 'participant' status, this decision has lead to the integration of long-term GHG emission and sustainability goals into City planning. Concrete targets to emerge for the entire City of Oberlin[69] include a 50% reduction by 2015, 75% by 2030 and below 100% by 2050 (base year 2007). These goals are now inscribed into City policy via the Climate Action Plan (City of Oberlin, 2013) that Oberlin Project actors played a key role in drafting. Far from being long-term targets passed onto a future generation, what entails this legal commitment to pursuing

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[68] This governance structure refers to the various sub-committees (i.e. economic development, energy planning etc.) established by the Oberlin Project, in addition to its core planning and management framework, which also consists of College, City of Oberlin and civic representatives.

[69] Oberlin College is aiming for climate neutrality by 2025 and will fix its own course of action under the guidance of CPDP.

climate positivity is the obligation to measure and verify progress. Although the CPDP framework is not rigidly prescriptive in this regard, the City is nevertheless required to conduct a greenhouse gas emissions inventory. Established in 2010 by faculty from Oberlin College, the City plans to update the inventory every five years and work towards the incremental goal of reducing CO_2e emissions at the rate of 1.5% each year (City of Oberlin, 2013). Not just limited to energy or GHG emissions, pursuit of carbon neutrality also entails pursuing sustainable development in an array of interlinked areas such as water, waste, transport, buildings and local food production. Although this engagement to CPDP reflects earlier established priorities, this top-level commitment to community-wide decarbonisation and sustainability has manifested as a direct result of consensus building, lobbying and advocacy activities of various Oberlin Project members (Norenberg, 2013). With the commitment period set to extend until the year 2050, the quantitative target of 'climate neutral' will in effect permanently remain as a core criteria by which the City conducts future planning and policy making. This will continue to be the case long after the dismantlement of the Oberlin Project office and the withdrawal of college-led interventions. In this way, the Oberlin Project has succeeded in achieving one of its core objectives—to institutionalise sustainability into policy where it would serve as a guiding principle for future decision making in the community (Orr, 2013).

Other key impacts to have manifested as a result of activities corresponding to the societal engagement mode of *governance and planning* are the successful decarbonisation of the municipal energy mix. Again, this was achieved through the building of a community consensus, which shaped a landmark decision from the City Council in 2011. It was decided that the City-owned power utility (OMPL) would withdraw from a 50-year purchasing agreement for coal power to a 15-year contract to purchase approximately 62% of annual power requirements from a local landfill gas generation project (Payerchin, 2013). In parallel to this shift, OMPL is also in the process of transferring 23% of power needs to hydro, as compared to 10% in 2011. All this has occurred in spite of a projected 15-20% increase in community power bills (Dupee, 2013). On a personal level, the director of OMPL has admitted that his involvement in the Oberlin Project has converted his thinking from climate scepticism to a genuine understanding of the need and benefits of sustainability-informed decision making for the long-term.

6.2.3.3 Technical demonstrations and experiments

At present, the flagship achievement for the Oberlin Project in the engagement mode of *technical demonstrations and experiments* is the already-mentioned development, deployment and trialling of the 'environmental dashboard' technology. Through this initiative, live and visual data pertaining to water and electricity consumption is now available in all of Oberlin on both an aggregate city-level and individual building-level. This is achieved via a web-platform[70] generating real-time and visual representations of data collected for aspects such as: per capita water and electricity consumption, associated CO_2 emissions, total solar power generated and watershed-level data. Residents can access the data directly from the website, or view live feedback from dashboards installed in multiple buildings in Oberlin College, in addition to strategic locations across the City such as in the public library, elementary school and local cafe.

As well as functioning as a technical demonstration of the potential of live environmental

[70] http://www.oberlindashboard.org

feedback technologies, the dashboard project is also running as a research platform. Faculty involved with the initiative are currently attempting to quantify the effects of the technology in regards to reducing water and electricity consumption and changing building use behaviours. Results from the research are then used to determine which types of visualisation techniques evoke the most effective response when trying to change water and electricity consumption behaviour. The platform is also carrying the wider ambition of deploying the technology to other towns throughout the region, as well as commercialising the invention.

6.2.3.4 Technology transfer and economic development

Economic revitalisation involves the most challenging component of the Oberlin Project. Although concrete impacts in this area are for the most part yet to materialise, some key projects in progress are outlined below.

A key project to create jobs and stimulate the economy is the realisation of a greenhouse facility for using waste heat from the local landfill methane gas generator (currently supplying around 60% of Oberlin's power needs) to enable year-round growing of leafy vegetables. It is envisioned that this project would create approximately 50 jobs, whilst at the same time assist efforts to boost local agricultural consumption and create entrepreneurial opportunities for local producers. A feasibility study was conducted with a private contractor during 2013 in conjunction with the City of Oberlin. The realisation of this project is currently hinged on financial considerations, with the cost estimates being reported as significantly higher than expected (Braziunas, 2013).

Other outcomes to emerge from efforts to stimulate low-carbon development in Oberlin involve the identification and tendering of six hectares of private land in central Oberlin to the private sector. It is envisioned that this land be used for a residential development. Principles of the Oberlin Project and the City Climate Action Plan have been integrated into a request for proposals. This document has specified that all development bids integrate high-energy performance, low-impact storm water management and respect of local ecology, in addition to use of local contractors and suppliers. Collaboration in this regard has been largely achieved by the new position of a housing and economic development officer in the City of Oberlin, for whom a formal part of the job description is to liaise with the Oberlin Project (Frederick, 2013).

6.2.3.5 Reform of built or natural environment

The main driver of sustainability and economic impacts in the built environment for the Oberlin Project will be the earlier mentioned 13-acre development of a downtown block into a Green Arts District. Although this initiative will involve mostly new construction (outlined further below), two completed renovation projects form the first two pieces of this downtown reform. The first is the Allen Memorial Art Museum, renovated to achieve a LEED Gold standard. Features attained by the finished project include a geothermal temperature and humidity control boosting energy efficiency and the use of ecological building materials (locally sourced wherever possible and timber certified from Forest Stewardship Council) and avoidance of toxic substances (Nagy, 2011). A second renovation project undertaken in the context of the Green Arts District is the completed LEED-silver level renovation of the local Apollo Theatre. The significance of these renovation elements is that the Oberlin Project is the only participating member on the CDCP programme involving reform of existing buildings.

Regarding the new construction dimension of the Green Arts District, this is yet to begin due to the time associated to secure adequate funds and approval from College decision making bodies such as the Board of Trustees. However, with the conception of this project an achievement in itself, some key features of the planned development will be summarised below.

Preliminary plans for the Green Arts District such as feasibility and technical studies, artist renderings and 3D models are complete. The vicinity is conceived to be zero-discharge (i.e. no discharge of waste water off-site) and entirely carbon-neutral (i.e. will produce all required energy on site via renewable sources). It is intended as a mixed-use site with architectural renderings currently showing plans for both College and public facilities such as a new four-star Oberlin Inn, new art galleries, studios and performing spaces, a conference centre, restaurants, and 240 student apartments. (BNIM, 2013). The entire 13-acre development is being designed so as to qualify for platinum level for LEED Neighbourhood Development.[71] Present plans for energy systems involve integrated on-site production of renewable energy from sources such as geothermal, solar, wind and biomass. Energy efficiency is being integrated into architectural plans with features such as high insulation and exploitation of natural sunlight for lighting. Being also conceived to respect and mimic natural ecological systems, a technical showpiece of the site will be the eco-machine developed for the Adam Joseph Lewis Centre for Environmental Studies at Oberlin College, which treats all waste water on site through manmade wetlands.

It is envisioned that the Green Arts District will attain several impacts towards project goals. Firstly, it will act as a driver of economic revitalisation by consuming local products such as food, timber and biofuel, and creating local employment and investment opportunities. Secondly, it will act as a test bed and living laboratory for the trial of emerging technologies. Thirdly, it will function as a site for experimental ways of living and working where the creative arts, natural sciences and humanities are brought together around the theme of sustainability. Fourthly, by performing these functions it will thus serve as the physical representation for the societal transformation process underway in Oberlin, most of which is so far invisible to the eye.

6.2.3.6 Socio-technical experiments

It was discussed above that much of the social innovation efforts in the Oberlin Project are centred around efforts to stimulate local consumption of agricultural products in pursuit of a 70% shift to local consumption by 2030. With the Oberlin Project still in early the stages of implementation, concrete impacts towards this metric are yet to materialise. Yet the following discussion presents some key projects in progress.

The knowledge base for a shift to local food consumption has been largely assembled, with efforts now underway to implement recommendations. Knowledge on the various pathways to expand local agricultural consumption and production have been compiled into a report and roadmap (Masi, 2012). Key recommendations include the creation of a local food hub (for storage, distribution, processing and marketing of local foods), a waste-to-food energy hub (for converting organic waste to inputs for local agriculture), the expansion of urban agriculture and a large-scale education effort regarding the local food cycle (Masi, 2012). At present, efforts towards the

[71] To qualify for LEED-platinum level the development must amass more than 80 points across six areas of sustainability defined by the US Green Building Council: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation in design.

realisation of a local food hub are occurring in the neighbouring town of Lorain where abandoned facilities are being recovered for the use of storing, manufacturing and distributing local foods (Adelman, 2013; Burgess, 2013). The goal of this effort is to provide access to an affordable and convenient commercial certified kitchen for local food entrepreneurs. Construction of this food hub is projected for 2014. This extension of activity to the neighbouring town also shows the regional scope of efforts to transform the local food chain. In addition to this, efforts are also being made to increase local agricultural production and sales through the fostering of existing initiatives. A key project here is the local farmer's market of which the management has been taken over by the Oberlin Project and converted to NPO status. As a result of promotion efforts, the number of vendors doubled in the 2013 period and $70,000 was generated in total income (Adelman, 2013).

On top of these efforts to expand local consumption and production of food, other experimentations with social innovation are underway in the form of pilots for local carbon funds. Again, the role of the Oberlin Project staff has been to foster and spring board off existing initiatives. One to have received the support Oberlin Project staff (in the form of grant writing, management and integration into the Climate Action Plan) is a student initiated tree-planting carbon scheme. Here, a $US10 student fee increase is used to finance tree planting to offset student travel to and from Oberlin. The Oberlin Project is hence working with the project as a 'proof of concept' in the wider ambition of creating a local carbon offset market in Oberlin as a means of sequestering carbon and stimulating local investment.

6.2.3.7 Collective impact of co-creative engagement modes

The discussion until this point has examined key outcomes of each of the societal engagement modes in isolation. This sub-section will consider their overall impact in relation to project goals.

The first concerns the emergence and propagation of an action-focused vision of full spectrum sustainability and socio-economic regeneration from the College. This has been adopted and shared by key leaders in the community and translated into a concrete and functioning framework. The value of this 'umbrella' effect is described by Frantz (2013) pointing out that before the Oberlin Project, numerous small pockets of sustainability initiatives were unfolding across the City. Yet they were under-resourced and often in competition with each other. This was due to the absence of an overarching vision or framework to link and synergise these various activities. A key achievement of the Oberlin Project is therefore its ability to mobilise, nurture and up-scale these pre-existing yet isolated initiatives, commitments, key individuals and organisations around a common vision and set of values (Stubbs, 2013). As a result, the Oberlin Project has succeeded in harnessing and channelling the creative and decision making powers of the community to the ambitious and on-going task of simultaneously transforming the economy, energy portfolio, built environment, transport usage, K-12 and higher education, food and agricultural flows, and ultimately, the way people live. This has only been made possible due to a bottom-up approach seeking to co-create the vision of post-fossil fuel sustainability and resiliency—as well as the means by which it would be realised (Orr, 2013). In the same vein, a key strategy in pursuing the materialisation of this vision of post-carbon socio-economic revival has been the commitment to broad and inclusive engagement. This has focused on empowering local change agents, equipping the community to "take care of itself" and make decisions based upon sustainability (Stubbs, 2013).

The second and arguably most striking achievement of the Oberlin Project so far has been its ability to realise exactly what it aimed for at the outset—to permanently shift development trajectories and decision making criteria by institutionalising sustainability in City governance. The major indicator standing in testimony of this accomplishment is the legally binding commitment from the College and City to pursue climate neutrality (and then positivity) in tandem with the CPDP, and the Climate Action Plan (City of Oberlin, 2013) that has subsequently emerged. As discussed above, the securing of political commitment and formal institutionalisation of sustainability into long-term City planning is largely the result of a political decision shaped by a community consensus. This has been heavily shaped from the mobilisation of important community leaders into the Oberlin Project framework, where a community consensus was formed through ongoing discussions between key stakeholders. With the CPDP commitment period set to extend until the year 2050, explicit metrics toward attaining carbon neutrality now serve as permanent and quantifiable measures of sustainability and progress to climate positive development. Furthermore, not being just limited to just energy, this formal and long-term commitment will also guide policies and actions for a range or urban management areas extending from energy to solid waste, water, transport, agriculture and forestry (City of Oberlin, 2013).

Regarding the benefits ensuing formal commitments to sustainability and carbon neutrality in tandem with College and community actors, the City of Oberlin has reported the following advantages. Firstly, collaboration with the Oberlin Project has resulted in accelerated progress toward already pre-existing sustainability goals and commitments. Secondly, the national and international profile of Oberlin as a destination for living and working has increased, whilst it has developed a regional reputation as being an expert on various policy and innovation matters related to sustainability development and decarbonisation (Norenberg, 2013). As for the City owned power utility, the Director (Dupee, 2013) has reported that the exposure to external best practices and expertise through the Oberlin Project framework has been highly beneficial to his role as utility leader and chief decision maker. As for community stakeholders, an important benefit is the financial and project management assistance, leading to increased visibility and an up-scaling of activities across the community.

Table 6.22 Summary of key impacts from Oberlin Project

Engagement mode	College and Project office role	Key achievements or progress
Knowledge management	• Creation of research agendas • Fundraising and allocation of funding • Translation of academic concepts to city-level ('sustainability', 'carbon neutrality' etc.) • Contribution with research (GHG inventory)	• Mobilisation of local and regional experts into knowledge sharing network. • Creation of knowledge base on varied themes: energy efficiency, renewable energy, transport, agriculture, community investment etc. • Application of this knowledge into projects and policy such as City Climate Action Plan (see City of Oberlin, 2013).
Governance and planning	• Core leadership and recruiting of stakeholders • Collaborative planning and political lobbying	• Creation of local governance structure focused on action and holistic pursuit of sustainability • Securing of commitment of both College and City to climate neutrality and sustainable development through (CPDP). GHG reduction goals of 50% by 2015, 75% by 2030 and below 100% by 2050 (base year 2007). • Institutionalisation of sustainability and above climate goals into City policy (Climate Action Plan). • Creation of community consensus, leading to transformation of City power mix from 10.5% renewables and 68% coal (2011) to 90% renewables and virtually 0% coal by 2015.
Technical demonstrations and experiments	• Creation of bioregional dashboard technology	• Development of biofeedback technology. Demonstration in multiple sites across community.
Socio-technical experiments	• Fostering of social capital and existing initiatives • Managerial assistance	• Efforts to kick-start local food hub. • Expansion of local farmer's market.
Technology transfer or economic development	• Project conception and direction	• Conception and feasibility study for year-round vegetable greenhouse with waste heat • Integration of sustainability principles into call for tenders for six-hectare residential development.
Reform of built or natural environment	• Overall conception and direction of • 13-acre Green Arts District development • Initial fundraiser • Design of functionality and contribution to architectural design • Direction of construction	• Conception of 13-acre Green Arts District to function as driver of post-carbon economic revitalisation and showcase sustainable buildings and lifestyles. • Renovations complete for Allen Memorial Art Museum (LEED Gold) and Apollo Theatre (LEED silver). • Demonstration of ecological building and energy efficiency. Only member of CPDP demonstrating retrofitting.

6.2.4 Part 4: Drivers and barriers

This fourth part will highlight positive factors aiding the development of the partnership, as well as identifying obstacles encountered and steps taken to overcome these. It will thus address the following specific research questions:

3.5 *What range of factors has contributed to successful development of the partnership and implementation of various projects?*
3.6 *What obstacles have been met and what measures were taken to overcome these?*

6.2.4.1 Drivers

A major set of factors aiding momentum of the Oberlin Project come from the town's historical leadership and readiness to engage in socially progressive causes. This unique culture has been cited in several of the author's interviews as being a key driver for the myriad of interconnected activities making up the Oberlin Project. The town of Oberlin's engagement to pressing causes dates back to the 1833 founding of the College itself, which was born as the nation's first co-ed higher education institution. Two years later the College made another historically, unprecedented decision—that of adopting a race-blind admissions policy and accepting African American students (City of Oberlin, 2013). This commitment to social justice was also embraced by the community, with the town of Oberlin also serving as a key stop on the 'underground railroad'; a secret escape route to the north for escaping African American slaves from the Southern states. The contemporary residents of Oberlin are proud of this historical leadership and readiness to confront pressing moral issues. Citing historian Geoffrey Blodget, Orr describes such an ethos as "stubborn moral idealism" (2011b, p. 19). Linking this historical inclination to the present day sustainability crisis, in 2006 Oberlin College was one of the first four institutions to sign the American College and University Presidents' Climate Commitment (ACUPCC) and commit to reaching climate neutrality by the year 2025. In addition to this institutional-level engagement, the College also boasts a student population equally committed to pursuing sustainability initiatives. This sprit is also present in the Oberlin community, which is characterised by the presence of many local 'sustainability champions' and activists (Flynn, 2013). As for municipality engagement, the City government has been embracing sustainability policies since 2004 (Norenberg, 2013) and been a member of ICLEI-Local Governments for Sustainability since 2007 (City of Oberlin, 2013). Joining all of these strands together, the Oberlin Project has at its back an entire town, college and City government that has long shared an interest in tackling socially pressing issues, with the challenges of climate change and sustainable community revitalisation being no exception. Actors from the Oberlin Project have therefore endeavoured to harness the innate socially progressive culture of Oberlin to their advantage as much as possible by mobilising and aligning activities with pre-existing sustainability efforts of various organisations and community leaders.

6.2.4.2 Barriers

A major barrier at present concerns difficulties in engaging a broad and inclusive proportion of local residents and lifestyle patterns to the shift towards sustainability and carbon neutrality (Jindra, 2013). Challenges of this nature are surfacing in spite of a community engagement committee group and numerous efforts to increase visibility and awareness in the community outside of the main group of actors and stakeholders involved. Stubbs (2013) points out that the core problems of Oberlin are *social*, not technical. With poverty alleviation and economic development as core priorities, one of the key target populations for the Oberlin Project—the

28% living at or below the poverty line—has ironically been reported as one of the hardest to reach and engage (Jindra, 2013; Pearson, 2013). On a top-level, engagement of the community is assured. Chief decision-makers from the City government, Oberlin College, the local K-12 school system and community colleges, the local power utility, in conjunction with other influential leaders and sustainability champions, are all participating in the Project. On a public level, however, the engagement of a critical mass of civilians such as college students, restaurant and business owners, regular visitors to town, and most importantly, the local population is yet to be realised. Factors hindering the engagement of a critical mass are numerous. They firstly include general low awareness levels of the Project, disinterest or locked-in lifestyles and values. They also encompass misconceptions or mistrust that sustainability is an issue of high relevance to those in the wealthier segment of town with closer ties with the College, yet of low relevance to the underserved population with fewer exchanges with the College or local governance structures.

Key strategies taken to address this situation and engage more distant population segments have been mostly concentrated on communication and 'marketing' of the Oberlin Project. These include information and discussion sessions across a range of public, private and residential venues; newspaper coverage via an 'Energy column' in the local newspaper; electronic newsletters; the use of social media such as Facebook; cooperation with pre-existing community development organisations; and more recently, the creation of a 'community voices' multi-media initiative to showcase residents' daily engagement to sustainability issues. Furthermore, Project actors have gone to great efforts to foster solidarity around the theme of sustainability by providing resources to existing community initiatives, and joining forces wherever possible (Jindra, 2013). Such efforts have been reported as achieving some impact, but far from what is required. As captured by Stubbs (2013), the Project can only ever be "as strong as the people". As captured in the saying "You can lead a horse to water, but you cant make him drink", the complete engagement of all citizens in Oberlin is paramount to the success of the Project. As the Dean of Arts and Sciences at Oberlin College has argued, "if we build new green buildings but populate them with the same old types of activities, we will have failed" (Decateur, 2011, p. 20). The Oberlin Project and College actors are therefore faced with the task of having to penetrate into the realm of civic and public responsibility (Stubbs, 2013). The securing of community engagement therefore remains an urgent, yet largely unresolved issue.

A second challenge or barrier reported for the Oberlin Project concerns tensions that surfaced when the two vastly differing cultures of academia and local government bureaucracy came together to collaborate. This potential for conflict has been fuelled by three converging factors. The first is the presence of pre-existing 'town and gown' tensions. Also present in other college and university towns across America (Perry and Wiewel, 2006), College and City friction in Oberlin has roots stretching back to the 19th century, to differing mind-sets and approaches to carrying out local urban development (Goldstein, 2011). As such, even today many civic and municipal actors today are wary of College initiatives to intervene on the town, no matter how well-intentioned. For the reason that "many people don't like being told what to do by the College" in the City offices of Oberlin (Woodrum, 2013), interventions on City governance and development trajectories by College and Oberlin Project actors initially provoked much resistance (Norenberg, 2013). This situation also appears to have been fuelled by a predisposed "aversion to risk-taking" in the City (Woodrum, 2013). As explained by Frantz (2013), actors from the College and City are operating in two radically different reward systems. City officials on one hand are encouraged to confirm to past norms and protocols, and on the other hand College actors—and faculty in particular—are rewarded for risk-taking and innovating. The unprecedented social transformation goals of the Oberlin Project, coupled with the highly ambitious and novel approaches designed to attain these, have therefore served as a major challenge in identifying areas of common interest for the starkly differing institutional cultures of the College and City. Finally, the third ingredient fuelling tensions is the initial lack of understanding and appreciation of the differing decision making protocols in the City and College. In brief, top-level decisions in the City are ultimately determined by an elected council of seven, whose primary focus is to represent the interests of the community. In the College, on the other hand, many decisions are made by a bi-annual convening of the board of trustees, consisting mainly of alumni. These highly distinctive planning cultures initially created a situation where actors from the City and College accused each other of moving too slow in regard to Project commitments (Norenberg, 2013). Frictions emerging as a result of the three compounding factors described above have, for the most part, been overcome. This has been accomplished through perseverance, continued communication and honouring scheduled meetings and cooperation in spite of tension (Frantz, 2013). Together with the subsequent sharing of mutual success, this persistence has sufficed to foster the emergence of solid relationships and trust, whilst significantly improving City and College relations to unprecedented levels (Norenberg, 2013; Stubbs, 2013).

6.2.5 Part 5: Appraisal of strengths and limitations

This final component of the case analysis will offer an overall critical appraisal of the partnership by considering its approach in regard to its objectives. In so doing, it will respond to the specific research question:

> 3.7 *What are the overall strengths and limitations of the approach of the partnership?*

6.2.5.1 Strengths

A core strength of the Oberlin Project lies in its orientation towards action and practice as opposed to research. This essentially means that the formal knowledge production taking place in the framework of the Project is more so a means to an end, with efforts being made to swiftly translate this into both implementation projects and policy in a wide array of areas. This situation is undoubtedly reflective of the institutional characteristics of Oberlin College, which is not subject to demands for scientific knowledge production and publications that would be expected in a research-intense university. This orientation towards action rather than research has been explicitly articulated by Orr (2013) who underlines that “the academic tendency of turning things into research projects so you can add one more line to your CV does not apply here at all”. Instead, the Oberlin Project is a social transformation project of which the core objective is to “go about the hard business of transforming this little city”.

Another strength stems from the active engagement of the civic sector into co-ordination and governance of the Project (i.e. in both the Project office and various committees). This has been conducive to enhancing public acceptance and synergising the Project with pre-existing sustainability initiatives already taking place in the community. The commitment to grassroots engagement has also allowed the integration of much valuable local knowledge, particularly in regard to food production, forestry and land resources (for example Masi, 2012; Western Reserve Land Conservancy, 2012). The Oberlin Project has therefore employed a simultaneous top-down and bottom-up approach to driving societal transformations towards socio-economic regeneration and carbon neutrality. On one end College financial assets and real estate development projects are being exploited to drive a transformation of the economy and built environment, whilst on the other a core strategy lies in empowering local change agents in the civic sector and fostering existing and new grassroots initiatives.

Finally, another forte of the Oberlin Project lies in the holistic vision of full-spectrum sustainability. This has integrated a wide array of interconnected urban systems into a comprehensive framework for post-carbon economic revival and environmental sustainability. As already outlined in 6.2.2.1, this array of social and environmental systems encompasses everything from energy, policy, the built and natural environment, economy, transport, water, food and agriculture to waste and transport. Projects are therefore being designed in the framework of the Oberlin Project to overlap and generate sustainability gains in as many of these intertwined systems as possible and to contribute to the prosperity and resiliency of the greater town and region (Orr, 2013b, p. 290). The significance of this approach is that until now many approaches to driving sustainable development have been reductionist and focused on single aspects such as buildings, agriculture or transport for example (2011c). The core strength of the Oberlin Project regarding its ambition of bringing about widespread societal change is therefore its attempt to integrate all of the ‘strands’ of sustainability into a single, integrated response to converging challenges of socio-economic decline, energy and climate change (Orr and Cohen, 2013). By doing so, this approach draws simultaneously upon a myriad of previously established academic paradigms for societal engagement. These include urban reform, regional development, transdisciplinarity, technology transfer, economic development, living laboratories and service learning. Consequently, the strength of the Oberlin Project also comes from its holistic objectives activities generating the opportunity for diverse academic and non-academic actors to come together and simultaneously apply College multiple functions to the task of socio-economic regeneration. With such functions including community outreach, buildings and operations, research and education, ensuing impacts of this combining of College resources will potentially encompass social capital building, reform of built environment, economic stimulation, education enhancement and academic knowledge production.

6.2.5.2 Limitations

A core challenge facing the Oberlin Project is the so far limited capacity to drive rapid economic growth in a detracting economy. Despite an explicit resolve to increase total service/retail revenues and new job creation in the community, the author's fieldwork unveiled several concerns that economic development related activities are, so far, not generating as rapid and tangible impacts as expected during the launch of the Project. Several reasons appear to explain this. The first is the lengthy amount of time required to build consensus, raise funds and launch new business ventures; a core area of current activity. Secondly, it has been reported that plans to reduce economic leakage by encouraging local consumption of agricultural products and employment of locals are being hindered by buying behaviours of the College and local businesses; where cost and availability drive most purchasing decisions. Third, Project actors are currently experiencing difficulties in luring outside investments and existing green businesses to Oberlin, which suffers a negative image across the US due to its 'Rust Belt' branding. Lastly, efforts to revive the local economy are to a large degree dependant on the physical realisation of the Green Arts District real estate development. This is because a major role of this urban reform effort will be to boost the economy through both the construction and operation phases. That is, during the building process the development is conceived to consume local products such as timber, whilst creating new jobs by employing local contractors. Then, during the operational phase, it is projected to provide further economic stimulation by sourcing local food and beverage products, whilst also providing infrastructure and physical space for new businesses. However, if comparing progress of the Green Arts District to the timeline in Orr's (2009b) original planning document, it can be seen that the realisation of this vision is any many respects running at least two years behind schedule[72]. This is largely due to fundraising restraints and the time required to build consensus and clear College decision making procedures. As a result of these above-described factors, the economic revitalisation of Oberlin is currently proving more challenging and time consuming than first envisioned.

Another limitation of the Oberlin Project is 'engineered' into its design. Orr (2013) explains that the Project is only intended to function as a College-driven intervention for between four to six years (not forgetting the several years required for its planning and assemblage). This means that there is a paradox of working to trigger a societal shift toward extremely long-term sustainability targets

[72] For example, the new four-star hotel and restaurant in the Green Arts District was originally envisioned as beginning construction in 2011. Furthermore, it was originally envisioned that the acquisition of land for the 20,000-acre greenbelt would begin in 2011, but this too is yet to proceed.

(i.e. climate neutrality by 2050) in a significantly limited amount of time. Coupled with the imminent retirement of initiator Orr, the ability of the present leadership (and the College in particular) to remain as a driving force behind the transformation process and ensure that the initial vision, values and strategies are sustained in the years to come is therefore not possible. The task facing the Oberlin Project is hence as follows. It must firstly lay out the groundwork for a long-term shift towards sustainability and post-carbon economic regeneration in an extremely limited space of time. Afterwards, it must then transfer the ownership and direction of the partnership to the City and community, before finally "going out of business" (Orr, 2013). Although the eventual 'transfer of power' to the City could theoretically be achieved, all indications at present suggest that this will be far from easy. Some Project members have confided that the City is currently hesitant to assume ownership for the Oberlin Project. One possible reason for this appears to be a low-level of involvement and interest in the Project from the lower ranks of City operations (Burgess, 2013). Another reason appears to be the extreme difficulty for a resource-constrained municipality to assume a historically unprecedented leadership role in a cross-sector and highly ambitious socio-economic and environmental transformation towards long-term sustainability goals.

6.3 Discussion of key findings

This sub-chapter extracts and ties together several key theoretical lessons, with potential for generalisation, emerging from the two case studies.

6.3.1 Defining two models of co-creation

This chapter has illustrated two highly distinctive models of co-creation. One occurred in a context of *innovation* and the other in a cadre of socio-economic *regeneration*. Each was shaped by a combination of differing societal conditions and needs on the one hand, and on the other by varying institutional characteristics and motivations. As illustrated in Figure 6.7 below, the convergence of these factors influenced the objectives of each case, which then shaped the type of partnership formed. This in turn influenced the kind and role of key partners and stakeholders involved, together with societal engagement modes exploited, activities implemented, and ultimately, the impacts of each partnership. As well as being demonstrated by each case, the influence of external conditions and internal university motivations has also emerged as highly significant in the macro-level global survey results. Here findings from Section 4.3.6 concerning motivating factors behind the formation of the cases in the global sample demonstrated that the two most important were related to both societal (as represented by the *strategic/developmental* motivation) and university-level factors (as represented by *scientific/scholarly* motivation).

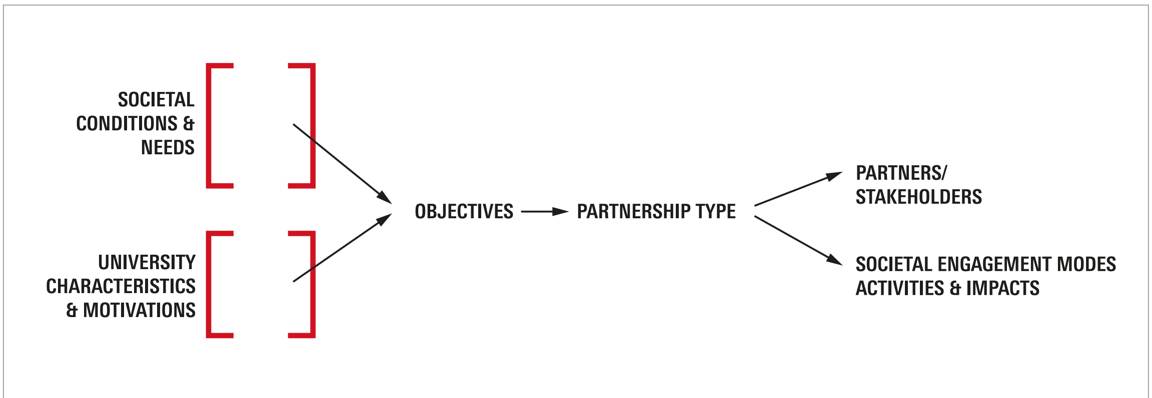

Figure 6.7 Factors influencing the type of co-creation performed

Both case analyses have portrayed the university function of co-creation for sustainability as a form of societal collaboration involving a range of highly complex engagement modes and societal interventions. As such, it cannot be fully understood through conventional notions of technology transfer and university-industry collaboration. That is, both partnerships have clearly demonstrated that other forms of stakeholder collaboration for innovation are possible—models moving beyond conventional processes of technology transfer. If comparing the two cases, admittedly the differences tend to overwhelm any similarities (which are discussed below in 6.3.2). Yet both are testifying to a radical paradigm shift in the academy—a move from the idea of merely generating new knowledge for its own sake to using knowledge and university resources as a means of intervening on society and become a societal transformer (this shift in paradigms is in part described in Figure 3.1 In Chapter 3). Further, both cases have also testified to the potential of co-creation for sustainability to function as a collaborative stakeholder platform for innovation (not just technological but also *scientific, social* and *governmental*) and societal transformations in highly contrasting academic institutions, disciplines and socio-economic conditions. Although the ambitious objective of creating physical societal transformations towards long-term sustainability targets was common to both cases, the approach and structure of each partnership was acutely distinctive. These are briefly elaborated below.

6.3.1.1 A model of co-creation for innovation

Figure 6.8 below maps out a generic model of co-creation for *innovation* based upon firstly the 2000 Watt Society Pilot Region programme from ETH, and secondly from other cases (see Table 6.23) in the global sample corresponding closely to this type of stakeholder collaboration*.* As depicted, this model of co-creation can be expected to emerge in prosperous societal conditions characterised by a strong innovation base, where sustainability challenges are perceived as strategic opportunities to drive scientific, industrial and governmental innovation. In the same vein, this model could be expected to emerge from research-intense institutions and motivations to enhance research activities by engaging in collaborative networks and trial emerging technologies in 'urban laboratories'. A convergence of such factors would shape the objective of driving urban transformations toward sustainability with scientific knowledge & technical innovation, which in many cases of this model has resulted in hybrid partnerships performing a dual function of *research, demonstration or knowledge exchange* and *physical environment transformation*. As also depicted in Figure 6.8, this type of partnership principally concerns the research function of the university and in particular fields in the hard sciences such as engineering and material sciences. These factors lead naturally to a technical approach, which would most likely focus on a set of specific urban sub-systems such as energy, buildings and transport. The societal engagement modes involved by such a model would be chiefly *knowledge management* (i.e. publications, forums and diffusion of results), *technical demonstrations and experiments* (i.e. long-term field tests of emerging technologies such as electric or hydrogen vehicles), but also additional activities in *governance and planning* (reform of industry governance systems and policy making) and *reform of the built natural or environment* (i.e. demonstration buildings and interventions on construction planning). With faculty and researchers being the main university actor involved, another characteristic of this model would be the recruiting of industry experts for the bridging platform to manage and co-ordinate the partnership and set up the various activities and projects. Also distinctive is the presence of industry as a core external partner. Various roles assumed here would be related to research and development, the provision of resources and testing infrastructure such as car fleets and buildings, in addition to the assimilation of scientific knowledge.

Potential impacts that could be expected from this model of co-creation are as follows. Firstly, there would be an integration of scientific knowledge into real-world implementation projects, which would enable the verification of both technical and social aspects of new technologies in 'urban laboratories'. Demonstrated solutions such as new technological prototypes, decision making instruments and socio-technical systems could then be exported as 'tools' to aid wider societal transformations. Efforts to reform governance of industry behaviour via science-backed policy making and regulation could also lead to a change of industry practice. Further, as occurred in the ETH case, this model of collaborative activities with industry and city governments would also facilitate the transfer of promising technologies—either with or without patenting[73].

[73] As technology transfer and economic development was not a major focus of the ETH case, this societal engagement mode has not been integrated into this conception of co-creation for innovation. Yet it should be noted

Case study results suggest that strengths of this model would include the use of scientific research to measure sustainability, shape public policy and influence industry behaviour. Other drivers would come from the recruitment of industry experts, which would allow the synergy and advancement of both industry and scientific knowledge. However potential limitations could arise from the incapacity to tackle lifestyles due to overwhelmingly technical approaches and absence of civil society actors. Other difficulties could include tensions when aligning long-term scientific research agendas with short-term local government priorities for implementation. Strategies in this model must therefore include the co-design of implementation projects with scientific value that could respond to differing priorities and time horizons in local government and academia.

Several other cases in the global sample correspond closely to this conception of co-creation for innovation. Several of these are compiled into Table 6.23 below (and also marked in Figure 4.10 in Chapter 4). The presence of other partnerships closely resembling the attributes of this described model demonstrate empirically that this type of co-creation is also occurring in diverse settings across Europe, Asia and North America in the context of pursing urban sustainability predominantly through technical innovation.

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that several other cases of co-creation for innovation in Table 6.23 involve explicit expectations for the transfer of intellectual property to industry and commercialisation of new technologies.

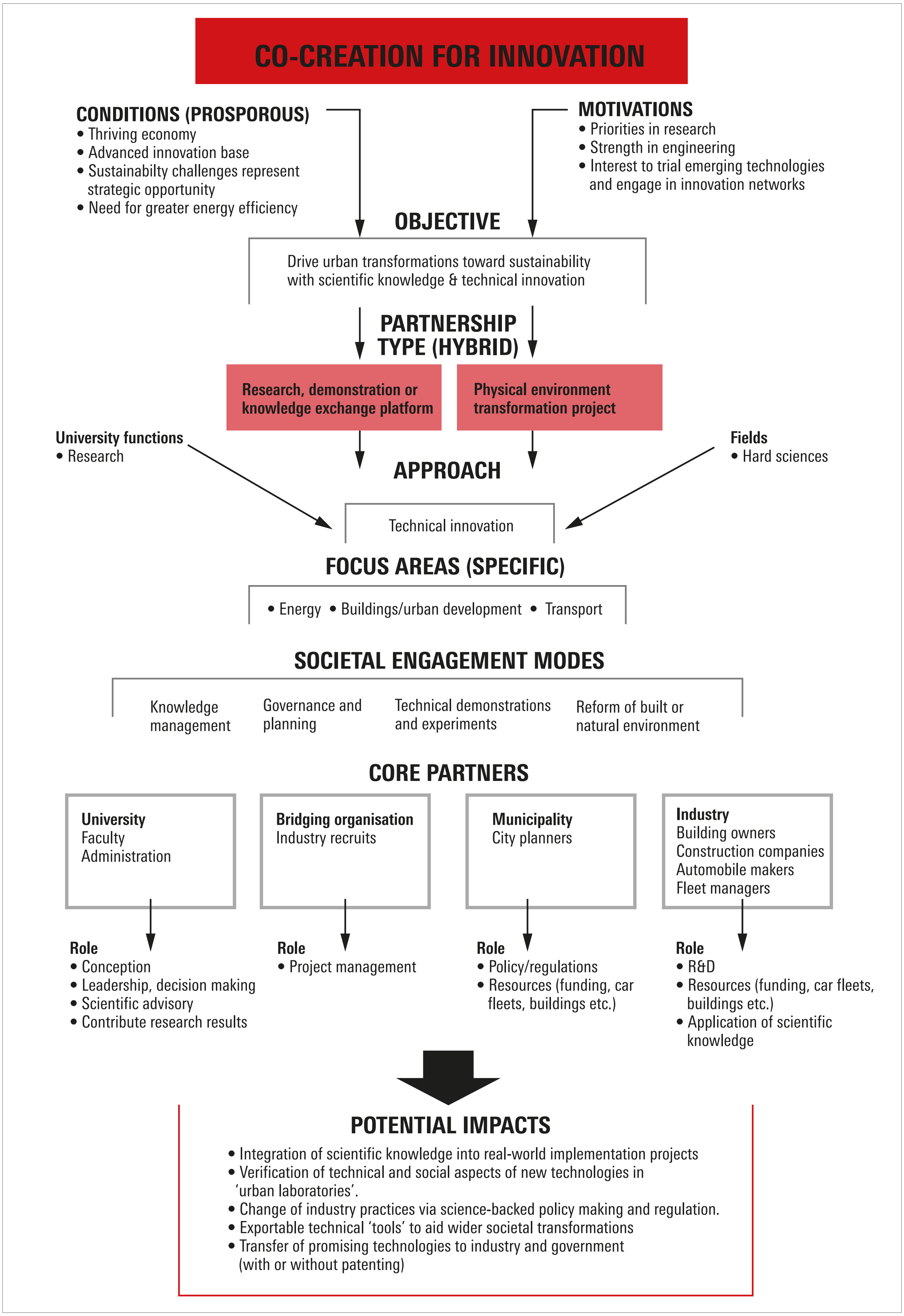

Figure 6.8 A model of co-creation for innovation

Table 6.23 Other cases of co-creation for innovation

Partnership name	Lead institution	Focus areas	Description
PSU/PGE Partnership	Portland State University, USA	• Energy, smart grids • Buildings • Mobility (EVs)	R&D and demonstration platform to drive green growth in the Portland metro region and trial emerging technologies from PSU and PGE in urban settings.
Triple Water Supply (TWS) System	Hong Kong University of Science and Technology	Sewerage and water recycling	On-going R&D, demonstration and implementation platform to utilise Hong Kong's citywide seawater flushing system to develop energy-efficient and low-carbon sewage treatment technologies.
TUM-Create	Nanyang Technological University, Singapore	Electric taxis for tropical mega-cities	Large-scale R&D and eventual field-testing platform with focus on developing an electric taxi for Singapore, with potential for application in other tropical mega cities. Involves all levels of EV taxi transport: from batteries to car design, also extending to citywide infrastructures and traffic control systems.
Energy Atlas	Berlin Institute of Technology	• Energy demand • Visualisation tools	Development, application and transfer of decision making and planning tool for making comprehensive assessments of energy demand, energy balancing and planning, based on a digital 3D model of Berlin city.
City Lab Coventry	Coventry University, UK	• Transport • Buildings • IT • Green business, high-tech startups	Initiative to establish Coventry City as a test-bed, incubation hub and international showcase for low carbon innovation.
SusLabNWE	Delft University of Technology, Holland	Household products and services	A series of model homes have been built or appropriated and integrated into an R&D and demonstration network for generating and trialling sustainable products and services for European households.

6.3.1.2 A model of co-creation for regeneration

Figure 6.9 depicts a generic model of co-creation for *regeneration.* As in the previous discussion, this conception is based firstly on the Oberlin Project and secondly from other cases (see Table 6.24) in the global sample corresponding closely to this kind of collaboration. As depicted, this model of co-creation would be expected to emerge from deteriorating socio-economic circumstances of post-industrial decline, poverty, social exclusion and cities and towns troubled by ageing infrastructures and built environments. In such settings, sustainability challenges such as these, in addition to energy security and climate change, pose a threat to the survival of the town. In this model of co-creation for regeneration, one would expect to see less-research intense institutions (or non-academic actors such as from administration) animated by the awareness that as 'anchor institutions'[74], the long term well-being of that university would be seriously threatened by such sustainability challenges. The combination of these factors would

[74] As argued by Birch et al. (2013), this expression refers to the fact that universities and other social institutions such as schools and hospitals are literally 'anchored' to their surrounding communities. This implies that they cannot easily re-locate to other areas, should this become desirable due to deteriorating external circumstances.

then shape an objective to regenerate socio-economic and physical conditions via sustainable development. This would in turn lead to a hybrid partnership performing a dual function. Firstly that of *socio-economic transformation* and secondly that of *physical environment transformation*. Approaches of this model would be predominantly social, often driven by real estate and economic development. With research being a means rather than an end, the main university functions involved would be buildings and operations and outreach. There would however be potential for the integration of activities from education and research from an array of fields, also extending to the social sciences, humanities and creative arts (as was the case in Oberlin).

The scope of such a model would be broad, with targeted urban sub-systems consisting of multiple areas, as envisioned in Figure 6.9. In contrast to the first model of co-creation for innovation, this type of collaboration could potentially involve an array of initiatives stemming from all six societal engagement modes. Distinctive activities would include experiments with new configurations of businesses, services and financial arrangements (i.e. *socio-economic experiments*), explicit efforts to drive economic development by fostering new business ventures for sustainable technologies and services (i.e. *technology transfer and economic development*) and university-led urban reform and real estate development (i.e. *reform of built or natural environment).* As was the case in Oberlin, *knowledge management* related activities would often revolve around the translation of university-funded studies on external best practices and policy options. They would also likely involve a high degree of political lobbying and collaborative planning and policy making with municipalities (i.e. *governance and planning*).

Regarding actors that would be expected to be involved in this type of co-creation, on the university side this would be potentially broad, generating opportunities for collaboration for faculty, administration, sustainability offices and students. A key feature of the bridging platform set up to manage and co-ordinate the project (this is not a mandatory feature of this type of model) would be the recruitment of civil society experts, as was the case in the Oberlin Project. Regarding external actors, another distinctive attribute would be the broad inclusiveness of civil society as *core partners* (i.e. implementers and knowledge providers) rather than mere stakeholders.

Impacts that could be expected from this model of co-creation are as follows[75]. Firstly, one would expect to see the advancement of *human* dimensions of sustainable development such as the fostering of social capital, social innovation and social inclusion. Other possible impacts would encompass societal transformations or working prototypes of new configurations of energy, policy, transport, carbon finance and food systems etc. Expectations for economic regeneration would be based upon potential to generate economic activity by reducing leakage (i.e. expenditures on imported energy, goods and services) and creating new low-carbon businesses and employment opportunities. Further, efforts to improve socio-economic and physical environmental conditions would also potentially lead to more efficient infrastructures and an improved built and natural environment. This would then generate potential to demonstrate and export emerging building technologies and urban design strategies based upon principles of sustainability, new urbanism and smart cities.

[75] Such potential impacts are also based upon empirical observations from other cases of co-creation for regeneration outlined in Table 6.24.

Strengths of this model would include the potential to generate public support and engagement to sustainability agendas due to a high involvement of the civil sector. However challenges would be encountered in engaging civil support however due to lifestyle and cultural lock-ins. In addition, difficulties should be expected driving economic growth due to the complexity and time required for this task in a contracting economy.

Several other cases in the global sample correspond closely to this model of co-creation for innovation, with some forming in the US Rust Belt or the European equivalent. Several of these have been compiled into Table 6.24 below. Similarly to co-creation for innovation, the presence of other partnerships closely resembling attributes of this model demonstrate empirically that this type of co-creation is occurring in numerous settings and institutions across Europe and North America in the context of spurring socio-economic regeneration through sustainable development.

Table 6.24 Other cases of co-creation for regeneration

Partnership name	Lead institution	Target area	Description
Connective Corridor	Syracuse University	Syracuse, USA (Rust Belt)	Urban-reform initiative to drive economic and socio-cultural revitalisation by linking surrounding community with downtown through public works driven initiative focused on art, technology, and sustainable design.
Rust to Green	Cornell University	Utica, USA (Rust Belt)	Participatory action research effort to connect key stakeholders and generate strategies and projects to trigger Utica's transition from a rust town to a green economy.
Corridor Manchester	University of Manchester	Manchester, UK	Urban reform effort to transform built environment and infrastructure on 243-hectare strip of Oxford Road. Is aiming for a low-carbon hub of knowledge driven business activity, simultaneously generating economic growth, employment and opportunities for research through a living laboratory function.
SUN (Sustainable Urban Neighbourhoods)	*University of Liege*	Meuse-Rhine Euregion: Belgium, Netherlands Germany	Participatory action research and multi-actor learning driven alliance to put seven urban neighbourhoods on pathway to sustainability and stimulate a stagnating socio-economic fabric.
Verdir	*University of Liege*	Liege, Belgium	Socio-economic and research platform to transform industrial waste zones into centres of urban agriculture and aquaculture, stimulating the local economy and creating employment.

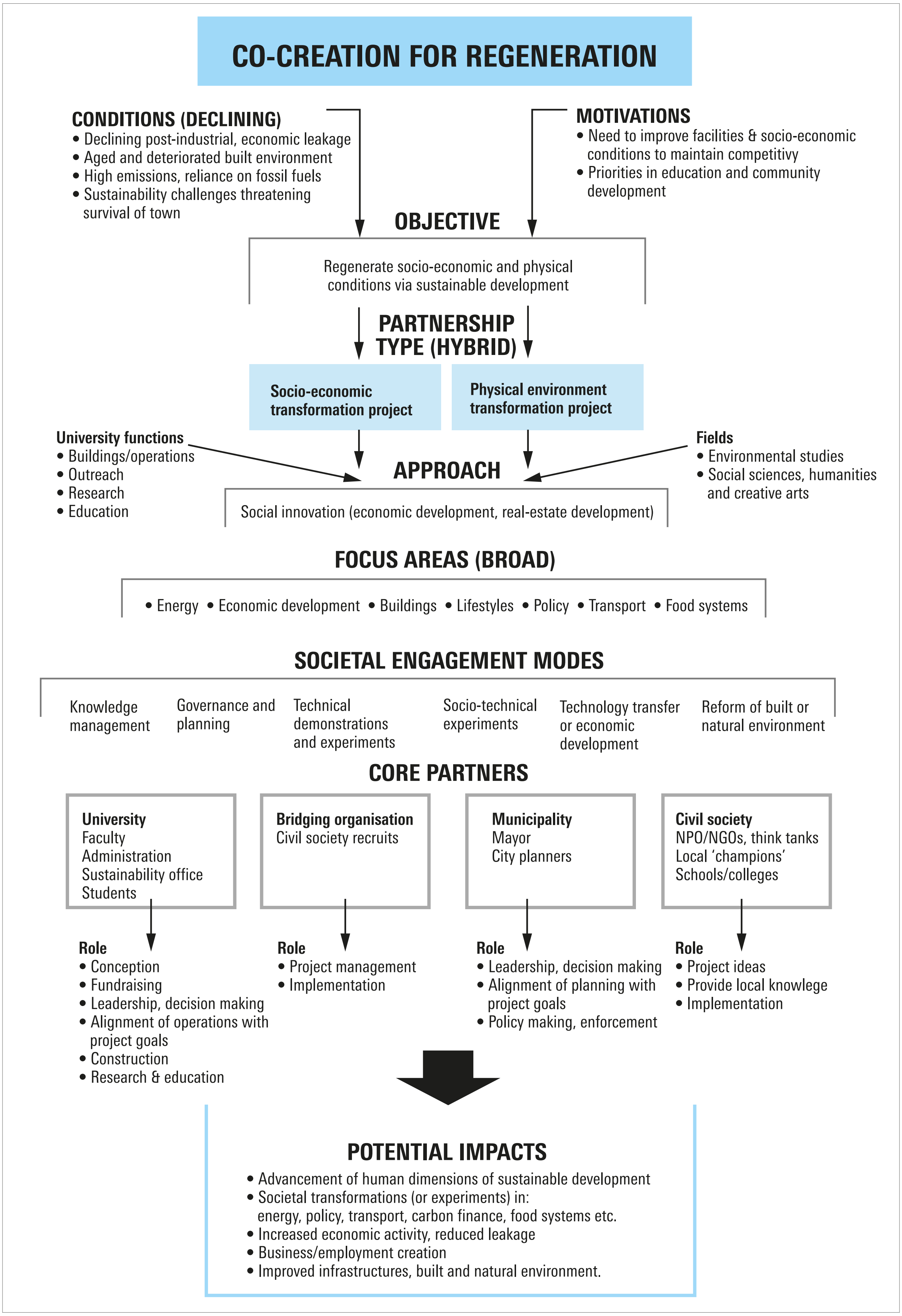

Figure 6.9 A model of co-creation for regeneration

6.3.2 Common processes and impacts in the two models

As has become clear from the above discussion, this chapter has presented two distinctive examples of co-creation for sustainably that can be considered as two “extreme cases of heterogeneity” (Gerring, 2007, p. 51). However, strong patterns have emerged at this point in regard to the exact role played by the lead institution, and the process by which both partnerships have sought to create societal transformations in view of advancing the sustainability of both target cities. This process has been illustrated in Figure 6.10 below. Due to the simplification of the graphic, it should be noted that the depiction of this process does not necessarily represent the true chronological order by which events unfolded.

As can be seen, both partnerships began with a stage of ‘translation’ of universal and scientific concepts to the scale of a single city. In the Swiss example, this involved the application of the scientific vision of a ‘2000-watt society’, which had emerged in the ETH domain almost a decade previously (Imboden et al., 1992; Kesselring and Winter, 1994). Until this point, the use of the 2000-watt terminology was mostly focused on global or national level discourses and had not been applied to any particular location or socio-economic context. In the case of Oberlin, the universal concepts translated to the scale of a city and a specific socio-economic context were ‘carbon neutrality’ and ‘sustainability’. Although global and national climate commitments had fostered other efforts in various cities around the world to pursue sustainable urban development, in Oberlin a global and national discourse was applied to the scale of a semi-rural town of some 8000 residents and a small city municipality. University actors from both ETH and Oberlin College were the main actors involved in the translation of these concepts to external stakeholders, mostly through the creation of discussion spaces and face-to-face meetings. A key outcome of this stage is the shared understanding of the problem (i.e. what needs transforming). When viewed through the lens of the societal engagement modes this process of communication and translation and could be viewed as *knowledge management.* It also became apparent during the case analyses that the institutional reputation and societal trust of both institutions was a major driving factor here in winning stakeholder support.

The next level reflects the ‘coalition building’ stage. As already explained, differing socio-economic conditions, project objectives and institutional priorities have clearly influenced the type of actors recruited. In the co-creation for innovation case of the 2000 Watt Society Basel Pilot Region, goals of creating technical mobility demonstration platforms with scientific value and changing building industry behaviour in regard to energy efficiency and sustainability have prompted the mobilisation of actors from the City of Basel (chiefly from the Office for Environment and Energy), industry (car fleet managers and construction industry players), in addition to the department of energy and building at the local university FHNW. In Oberlin, more ambitious goals of triggering a socio-economic revival, attaining carbon neutrality and enhancing the environmental sustainability and resiliency of the entire City have called for broad civic sector participation. This has implicated local NGOs and development agencies, regional think tanks, local sustainability champions and the K-12 school system, in addition to the highest levels of management in the Oberlin municipality such as the City manager and head of the local power utility. As depicted in Figure 6.10, a key outcome of the university’s role at this stage is the mobilisation of the resources, organisations and actors required to achieve project objectives, in addition to the diffusion of a common vision and set of values.

The next step illustrates the 'strategy and project design' stage. The aim of this stage was to design and then implement a series of interconnected and mutually re-enforcing projects that would spur the societal transformations required to pursue the long-term goals of each partnership. Again, this level could occur either before or after the process of gaining political buy-in. Project ideas in the case of ETH were created through stakeholder workshops with stakeholders from the City of Basel and industry players such as construction companies, building owners and car fleet managers. In the Oberlin Project, project ideas were formed also through stakeholder consultation. They have also been heavily influenced by the specific goals of the Oberlin Project as originally stated in the original planning document (Orr, 2009), which is itself the product of many face to face meetings with various stakeholders. It should also be recalled that this was initially a time of great tensions for both cases as actors from academia, local government and industry/civil society struggled to find a common footing and agree on a set of shared strategies. In the case of the Basel Pilot Region, the initial portfolio of projects to emerge consisted of three areas: mobility, buildings and urban development. In the case of Oberlin, this resulted in much vaster array of project areas: energy planning, economic development, education, policy, community engagement, land/agriculture/food and transport. In both cases, these project areas each then formed their own sub-committees, with university actors maintaining control of the various activities through a core steering committee. In addition to playing a leadership and expert role during this stage, university actors in both cases also played another key function of granting seed funding to the various projects spinning-off from this process. A major outcome to emerge at this stage for both cases is the identification of shared priorities and areas of interest, which then lead to the creation of a portfolio of individual yet mutually re-enforcing projects and corresponding sub-committees. Consequently, this contributed to the synergistic aligning of activities towards a common goal in each of the sectors concerned. That is to say, the integration of research and university activities with government policy and industry or civil sector projects. This stage of co-creation also corresponds to the societal engagement mode of *governance and planning.*

The next step depicted is that of long-term political 'buy-in and target fixing'. This has taken place at differing points in each case. For the Swiss example, the institutionalisation of the 2000-watt target into City legislation took place several years after the commencement of the partnership. Resulting from a citizen referendum, it can be interpreted as occurring both as a result of—and in spite of—the pilot region.[76] Regardless, the City of Basel is now committed to continue its pursuit of 2000-watts and 1-tonne CO2 per capita goal until around the year 2075. In the case of Oberlin, however, this buy-in of political commitment took place at the very early stages of the partnership. It was marked by the City Council's unanimous vote to enter into a legally binding Memorandum of Understanding with the Clinton Foundation Climate Positive Programme (CPDP). This decision was shaped by political lobbying and a bottom-up community consensus that Oberlin College actors played a large part in building. The key outcome for the university actors at this stage is therefore the winning of official political commitment and the institutionalisation of long-term and measurable sustainability targets into local political structures. This period of securing political buy-in could therefore be interpreted as heavily corresponding to the societal engagement mode of *governance and planning.*

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[76] As explained earlier, pursuit of the 2000-watt target was officially institutionalized into City legislation as a result of a City referendum. Decision to officially adopt pursuit of the 2000-watt goal was a reflection of citizen support. This appears to have been shaped by the activities of the pilot region programme on one hand, and by national-level media and scientific communication on the 2000-watt society on the other.

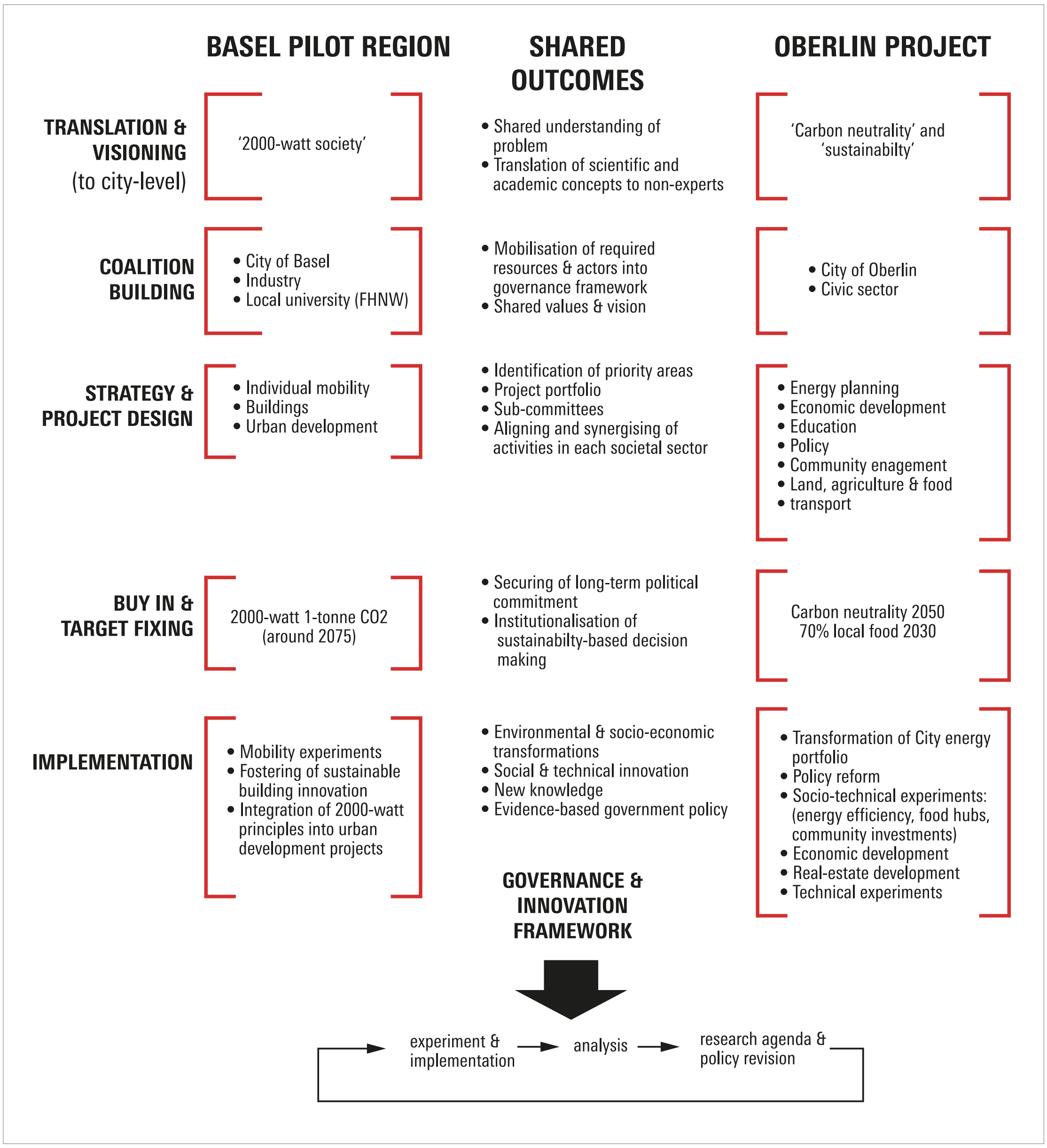

Figure 6.10 The process of co-creation in both cases

The final stage depicted is project 'implementation'. As the various projects carried out and respective impacts have already been dealt with they will not be re-visited here. Yet the crucial point to be retained from Figure 6.10 is that one of the net outcomes to emerge from the various activities taking place in the various societal engagement modes employed is a new *governance framework.* This structure serves on top of existing political processes and is characterised by a focus on action and innovation in pursuit of long-term sustainability goals. Such a view corresponds with empirical observations from other scholars. Bulkeley and Castan Broto (2012) observe that experimental governance is becoming an increasingly crucial way for municipalities around the world to respond to urban climate issues. They argue that the wider trend of cross-sector partnerships for urban sustainability challenges are serving as "new forms of political space within the city" (2012, p. 1), with the implication of this trend being a blurring of city, public and private authority. Evans and Karvonen (forthcoming) have also remarked the emergence of this same phenomenon. They argue that what occurs in experimental governance for sustainability is a recursive learning cycle. After experiments are set up and conducted, data is collected (or effects observed) and this is then fed into government policy. This then sets up a new cycle of research agenda creation and project implementation, from which results are then analysed, and then fed back into policy and research agendas. It is by this process of "learning by doing and doing by learning" (Brown et al., 2003, p. 292) that both partnerships are attempting to create societal transformations in pursuit of the long-term sustainability targets. This theoretical argument from Evans and Karvonen (2012) corresponds clearly with what is happening on the ground in both cases. After a decade of technical experiments and implementation projects, the Basel Pilot Region steering committee has just decided on a reformed set of research priorities for a new term of funding (2013-2017). With the same focus in buildings and construction, a new priority area has now become the renovation of existing buildings with recently ETH-developed insulation plaster for exterior building shells (Government of the Canton of Basel, 2013). This development has occurred after the growing realisation over the past several years that the upgrading of energy efficiency in the existing building stock in Basel remains a mostly unresolved challenge (Stulz, 2012). Similarly, a new area of priority has also become electric vehicles and the installation of ETH-developed fast-charging stations across the city (Government of the Canton of Basel, 2013). In the same vein, the Oberlin Project is also seeking to function as a recursive-learning and governance framework for innovative policy and evidence-based decision making. The array of experiments taking place currently in areas such as energy efficiency, local food, economic development, community investments, transport and so on are also envisioned to serve as learning and knowledge creation platforms for informing evidence-based policy making (Pearson, 2013).

6.3.3 A 'spin-off' model of co-creation

In an attempt to further sketch out potential university models of co-creation for sustainability and extend the process-focused discussion in the preceding sub-section, Figure 6.11 below maps out the lifecycle of the collaboration periods for the two case studies. It envisions both of these cases as a 'spin-off' governance and innovation framework for sustainability that continues to function even after the withdrawal of university leadership. It should be emphasised that this depiction would correspond strongly to co-creation platforms involving *physical environment transformation projects* and *socio-economic transformation projects* involved strong collaborations with local government and commitment to long-term sustainability targets. It is also a type of co-creation that would be highly relevant to the co-creation for *regeneration* model.

The intensity and frequency of university interventions on society are reflected on the *x*-axis, with time depicted on the *y*-axis. In reflection of what occurred in both the Oberlin and ETH case, the university's role begins with a preparation phase of visioning and coalition building. This phase of low-intensity societal interventions corresponds with the period in both cases during which university actors took the respective visions of a '2000-watt society' and a 'carbon-neutral, post-fossil fuel, resilient and sustainable economy' out into society and assembled a team of partners and stakeholders. In the case of Oberlin, it was also an intense time of fund-raising activities. The next phase, that of implementation, marks the period during which the intensity of university-led societal interventions (i.e. the use of various societal engagement modes) escalates. It is the initial 'doing' period and in both cases it involved varying degrees of research activities, technical and social experimentation, and interventions on the built or natural environment. The series of arrows flying away to the right depicts the exporting of experiences (through *knowledge management*), which increases as the partnership grows in maturity. The intensity of the university's societal interventions then reaches a peak and suddenly wanes in accord with the 'transfer of ownership'. With limited funds and human resources dictating collaboration periods, both cases have faced the need to transfer the decision making power and co-ordination of the partnership to the local government authorities or community.

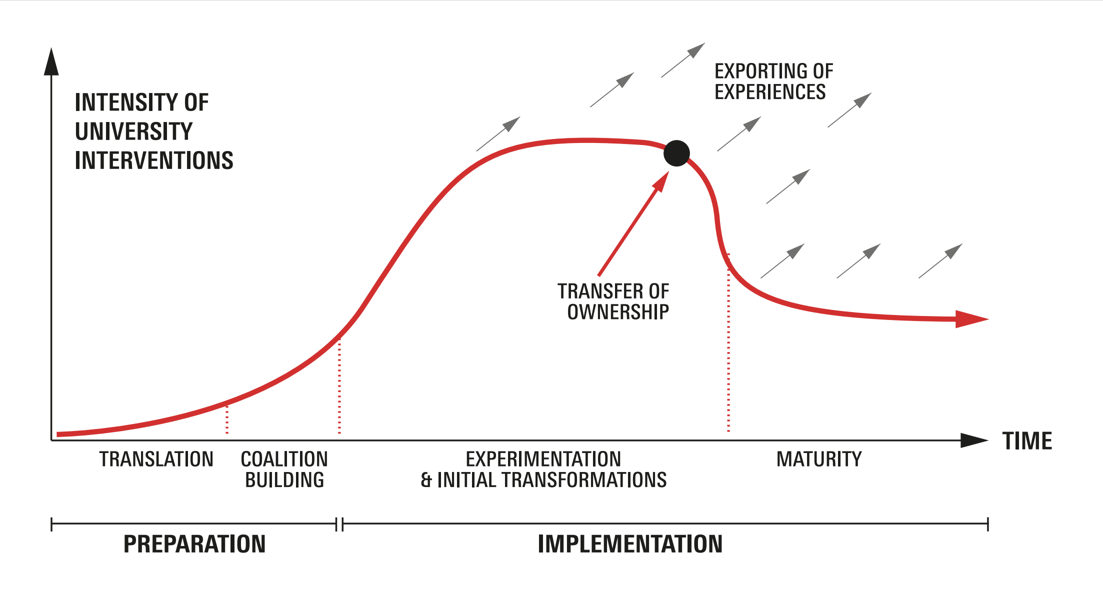

Figure 6.11 Lifecycle of a 'spin-off' governance framework for sustainability

In the Swiss case, this was successfully achieved after the initial ten-year funding period from ETH expired and the co-ordination of the pilot region was transferred to the City of Basel. This transition then reduced the role of ETH to technical input and scientific support. As Stulz (2012b) explains, the vision of a 2000-watts per capita was born as a scientific project that was later transformed to an implementation project, eventually evolving into a political project and 'business model' that has now been 'outsourced' to Basel. In the case of Oberlin, efforts are currently being made to transfer the ownership and decision making power to the municipality and community (Orr, 2013; Pearson, 2013) in consideration of David Orr's eminent retirement and the uncertainty of mostly grant-derived funds for the Oberlin Project office. The timing of these transfers of power and ownership in each case appear to have been determined largely by external factors such as the retirement of partnership leaders and expiration of funding periods. Yet this transition of partnership governance appears both inevitable and necessary when bearing in mind the presence of long-term sustainability targets and the several decades required for their realisation, which sits at odds with the limited time-spans of academic funding programmes. This eventual transfer of power in the spin-off model should therefore be noted as an inevitable means of ensuring the physical continuity and self-sufficiency of the governance platform and progress towards long-term sustainability targets.

6.3.4 Other lessons emerging from the cases

6.3.4.1. The significance of the university's role

In the literature, the powerful transformative potential of the academy to contribute to the materialisation of sustainable development in a particular location or region is neatly portrayed by the term 'change agent' (Peer and Stoeglehner, 2013; Stephens et al., 2007). This ability to act as a societal transformer has been clearly illustrated by both cases. That is, when academic institutions with a powerful technical and socially creative potential such as the ETH domain or Oberlin College apply parts of their research, real estate and community development resources to the task of carrying out social transformations in view of advancing sustainability—the impacts are potentially vast and permanent. The intensity of such a shift is described by a City Council member in Oberlin who recalls: "This is a town where we were getting ready to build another coal power plant only a few years ago" (Burgess, 2013). However the co-creation of societal transformations towards enhanced sustainability was not carried out by university actors alone. It was achieved collaboratively, and this means that tensions will inevitability arise as actors from the "different planets" (Binz, 2013) of academia, local municipalities, industry and civil society come together and search for common ground. Yet both cases have also shown that perseverance can lead to the fruition of synergistic and useful projects capable of balancing and serving the interests and priorities of all parties.

In the vast multi-actor networks and overlapping roles of co-creative sustainability partnerships, it is easy to lose sight of the specific role played or value added by the presence of university actors. Furthermore, functions assumed by university actors in both cases presented in this chapter were strikingly different. For the ETH case it was a primarily a scientific, technical and monitoring role, with co-ordination assumed by the bridging office of Novatlantis, directed by ETH-recruited industry actors. In Oberlin, the role of faculty was far less scientific and more about governance and leadership. For actors in administration the overall function was mostly focused on urban development and using College assets and buying power to drive socio-economic regeneration, in addition to utilising College influence to sway local decision making and development trajectories. Despite the highly distinctive characteristics and mechanisms in each model of co-creation, it should be noted that the special value of the university roles played in each case mirror strongly existing observations in the literature.

Regarding the value and distinctiveness of academic research, for example, Washburn (2006) argues that this lies in the speculative and innovative paths of enquiry adopted by academic researchers—unfettered by immediate concerns for practical use or commercial value. Such a research paradigm, it is argued, is generally too costly or risky for corporations. The development of the hydrogen-powered street sweeper from the ETH domain, and the environmental dashboards from Oberlin College are two perfect examples of innovation and 'risk-taking' that could never be achieved in a commercial model of science focused on short-term commercial gains. Yet the sustainability gains harboured by each, together with the long-term potential for commercialisation and widespread diffusion, would seem to justify the time and resources required for their development. Regarding the real estate and urban development function assumed by faculty and administration in Oberlin, the potential and uniqueness of this generative role for tackling socio-economic decline and revitalising urban areas is also documented and appraised by Perry and Wiewel (2005). They bring attention to the vast economic spending power of universities, which by far dwarves that of most other institutions in the urban environment, in addition to their massive land and real estate portfolios—typically positioned in prime downtown locations. As illustrated by the up-coming Green Arts District from Oberlin College, these assets and buying power have much potential to act as a driver of economic revitalisation and a showcase of sustainable urban development and construction. Finally, the special value of university governance roles is also described in the literature. Gunasekara (2006, p. 103) for example brings attention to the special institutional capacity building ability of universities, emerging from their "broad resource base of people, skills and knowledge". Others such as Arbo and Benneworth (2007) argue that the university has an innate capacity to link vast areas of expertise across society and different geographical scales. Goddard and Chatterton (2003) go so far as to contend that the university's most valuable contribution to regional engagement lies in this ability to "join things up regionally" (cited in Arbo and Benneworth, 2007, p. 55). Finally, Stephens et al. (2008) make the point that such a governance role is enhanced by the university's non-profit focus (which boosts the societal trust afforded to university knowledge and activities) and special capacity to foster long-term thinking critical for sustainability.

6.3.4.2 Institutionalising sustainability goals and commitments via policy

Both cases have illustrated the crucial role played by policy and legislation in permanently shifting development trajectories and the criteria by which government decision making is conducted. In this regard, the case from Oberlin was highly noteworthy. Firstly, it succeeded in building a community consensus droving the City to enter into a legally binding commitment with the CPDP to pursue carbon positive development and reduce CO2e emissions to at or below zero by the year 2050. Secondly, many current efforts are focused upon the collaborative drafting of policies with the City in a range of areas from energy to solid waste, to water, transport, agriculture and economic development. Although advocacy and directly university-influenced policy reform was not an explicit strategy of the 2000 Watt Society Basel Pilot Region programme, city legislation nevertheless played a key role here as well. For example, integration of the 2000-watt target into City constitutions in Basel (and in Zurich as well) has firstly helped to ensure the physical continuation of the partnership. This is in spite of a shift in ETH presidency, which triggered an official renouncement of ETH domain support for the vision of a 2000-watt society—and subsequently for the Novatlantis platform. Secondly, the institutionalisation of energy efficiency standards confirming to the 2000-watt goal have also been used to reform construction industry governance frameworks on a national level. This has largely been accomplished through the integration of scientific knowledge on the 2000-watt society from ETH into the national guidelines for the Swiss Society of Engineers and Architects (i.e. the SIA 2040 Energy Efficiency Path), which, in conjunction with experiences from the pilot region, have also been used as a basis for tightening building code requirements in Basel in regard to building energy efficiency[77]. The influencing of public policy for sustainability in this way now means that in Basel and Oberlin, the outcomes of partnership activities today are in effect 'set in concrete'. Measurable and verifiable sustainability targets (i.e. 2000-watts/1-tonne CO2 per capita and 'carbon-positive') will now continue to influence future urban development and decision making for many years—and possibly decades—after the termination of each partnership.

[77] To recap what was discussed in the ETH case, all new government buildings in Basel must satisfy the equivalent of a Minergie®-P rating, and Minergie® for all new private buildings.

6.3.4.3 Importance of bridging platforms with devoted staff and resources

One common factor that appears to have been essential to the success of both partnerships was the establishment of a bridging platform (i.e. Novatlantis and the Oberlin Project office) with devoted full-time staff and resources. Conforming with the definition of Cash et al. (2003), in both cases this body was intended to act literally as a 'bridging' interface between the university domain and external stakeholders. Both were staffed with full-time experts and practitioners recruited from outside the university, and both were charged with the overall management and co-ordination of partnership activities. Furthermore, as observed by Lienin et al. (2004) the 'dual accountancy' towards the university on one side and external stakeholders on the other appears to have played a key role in ensuring that the huge volume of projects implemented in both cases represented the interest of both internal and external stakeholders. Although the two case analyses in this chapter did not focus specifically on the role performed by the bridging platform, the presence of each appears to testify to their necessity in maximizing chances of success. It is well documented in the literature (Trencher et al., 2013b; Yarime et al., 2012; Whitmer et al., 2010; Zilahy and Huisingh, 2009) that university faculty are constantly subject to time restraints and traditional incentive systems which do not necessarily reward efforts spent with external stakeholders to tackle localised sustainability issues. Furthermore, as one community stakeholder remarked in Oberlin, "it is hard to motivate people when they are volunteers" and when they are participating as a secondary obligation to normal duties (Jindra, 2013). From these perspectives, the value of bridging platforms with devoted, full-time staff and resources to oversee co-ordination efforts and maintain partnership momentum has been highlighted in both cases.

6.3.4.4 The need to engage lifestyles and promote 'sufficiency'

Both cases have demonstrated two vastly differing approaches. The ETH case is pursuing energy efficiency predominantly via technological innovation in construction, urban development and individual mobility. Conversely, the Oberlin case is exploiting mostly social innovation to drive sustainability in a much broader range of sub-fields. Despite these differing approaches, in order to meet aggressive sustainability targets and bring about the holistic transformation of urban systems, both partnerships are facing the need to engage the lifestyles sector. As one Oberlin Project actor explains, the co-creation of societal transformations toward sustainability ultimately requires entering into the realm of "public and civil responsibility" (Stubbs, 2013). In the case of Switzerland, this necessity has come into view with the growing realisation that the 'rebound effect' has the potential to offset sustainability gains from energy efficiency in buildings due to the increase in national flooring space[78] (Spreng, 2013; Stulz, 2012b). The danger of attempting a social transformation project with only technical experts and technical means has also been previously emphasised in Section 6.1.5.2. Here results of an ETH and EMPA study (Notter et al., 2013) were cited to highlight the importance of also advancing the human dimensions of sustainability when pursuing highly ambitious energy efficiency and GHG reduction targets at the scale of an entire city. As argued by the authors, technical approaches to urban sustainability must be complimented by governance and education in the lifestyle sector if populations are to be guided to adopt the principle of 'sufficiency' and refrain from excessive consumption.

In Oberlin, however, this realisation was made much earlier. This may be sensed for example in the argument from Oberlin College's Dean of Arts and Sciences who argued: "if we build new

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[78] As cited earlier, unpublished data from Spreng (2013) shows that national flooring space has increased by 23.5% in 20 years (1990-2010) across Switzerland.

green buildings but populate them with the same old types of activities, we will have failed" (Decateur, 2011, p. 20). The resolve to engage the lifestyle sector may also be gauged from the 'engineering' of the Oberlin Project. It is observable from the dedicated community engagement and education committees and a much broader array of experiments employing social innovation approaches to foster sustainable consumption and lifestyles. More specifically, concrete strategies include attempts to discourage individual automobile transit into Oberlin, expand consumption of local agricultural products, create local investment opportunities (also involving carbon offsets for individuals), boost residential energy efficiency through weatherising and retrofitting, and also, exploit 'environmental dashboard' technology to bring residents to reduce water and electricity consumption. Although it is too early to gauge the success of these initiatives, from a project design perspective at least, the Oberlin Project seems more likely to make progress towards engaging the civic sector and bringing larger numbers of people to adopt a 'sufficient lifestyle' than could be expected from the ETH case.

6.4 Summary of key findings

This chapter has sought to build understanding in the field of co-creative university partnerships for urban sustainability transformations by 'zooming-in' on two frontrunner co-creative universities. The two highly distinctive cases chosen were the 2000 Watts Society Basel Pilot Region from ETH (serving as a model of co-creation for innovation) and the Oberlin Project (depicting a model of co-creation for regeneration) from Oberlin College. The primary goal of this chapter was to generate a detailed understanding of the processes and mechanisms by which co-creative sustainability partnerships emerge, develop and ultimately drive societal transformations towards greater sustainability in the target area. This was in addition to offering a critical appraisal of key outcomes and factors either assisting or impeding the pursuit of partnership objectives. The secondary goal of this chapter was to illustrate the larger point that the function of co-creation for sustainability is in fact capable of becoming an institutional priority—or *mission*—in vastly differing settings and contexts.

The detailed, qualitative analysis of each case demonstrated that the university function of co-creation for sustainability involves a range of highly complex engagement modes and societal interventions that cannot be fully understood through conventional notions of technology transfer and university-industry collaboration. Both cases have clearly demonstrated that other paradigms for collaborative innovation are possible, moving beyond conventional processes of technology transfer. The empirical evidence collected in this chapter is thus testifying to a radical paradigm shift in the academy—a move from the idea of merely generating new knowledge for its own sake to using knowledge and university resources as a means of intervening on society and becoming a societal transformer.

Several important findings have emerged from the this case analysis chapter, some of which are:

- The convergence of societal conditions and needs, on the one hand, and institutional motivations and characteristics, on the other, appear to heavily influence partnership objectives, orientations, mechanisms, partners and stakeholder roles—all of which shape potential impacts towards greater urban sustainability.

- Two models of co-creation have been defined and examined. The first—co-creation for innovation—was born in prosperous socio-economic conditions and a research-intense public university domain motivated by the need to implement a scientific vision through a technical and scientifically robust approach. Characterised by intense relations with industry, core impacts were the long-term demonstration of complete and exportable low-carbon car fleet solutions, also generating scientific value from the interaction of technical and human systems in the 'urban laboratory'. Another was the decarbonisation and transformation of building industry practices through the integration of scientific knowledge into governance and regulation frameworks. The second model of co-creation for regeneration emerged from an American Rust Belt setting of severe socio-economic decline and a non-research intense institution animated by the desire to improve socio-economic and physical conditions to enhance national competitiveness. This model involved a high degree of social innovation and civil society participation, with demonstrated impacts being transformations of policy, governance and social systems, the built environment and potentially, socio-economic revitalisation through low-carbon economic development.

- The collective impacts from these cases demonstrate potential to generate a wide range of outcomes and progress towards urban sustainability that could not be expected from dominating paradigms of technology transfer and university-industry collaboration.

- The two distinctive models of co-creation serves as evidence that the university function of co-creation for sustainability is capable of addressing the needs of a wide array of socio-economic conditions and institutional characteristics and priorities.

- A key net result from both cases is the formation of a governance framework for steering and generating innovation and societal transformations towards long-term sustainability metrics. Both cases have demonstrated the importance and feasibility of 'spinning-off' the ownership of these governance structures to local municipalities so as to ensure the long-term continuity of the partnership.

- Co-creative university partnerships possess the potential to maximise and render permanent political commitments and momentum towards greater urban sustainability (especially in regards to energy efficiency and reduction of GHG emissions). This can be achieved by institutionalising sustainability and numerical targets in government policy and legislation.

- Potential tensions for co-creative university partnerships can arise from starkly differing 'worldviews', priorities and time horizons in academia and local government. A key focus in the co-design of urban sustainability projects must be on finding 'middle ground' to balance the differing needs and incentives of academic actors, government decision makers and community stakeholders to create projects with mutual value for all parties.

- Challenges such as the 'rebound effect'[79] suggest that the ability of technical innovation alone to bring about citywide transformations of complex urban systems and achieve aggressive sustainability metrics is limited. Social innovation and civic sector participation is also required to engage the lifestyle sector and compliment technological innovation. This implies a need for partnerships to enter into the realm of "fostering public and civil responsibility" (Stubbs, 2013) and promote lifestyles based upon 'sufficiency' through governance and education (Notter et al., 2013).

[79] See 6.1.5.2 and 6.3.4.4 or Jenkins et al. (2011) and Nature (2011).

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Chapter 7
Discussion: Beyond the third mission through technology transfer

Purpose: To propose the emerging co-creative sustainability model as the new focus of an expanded and re-interpreted third mission for the university, and demonstrate the benefits, challenges and implications that promotion of this model would provoke.

This chapter draws back upon the various pieces of evidence to have emerged at differing parts during this study. It offers a synthesis of the main arguments, in addition to discussing their implications. It consists of four sections. The first will tie together findings and lessons from both the macro (global survey) and micro-level (case studies) empirical research. It will firstly propose the model of co-creation for sustainability as an alternative to the dominating paradigm of technology transfer and argue for its promotion in academia. It will then illustrate the special significance of the university's role in cross-sector sustainability partnerships. Next, a set of strategies will be proposed for enhancing the transformative potential of the co-creative sustainability model. Finally, it will identify potential institutional challenges that would likely be encountered when promoting the alternative model, suggesting a series of tactics that could serve to increase the visibility of co-creative efforts for sustainability in academia. The second section will then argue for a re-framing of the third mission to address failures until now to adequately account for environmental and sustainability dimensions whilst correcting the over emphasis on technology transfer activities and economic contributions. It will thus seek to redefine the third mission as a potential tool that could be used to promote the emerging co-creative model in academia. The third section will then sidestep from the juxtaposition framing of the dominating model of technology transfer against the emerging co-creative model. It will argue for promotion of the co-creative sustainability model from another perspective; by demonstrating how co-creative sustainability partnerships can enhance the effectiveness and societal relevancy of core university missions of education and research. Based upon these arguments, the fourth and final section then considers the major implications of the emerging phenomenon of co-creation for sustainability from multiple perspectives. Firstly from a policy perspective, by proposing a set of policy options for government decision makers to foster expanded interpretations of the third mission and the formation of additional co-creative partnerships across academia. It then considers the implication of the emerging co-creative model from a socio-historic perspective of the evolutional trajectory of the modern research university. Lastly, the scientific significance of co-creation for sustainability is considered from the perspective of recent international efforts to re-structure the scientific enterprise to rise to the challenge of the global sustainability crisis.

7.1 Towards a new model of stakeholder collaboration

This first sub-chapter is given to proposing the emerging university function of co-creation for sustainability as a stakeholder collaboration and societal engagement model suited to the broad development and sustainability needs of this century.

The advocating of this model is justified principally by two motivations. The first is an attempt to address the host of problems and criticisms directed at the conventional technology transfer model and its narrow economic framing through the third mission. The second is to increase the societal relevance of university activities and illustrate a way that the creative powers of this institution can be harnessed and directed to advancing the sustainability and resiliency of urban settlements and specific societal sub-sectors. This sub-chapter consists of four sections. The first will conduct a comparative analysis of key properties in the dominating technology transfer model with those of the emerging function of co-creation for sustainability. It will thereby demonstrate the ability of the co-creative sustainability model to address the problems associated with the dominating entrepreneurial paradigm. By the same token, it will illustrate the emerging model's potential to co-ordinate cross-sector efforts to advance the sustainability of specific urban or sub-urban areas and societal sub-sectors. The second section will consider the significance of the university's role in co-creative partnerships in relation to other societal actors. The third will then suggest a set of strategies for enhancing the transformative potential of co-creative partnerships for sustainability. The final section will then be given to identifying potential institutional challenges that would affect any attempt to promote the co-creative sustainability model across academia. By referring to the emerging field of sustainability science, it will then suggest tactics to increase the visibility of co-creative efforts across the globe.

7.1.1 Comparative analysis of technology transfer and emerging model

The following discussion offers a comparative analysis based upon Table 7.1 below. This table collates a series of arguments and pieces of evidence appearing at differing points throughout the dissertation until this point. It sets out a systematic comparison of key properties of the dominating model of stakeholder engagement (i.e. technology transfer) against those of the emerging function of co-creation for sustainability. By doing so, it will highlight firstly how the emerging model has the ability to address many of the limitations and concerns identified in the IPR-reliant stakeholder collaboration model of technology transfer. By the same token, it will demonstrate that the co-creative function is structurally and qualitatively more suited to the type of collaborations required for driving societal transformations towards sustainability.

Table 7.1 Comparison of key properties in the dominating and emerging model (After Trencher et al., 2013b)

	Dominating model		Emerging model
Model	Technology transfer	➔	Co-creation for sustainability
Objective	Commercialise research results and contribute to economic development	➔	Create societal transformations to materialise sustainable development
Paradigm	Market logic and entrepreneurship	➔	Sustainability
Catalyst	Technical or scientific problem	➔	Sustainability problem
Product	Technical innovation	➔	• Technical and social innovation • Societal and environmental transformations • Governance structures for innovation and societal transformations
Setting	Traditional laboratory	➔	Urban laboratory
Approach	• Exclusive • Closed-model innovation • Device-orientated • Few and weak societal interventions	➔	• Inclusive • Open-model innovation • Place and stakeholder orientated • Strong and frequent societal interventions
External actors	Experts from industry and/or government.	➔	Both experts and non-experts from industry, government & civil society
Disciplinary relevancy	• Disciplinary • Narrow set of fields including: life-sciences, bio-technology, and computer engineering	➔	• Interdisciplinary • Broad set of fields including: humanities, social and natural sciences, and engineering
Societal engagement modes	• Technology transfer and economic development	➔	• Knowledge management • Governance and planning • Technical experiments and demonstrations • Technology transfer or economic development • Reform of built or natural environment • Socio-technical experiments
Socio economic applicability	• For innovation in prosperous socio-economic conditions	➔	• For innovation in prosperous socio-economic conditions • For regeneration in declining socio-economic conditions

- *Objective*

  As observed by Etzkowitz et al. (2000, p. 313), technology transfer activities in the conventional model are undertaken principally in the aim of “improving regional or national economic performance as well as the university’s financial vantage and that of its faculty”. Chapter 2.4 however, has outlined the author’s argument against this overt focus on revenue generation and economic development, as well as the normative framing of this objective through the articulation of a third mission. Not forgetting that that the capacity of the entrepreneurial model to generate profit and drive economic development has been empirically shown to be grossly exaggerated (Bulut and Moschini, 2009), the author’s criticism of this economic motive is also connected to the sustainability needs of humanity in this century. It is based on the observation that the global sustainability crisis is threating the logic of pursuing economic development alone and that the development needs of contemporary human society are much broader, being situated at the intersection of environmental, societal and economic interests (Kanninen, 2012; Millennium Assessment, 2005). In the emerging model of co-creation for sustainability, there is a fundamental shift in objective. The goal becomes that of responding to local and regional challenges and creating social, economic and environmental transformations to advance the sustainability of a particular location or sub-sector. This has been demonstrated by both the twin case studies in Chapter 6, as well as the 70 cases in the global sample. As demonstrated by the application of the Analytical Framework [A] in Chapter 4.2.2, the holistic development agendas of many co-creative university partnerships will often entail attempts to advance sustainability simultaneously in multiple societal sub-systems. In addition to highly targeted areas such as the *built environment* and *energy,* results showed that many cases across the world are also attempting to transform and advance the sustainability of *governance* and *human and social systems.*

- *Paradigm*
  Criticisms from the author and other scholars concerning the excessive focus on economic contributions in the dominating model of stakeholder collaboration appear to stem largely from the paradigm, or organising principle, of this type of activity. As demonstrated in Chapter 2.3.4, discourses on the third mission, entrepreneurial universities and technology transfer are largely ideology driven. They are based on the belief that scientific knowledge should be capitalised via IPRs and treated as market goods to generate income and economic growth (David, 2003; Saunders, 2010; Slaughter and Rhoades, 2004; Washburn, 2006). Such thinking is based upon market-logic and paradigms such as the corporate model of propriety science. However, Chapter 2.4 argued that this ideology conflicts with the traditional values of academic science such as openness, sharing and collaboration. As many scholars and scientific organisations have argued (Bok, 2004; David, 2003; Heller and Eisenberg, 1998; Kenney and Patton, 2008; Mowery et al; 2004; Nature, 2001; Nelson, 2004; Royal Society Working Group on Intellectual Property, 2003), technology transfer models reliant on the assertion of IPRs risk to hamper overall scientific endeavour by replacing such values with secrecy and competition, which impedes the free flow of data and information. The result of this can be *less*—and not more—innovation and social impacts.

  Conversely, as has become clear from the two case studies and the numerous partnerships in the global sample, in the emerging model of co-creation for sustainability it is the concept of sustainability that forms the *leitmotif* or guiding principle. That is, there is a marked shift towards the pursuit of a type of development conceived in terms of interconnected environmental, social and economic progress, often laden with values such as democracy and social justice.

- *Catalyst*
  In the dominating model of stakeholder collaboration, technical, industrial or scientific challenges are the main catalyst for research activities leading to technology transfer initiatives (Mowery et al., 2004). On the other hand, the 70 cases forming the empirical backbone for this study demonstrate clearly that the process of co-creation for sustainability is triggered by larger societal concerns such as, for example, the need to

create sustainable energy systems, tackle localised socio-economic decay and boost environmental and economic sustainability and resiliency.

- *Product*
  The so-called ‘product’ to emerge from the conventional model of technology transfer is essentially technical innovation. Recalling that the majority of commercialisation activity is concentrated in fields such as the life sciences and software engineering (Mowery, 2007; Mowery et al., 2004), typical products include early-stage prototypes of medical devices, industrial materials, pharmaceutical products, genetic engineering techniques and software packages. The societal benefits of such inventions are often immense and hence cannot be dismissed. Yet it must be emphasised that such outputs are insufficient to tackle localised and complex sustainability issues and trigger the societal transformations required to address such challenges. Alternatively, the products to emerge from the co-creative process for sustainability consist of both technical and social innovation. This may range from visualisation tools for energy efficiency (i.e. Energy Atlas by Berlin Institute of Technology and MEU by Swiss Federal Institute of Technology in Lausanne), to affordable and sustainable urban housing systems (i.e. Alley Regeneration Project by University of Texas) to local food networks (e.g. SEED Wayne by Wayne State University). More importantly, the fruits of co-creation for sustainability can potentially be much vaster, consisting of entire transformations of socio-economic and environmental systems (e.g. UniverCity by Simon Fraser University and Verdir by University of Liege). Lastly, the case studies in Chapter 6 illustrated another important outcome to emerge from the co-creative process. That is a new governance structure for innovation and steering long-term societal transformations towards sustainability, serving as an addition to existing political spaces.

- *Setting*
  In the place-orientated model of co-creation for sustainability, a vast amount of activities take place in a specific real-world location, or at the problem source. The notion of a traditional laboratory is thus expanded to the idea of using the urban environment as a ‘living laboratory’ (Evans and Karvonen, 2011, upcoming; Konig, 2013; Molnar, 2011). Urban areas become a test-bed for sustainability solutions trialled in real-world conditions before exportation to other locations. This is a pronounced shift from the conventional model, where the majority of activities unfold in the traditional university laboratory, isolated from the realm of application.

- *Approach*
  Due to an explicit emphasis on generating and protecting intellectual property, innovation in the dominating model ensues from a closed-type of collaboration. This typically consists of an exclusive set of actors, usually experts from the same field. In the model of co-creation for sustainability, on the other hand, there is a pronounced shift towards inclusiveness and openness. This arises from less reliance on IPRs as a way of transferring innovation. Experts and non-experts from a wide array of fields collaborate in an open-manner. Results from highly visible experiments are typically shared freely amongst stakeholders; as came to light in the Swiss case on the Basel Pilot Region. Furthermore, the conventional model is characterised by a strong focus on ‘device engineering’. In the function of co-creation for sustainability, however, the subject of

enquiry shifts from devices and markets to a specific location, context and set of stakeholders. A consequence of this is a marked increase in the frequency and intensity of societal interventions, which are core drivers for co-creating societal, technological and environmental transformations.

- *External actors*
  The conventional model of technology transfer is often characterised by the conception of a set of 'triple helix' relations between academia, industry and government (Etzkowitz, 2008; Etzkowitz and Leydesdorff, 2000). For the university, the most active actor in the R&D process is industry researchers and experts from the same field. The problem with this is twofold. Firstly, this exclusive collaboration model does not readily encourage the insertion of non-experts and unconventional knowledge sources. Secondly, the participation of civic society such as NGOs, think tanks and civil society groups is lacking from the triple-helix (Etzkowitz et Zhou, 2006). With knowledge produced by the civic sector essential for academic sustainability collaborations (Spangenberg, 2011) it has been argued that the triple-helix conception of stakeholder collaboration is not suited to tackling placed-based sustainability challenges and driving green innovation (Yang et Holgaard, 2012). In contrast, quantitative data results from an application of Analytical Framework [A] in Chapter 4 have shown a marked shift in the co-creation for sustainability model towards diversity and inclusiveness. It was shown that all but seven of the 68 cases represented involved some sort of participation with civil society actors such as think tanks, NGOs and citizen groups etc. This is testifying to the co-creative model's ability to expand the societal reach and ownership of the collaborative innovation process by including a more diverse array of experts and non-expert actors.

- *Disciplinary relevancy*
  As argued earlier in Chapter 2.3, the majority of technology transfer activities in the conventional model are disciplinary and concentrated in the natural sciences (notably life sciences) and engineering (especially computer and bio-engineering). The issue here is that despite attempts to propagate this model through academia, technology transfer has so far not demonstrated its ability to function as a model of stakeholder collaboration and societal engagement in a wider range of fields also inclusive of the humanities and social sciences. The emerging function, however, addresses this concern. The 70 cases collected for this study all involve faculty and researchers from an extremely broad range of disciplines, with partnerships typically consisting of broad interdisciplinary collaborations across the humanities, social and natural sciences. To quickly demonstrate this diversity, project leaders of several cases stem from a range of fields extending from the creative arts (e.g. Green Corridor Windsor by Windsor University), the humanities (e.g. Erie-GAINS by Gannon University) landscape architecture (e.g. Rust to Green by Cornell University) and engineering and agriculture (e.g. Urban Reformation Program for Realization of Bright Low-Carbon Society by the University of Tokyo). This widespread adoption of the co-creative sustainability model appears to be principally related to the potential of utilising a much broader array of societal engagement modes of which technology transfer is but one means of interacting with society. Bearing in mind that other cases still are headed by actors in administration or bridging organisations, the co-creative sustainability model is showing a large potential to be applicable to a wide

arrange of university actors (both academic and non-academic) and disciplines.

- *Societal engagement modes*
  As documented in the literature (Mowery et al., 2004; Mowery, 2007; Philpott et al., 2011) and argued in Chapter 2, the process of technology transfer takes place through a specific set of channels. These include patenting and licensing, creation of spin-off firms and technology parks, contract research and consulting, publications, conferences and supply of graduates. The point was also made that industry continuously cites channels *other* than patenting and licensing as the most important to the technology transfer process (Cohen et al., 2002; Cosh et al., 2006). Chapter 2 hence argued that the problem at stake with the global promotion of the IPR-based technology transfer model is that the excessive emphasis on patenting and licensing can actually impeded the flow of innovation through the other traditional—yet more *important*—channels (Mowery et al., 2004).

  The emerging university model of co-creation for sustainability has shown itself capable of addressing these concerns on two levels. The first stems from its low reliance on IPRs (as confirmed by the low utilisation of the *technology transfer or economic development* engagement mode in Chapter 4.2.7) and its commitment to open-innovation and free sharing of results (as confirmed in both case studies). The second relates to the exploitation of a much broader range of societal engagement modes and innovation transfer mechanisms (listed at the bottom of Table 7.1). As demonstrated through the empirical research component, co-creative actors will typically exploit several of these engagement mechanisms in tandem as they pursue partnership objectives.

  The case analyses have also shown that the simultaneous exploitation of these diverse engagement modes can potentially generate vast and significant progress towards urban sustainability goals (see ‘Part 3: Impacts of societal engagement modes’ in each). The low-reliance of both of these cases on patenting and licensing-based technology transfer (and the majority of cases in the 70 case sample for that matter) appear to be demonstrating two points. Firstly, that other forms of open-model collaborative innovation are possible. Secondly, that the applicability of the conventional technology transfer model for creating societal transformations towards greater sustainability is perhaps limited.

- *Socio-economic applicability*
  The two case studies in Chapter 6 have illustrated two highly contrasting sets of socio-economic circumstances where the co-creative sustainability model can prove its social utility. The first was an instance of co-creation for innovation, unfolding in prosperous socio-economic conditions in urban Switzerland, in contrast to the Oberlin illustration of co-creation for re-generation, which took place in semi-urban conditions of socio-economic decline in wake of a transition to a post-industrial economy. Although these are but two examples, both testify to the broad spectrum of possibilities regarding the socio-economic relevance of the co-creative model. On the other hand, it should be pointed out that the dominating model of technology transfer is typically a phenomenon that ensues thriving economic conditions and environments characterised by dynamic university-industry linkages and well-established innovation bases.

As a final note, Table 7.1 also maps a transition of stakeholder collaboration paradigms in the university. In reflection of this is the observation that although the majority of the 70 cases collected for this study correspond strongly with the right-hand side of the table, several cases (particularly several R&D intensive cases in Asia) also contain characteristics of the convention technology transfer model[80]. Nevertheless, whatever the form that co-creative partnerships may take around the globe, the twin case analysis has shown that the above proposed paradigm of stakeholder collaboration and societal engagement is capable of generating significant impacts upon societal, technological and environmental systems in the context of advancing urban sustainability. This transformative potential was also confirmed by the macro-level appraisal of 55 cases in Chapter 5. Here, quantitative survey results demonstrated that overall there is a significant level of confidence around the world regarding the ability of this co-creative sustainability model to generate positive societal, environmental and sustainability impacts.

An argument has hence been laid out for the promotion of this still emerging and evolving co-creative sustainability model throughout academia. Propagation of this model as a desirable form of stakeholder collaboration would be justified by two purposes. First, to increase the capacity of the university to apply its various missions and other generative functions to the goal of advancing a broader form of social development more aligned to the sustainability needs of this century. Secondly, as a corrective strategy to address the host of problems and criticisms directed at the dominating technology transfer model and its narrow economic framing through the notion of a third mission.

7.1.2 The value of the university's role in co-creation

There have been several other studies around the world to better understand the phenomenon of cross sector attempts to tackle place based sustainability challenges. These include the already referenced studies on collaborative climate experiments (Bulkeley and Castan Broto, 2012; Castan Broto and Bulkeley, 2013; Hoffman, 2011) and sustainability experiments (Bai et al., 2010), which as explained, have not focused upon specifically university-driven cases. Questions that could therefore be raised at this stage in relation to the specific scope of this study are: *Why the particular focus on university-driven collaborations?* and more importantly; *What is the special value of the university's presence in cross-sector attempts to tackle place-specific sustainability problems and what are the implications of this for other cross-sector sustainability partnerships?* Although these points[81] have been in part addressed at various other stages throughout this study, the below analysis will seek to answer these questions by reflecting back upon the findings of the two cases, in addition to understanding gained from the macro-level empirical analysis of the other partnerships in the global sample. It will also support the discussion with insights from the literature.

Based upon the empirical observations conducted for this study, the special capacity of the university to play a decisive role in cross-sector attempts to advance urban sustainability could be summarised as follows:

[80] For example, if citing TUM-Create and Sustainable Supply Chain Centre – Asia Pacific (SSCCAP) as two such cases, attention should be brought to the fact that both involve a strong emphasis on generating intellectual property and commercialisable results. Further, participation of civic society is lacking in both cases.

[81] The author is indebted to Takashi Mino at the University of Tokyo for highlighting the importance of these considerations.

- *Societal influence*

  It was reported in the literature review that universities enjoy a privileged and influential role in society due to the societal trust that accompanies their non-profit status (Bok, 2003); longevity as social institutions and their ability to address long-term and pressing societal challenges (Stephens et al., 2008). From this perspective, it was contended that universities are covering a 'market failure' by undertaking long-term research agendas with little prospect for financial payoffs—a task that few other market actors have the luxury of fulfilling (Washburn, 2006). It is for these very reasons that universities are generally trusted as highly reliable sources of information, devoid of the biases and vested interests often observable in industry or government studies (Bok, 2003). The case studies have illustrated that this argument clearly holds weight. Lienin et al. (2004), for example, have pointed out that the reputation of the ETH domain was a decisive driver in winning government and stakeholder trust and support for sustainability projects based upon the ambitious vision of a 2000-watt society. Concerning the Oberlin College case, as members of an elite liberal arts institution, university actors here have also enjoyed an influential status as 'experts' within the community when it came to matters of sustainability, carbon neutrality, green buildings, energy efficiency and economic revitalisation.

- *Fund-raising power*

  A unique role emerging through the empirical analysis—yet so far not highlighted by the literature on university sustainability partnerships—is the fund-raising ability of the university. As institutions engaged in a permanent battle to secure research funds (Bok, 2003; Ueyama, 2010), university actors (and faculty and researchers in particular) are generally speaking, extremely apt at securing funding through grant applications. This capacity to secure research funds from diverse government, private and philanthropic sources is often superior to that of industry, government or civil society actors. Although lack of adequate funding was continuously cited throughout this study as a barrier, in the cases where sufficient funding was secured, this was reported as a driving force for winning support and mobilising other stakeholders. The Oberlin Project also highlighted the value of this fund-raising power. For example, the Green Arts District urban reform effort is a classic example of 'playing sustainability with other people's money'. A large proportion of the funds required for realisation of this project have been sourced from a combination of private and corporate donations and federal grants. Although the total amount of funds secured for the project is difficult determine due to privacy policies, at present the College is reporting that $US 13.8 million has been raised from donations alone[82]. These funds are being used to kick-start the initial planning and fund the renovations of the theatre and art museum. The City of Oberlin was also significantly aided with the College's procurement of external funding that was subsequently used to finance several studies that otherwise the City would not have had the funds to conduct (Braziunas, 2013). Furthermore, College-secured funding was also able to foster and up-scale existing sustainability initiatives in the community (Frantz, 2013) as well as provide seed-funds to new project activities born in the cadre of the Oberlin Project.

[82] See URL: http://campaign.oberlin.edu/green-arts-district, last accessed December 5, 2013.

- *Governance and linking capacity*
  It has already been mentioned in the literature review that universities are innate linkers and governors due to their multi-sector interactions with various regional, national and global networks (Arbo and Benneworth, 2007). The vast array of disciplines and activities making up the university means that they enjoy multi-faceted connections to expertise and diverse stakeholders from government, industry, civil society and other academic institutions (Sedlacek, 2013). This ability to exploit connections to mobilise required leaders, create a critical mass of commitment and innovation, and source knowledge and best practices from other societal sectors was cited by both the City of Oberlin (Norenberg, 2013) and City of Basel (Martin, 2012) as being of special value. This was for the reason that participation in each partnership allowed the respective municipalities to access knowledge, technology and best practices that would not have otherwise been possible. Also, the governance potential of universities has also been demonstrated by both case studies. It was argued that one of the key impacts or 'products' to arise from each partnership was a new governance platform for innovation and sustainability. The special value of these platforms is that they had not existed before and that they can be designed to be 'spun-off' to local government. This was shown by both cases as a means of ensuring their continued functioning as a long-term and action-focused directive body for rule-making and collaborative innovation activities—even after the withdrawal of university leadership.

- *Innovative potential*
  The special creative powers of the university and the significance of these for attempts to bring about the sustainable transformation of communities and regions (Cortese, 2009; M'Gonigle and Starke, 2006; Stephens et al., 2008) have been already acknowledged in the literature review. It was also argued that this potential to contribute technical and social innovation to cross-sector sustainability efforts is due to several factors. The first is the above-mentioned distinctive culture of academic science, which protects researchers from demands for utility and commercial gains, encouraging risk-taking and innovation (Washburn, 20006). The second is due to the collective expertise and intelligence harboured by the sum of the various disciplines in each university. Although this wealth of knowledge is often left unexploited due to disciplinary and 'separation of labour' approaches (Taylor, 2009), the potential of the totality of this knowledge should be regarded as far superior to that harboured by any other social institution. The remarkable level of technical and social innovation employed by each of the cases in the global sample brought into light the relevance of this argument, as do the two case studies. The hy.muve hydrogen-powered municipal vehicle (see Chapter 6.1.3) from the ETH domain and the bioregional dashboard system (see Chapter 6.2.3) from Oberlin College have both demonstrated that the university's creative potential is often far superior to any societal actor, and large appreciated by industry and government. It should be emphasised, incidentally, that the innovation arising in both of these contexts was largely the result of combined expertise from several departments or institutions—resources lacking to most social and government players.

- *Real estate development potential*
  Another key role to have emerged from the micro and macro-level empirical analysis

concerns the real estate development potential of the academy and the possibility of using this as a driver of economic revitalisation. Universities around the world possess vast real estate and land assets—often concentrated in strategic downtown settings. The potential of utilising these resources as drivers of economic development has been explored by the 'urban reform' body of literature (Hoereth et al., 2007; Perry and Wiewel, 2005; Wiewel and Perry, 2008). Yet the university's ability to utilise these same assets for driving sustainable transformations has, until now, been mostly unappreciated by the body of scholarship pertaining to sustainability. This is despite the potential of universities to exploit these assets as large-scale and influential demonstrations of sustainable construction and low-carbon urban development. Several cases in the global sample have proven that realisation of this potential is possible. To begin with mostly completed partnerships, large-scale real estate development projects UniverCity by Simon Fraser University and Connective Corridor from Syracuse University are both driven by principles of sustainability and new urbanism. Both are demonstrating the remarkable power of the university to transform the urban landscape, lifestyles and transport usage through real estate development, whilst also stimulating economic development. Other equally ambitious cases unfolding in the same way include the already discussed Green Arts District from the Oberlin Project and Corridor Manchester from the University of Manchester and Manchester Metropolitan University.

- *Wealth of expertise from diverse activities and functions*
  As well as being a place of education and research, the university is home to a vast array of other activities. To mention but a few, these include technology transfer, campus management, construction, purchasing, finance, outreach and community development. The problem, however, is that the totality of this knowledge and capability of these individual activities is seldom exploited for the purposes of driving sustainable development in the surrounding community. Yet the sum of the knowledge and expertise of the university's diverse functions is immense and often far superior to that of any other market, government or social player. Empirical research in this study has shown however that co-creative partnerships are often characterised by a high-degree of internal collaboration; not just across departments but across differing sectors of university activity. Numerous co-creative sustainability partnerships identified for this study are therefore demonstrating that there are growing attempts around the world to harness the totality of expertise and activities contained within the university and direct these to the task of collaborating with external stakeholders to create societal transformations towards greater sustainability.

To tie all these aspects together, the transformative power and sustainability impacts of the 70 cases collected for this study should be regarded as being positively influenced in varying degrees and combinations by the university's above-described properties. This is not to argue that university-driven co-creative partnerships are more effective at creating societal transformations towards greater sustainability than non-university partnerships. Rather, the point is that due to the above-described attributes and capacities, the goal-achieving potential of the 70 cases identified for this study has been significantly enhanced by the presence of university actors. The implication of this is that the transformative capacity and effectiveness of other cross-sector attempts (or planned attempts) to advance urban sustainability around the world could be significantly enhanced by the involvement of university actors.

7.1.3 Strategies for enhancing the effectiveness of co-creative partnerships

This section is targeted specifically at university actors and consists of a set of tactics for enhancing the transformative power of the university function of co-creation for sustainability. The following discussion is by no means intended as exhaustive. Instead, it simply aims to collate several lessons emerging as being of particular importance at various points throughout the literature review and empirical research.

Table 7.2 Strategies for locating 'middle ground'

Local government	'Middle ground'	Academic research
Project-driven	Practical projects with research value	Research-driven
Demands for practicality and implementation	Implementation projects with scientific credibility and value	Demands for scientific credibility and value
Short-term focus	Interconnected short-term projects as incremental steps to long-term targets	Long-term focus
Aversion to excessive risk-taking	Innovative projects to aid progress to government priority areas	Innovation and risk-taking encouraged

7.1.3.1 The need to find 'middle ground'

It has come to attention at various points throughout the empirical research in this dissertation that the 'worldviews', priorities and operating cultures of each societal sector differ significantly. In particular, questionnaire responses and case study interviews have highlighted that such differences tend to be particularly striking in relation to the interest areas and motivations of local government and academic actors. As depicted in Table 7.2 above, the case studies and the Application of Analytical Framework [B] for drivers and barriers in Chapter 5 has shed light on multiple views from academic actors that local government actors tend to be focused on implementation and the short-term, often with an aversion to risk-taking. This can be at odds with the long-term focus of academics dealing with sustainability, who in contrast, operate in an environment where risk-taking and innovation is encouraged, and scientific credibility and value is paramount. It was also established that such cultural differences can constitute a source of tension or difficulty in the early stages of partnership formation and project planning as actors from differing sectors struggle to find a common footing and shared set of priorities. As suggested in Table 7.2, this finding brings to attention the need for academic actors to search for 'middle ground' and shape the goals and research agendas of co-creative partnerships for urban sustainability in accord with the contrasting interests of local government actors.

The case on the 2000 Watt Society Basel Pilot Region programme served as an excellent illustration of this. Here it was reported that the cultural divide of actors from "two different planets" (Binz, 2013) was eventually overcome by structuring pilot region projects to serve the interests of both parties. In the mobility component, for example, a series of R&D and demonstration projects were set up to deal with priorities and strategies for the short (LNG), medium (biogas and EVs) and long-term (hydrogen). The short-term LNG project (involving integration of LNG powered vehicles into local taxi fleets) therefore emerged as implementation project with scientific value generated through the production of data on emission performance and driver and customer acceptance levels. The hydrogen fuel-cell mobility project was also able to move into the government interest zone. It achieved this by addressing the municipality need to reduce emissions and fuel expenditures arising from conventional diesel-powered street sweepers, in spite of a long-term time-horizon that also involved R&D. In the building component, long-term and target-driven academic sustainability agendas were brought into the government's field of interest by allowing university actors from ETH and FHNW to function as consultants and judges of tender bids for already planned industry and government projects. In Oberlin, it was also reported that College and City government relations were an initial source of friction as actors from the two sectors struggled to overcome differing priorities and a history of 'town and gown' tensions. However, time and perseverance—in spite of tensions—eventually sufficed to foster the emergence of solid relationships and trust. Another decisive factor in gaining local government support was the alignment of College development plans (i.e. facility upgrades via the Green Arts District) with the wider government priority of inclusive social development and economic revitalisation in Oberlin (Norenberg, 2013). In summary, both of these cases testify to the possibility of overcoming initial differences in local government and academia regarding priorities, value systems and time horizons.

7.1.3.2 Strategic alignment and synergy

Another key lesson to have emerged from the case studies was the importance of bringing into alignment government policy, university activities, industry practice and community initiatives when attempting to create societal transformations in pursuit of long-term sustainability goals. As depicted in Figure 7.1 below, the transformative potential of co-creation for sustainability is enhanced when the activities and long-term commitments of the four societal sectors are brought into alignment and in pursuit of the same objective. Figure 7.1 also depicts oscillations of short-term political cycles, typically lasting four-years. These waves can potentially constitute a major barrier to long-term commitments due to the shifting of government priorities in each cycle. However, the integration of long-term sustainability commitments into courses of action in the other sectors can overcome this by serving as a guiding principle and thread of continuity and permanence. Particularly for co-creative partnerships attempting to drive large-scale societal transformations requiring many years for their realisation, it becomes paramount to maintain this alignment of priorities and activities for as long as possible. Based upon observations from the two case studies it appears that this synergistic alignment can be achieved and sustained in three ways:

- By creating value for all parties involved
- By integrating long-term sustainability goals into government policy (i.e. institutionalise sustainability-based decision making)
- By fixing quantifiable and measurable targets

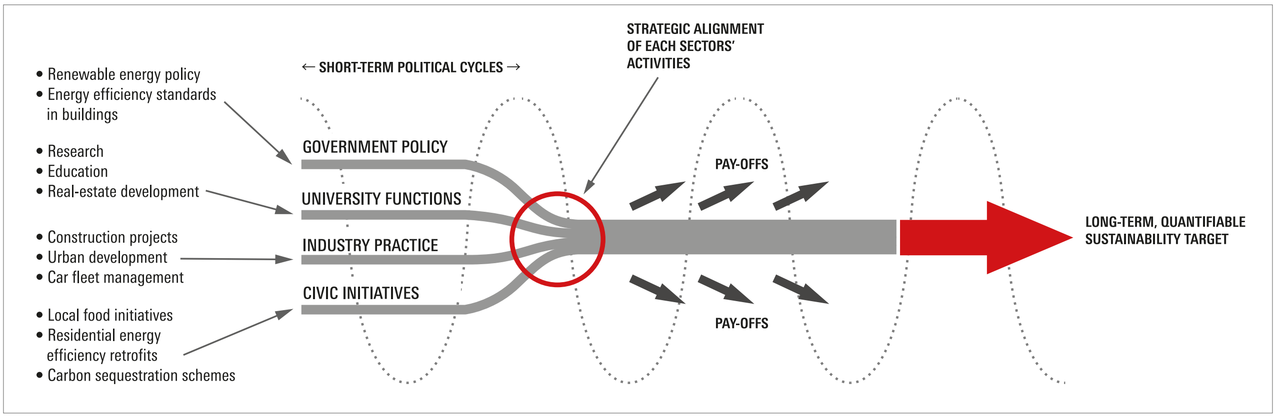

Figure 7.1 Enhancing transformative potential of co-creation via strategic alignment (own source)

The logic here is that when government policy is 'locked in' to pursuit of a long-term sustainability target, the continued commitment of government regarding progress towards this goal is assured, despite shifting political agendas. The value of quantifiable targets is that they allow incremental and measurable progress towards long-term goals, hence functioning as objective measurements of sustainability. Lastly, when 'pay offs' are generated along the way, this assures the continued interest of participating organisations.

Both case studies served as ideal depictions of how the above-described strategic alignment can be sustained. In the Swiss case, although civic sector participation was not prominent, scientific research agendas of the ETH domain and FHNW, government policy and industry behaviour have been brought together into alignment since 2001 through shared interest in creating functioning showcases of low-carbon urban development in the city of Basel, in addition to the procurement of a '2000-watt society' brand for building projects. The criteria of a '2000-watt' and 'one-tonne-CO2' society (itself a numerical and measureable target) serves as the long-term guiding principle for all undertakings, with a realisation date loosely set for the year 2075. Ongoing commitment from future government actors has been assured by the 2000-watt yardstick for sustainable development being 'locked into' City legislation—as well as that of other cities such as Zurich. As for pay-offs generated along the way, for academic actors these include the procurement of feedback and data results from real-world experiments outside of the traditional laboratory. For industry, this consists of the procurement of cutting-edge low-carbon technologies from the ETH domain. For local government this includes benefits in the form of progress towards lower energy expenditures in government infrastructure and greater energy security from enhanced energy efficiency and renewable production. Regarding the transformative outcomes of this co-creative relationship, as argued in Chapter 6 a significant outcome has been a substantial transformation of building sector practices. This was largely accomplished through the fostering of demonstration low-carbon buildings and innovative urban development projects integrating principles of a 2000-watt society. A key part of this process was the reform of building industry governance frameworks and strengthening of building code requirements in Basel.

In the case of Oberlin, the previously un-cooperating transformative potential of university activities (not only research but also campus and real estate development and education), government policy and civic sector sustainability initiatives have also been brought into alignment through the Oberlin Project. The mutual long-term commitment of these sectors is carbon-neutrality—also a measurable and verifiable target—and the economic revitalisation of the town of Oberlin. This commitment has been institutionalised via participation on the Clinton Climate Positive Development Programme. Although the core fruits from this nexus of forces are yet to materialise, major outcomes of this this strategic alignment to date include the transformation of the municipal power mix from 10.5% renewables and 68% coal in 2011 to 0% coal and 90% renewables (23% hydro and 59% landfill gas) by 2015, the creation of a concrete government road-map for achieving climate neutrality via incremental and target-based projects in energy efficiency and sustainable development; and the implementation of a portfolio of social innovation experiments dealing with food hubs, local investment and new business creation.

With long-term sustainability goals institutionalised in this manner in both Oberlin and Basel, it is expected that the above-described alignment of creative forces will continue to provide a thread of continuity and permanence to the short-lived cycles of political discourse in both Cities. It thus also expected that the momentum established by both co-creative partnerships will continue producing sustainability gains and progress towards respective targets well into the future.

7.1.3.3 Project management and bridging organisations

The application of Analytical Framework [B] in Chapter 5 has revealed that many of the key obstacles facing actors in co-creative partnerships are—with the exception of *external funding*—related to internal dynamics and the broader theme of 'project management'. Specifically, these include: *time restraints, lack of unity/harmony, communication difficulties* and *poor management and leadership.* Unlike external factors, these internal barriers should be regarded as surmountable or avoidable for the reason that they can be more easily controlled. In accord with the arguments of Hanleybrown et al. (2012) and Kania and Kramer (2011), a key strategy for overcoming these obstacles can be the provision of a dedicated staff and project co-ordination facility, often referred to as a 'bridging organisation' (Lienin et al., 2004).

From this perspective, the two case studies have clearly demonstrated the value of such organisations, which literally serve as portals located at the interface of academia and society. In the case of the 2000-watt Society Basel Pilot Region Programme, it was the Novatlantis platform—headed by industry practitioner Ronald Stulz—which served as both the founder of the pilot region and subsequent coordinator and promoter. In the case of Oberlin, day-to-day co-ordination and project management is headed by a specially established office housing a staff of four from civic backgrounds. This allocation of dedicated resources in both cases has ensured that project management related issues have been dealt with at the outset. That is, the issue of *time restraints* is to a major extent alleviated as dedicated project staff free up time and energy of principle actors by overseeing duties such as co-ordination, planning and data management. Secondly, allocation of project staff can also serve to alleviate or prevent other commonly citied barriers such as *lack of unity/harmony, communication difficulties* and *poor management and leadership.* Concretely, this can be achieved by bridging staff performing the three roles identified by Cash et al. (2003); namely, communication, translation and mediation. Regarding the communication function, office staff in the Oberlin Project, for example, are able to create and maintain partnership momentum, unity and the commitment of each societal sector by engaging regularly with partners and stakeholders on behalf of core leaders. Being neutrally located at the intersection of academia, local government and civil society, they are also able to perform the *mediation* function by identifying and resolving conflicts and facilitating the flow of information across societal sectors. Lastly, as was also the case with the Novatlantis platform, bridging staff are also able to carry out the *translation* function. That is, they can promote project cohesion and the sharing of a common vision and agenda by translating scientific concepts and 'jargon' to stakeholders; many of which are non-experts from civil society and local government. It is the combination of these above functions which can, as argued in the literature and demonstrated by the case studies, serve to alleviate or overcome obstacles related to internal dynamics and project management.

Finally, the 'outsourcing' of the project management to bridging organisations also has secondary payoffs. As observed by Lienin et al. (2004), the 'dual accountancy' towards the university on one side and external stakeholders on the other appears also to have the effect of ensuring the various projects and activities co-ordinated through the organisation represent the interest of both internal and external stakeholders.

7.1.3.4 Limitations of techno-centric approaches

The final strategy to be suggested as a means of enhancing the effectiveness of co-creative partnerships for urban sustainability transformations is an approach integrating both *technological* and *human* dimensions of sustainable urban development. The two case studies have demonstrated that two highly contrasting approaches are possible when seeking to trigger societal transformations to advance urban sustainability. The Swiss case, being the product of a large-scale research university with a strong base in science and engineering, has employed a techno-centric approach. This has focused predominantly on driving energy efficiency in building, urban development and individual mobility. Conversely, the Oberlin case, coming from a small liberal arts college, has adopted a chiefly social innovation-driven approach. Being still in the early to mid-term of its implementation period and fixing highly distinctive objectives, this case cannot therefore demonstrate the superiority of human-centred approaches over technical innovation. However, the limitations of techno-centric approaches alone (as already mentioned in Chapter 6) are becoming more and more apparent in the Swiss pursuit of a 2000-watt society. For example, the need to tackle the lifestyle sector has been voiced as a pressing yet still unresolved issue by key 2000-watt society actors (City of Basel and Novatlantis, 2013; City of Zurich, 2011; Stulz, 2012b) and critics (Morosini, 2010). Yet the most convincing evidence has come from the results of an earlier cited ETH and EMPA study which, based on an ecological footprint study of 3369 residents across Switzerland, concluded that "[e]nergy consumption in the near future of less than 2000-watts is realistic only when assuming a pronounced technological increase in efficiency combined with a smart sufficiency strategy" (Notter et al, 2013, p. 4019). The authors thus highlighted the need to integrate human-centred societal transformation strategies taking into account lifestyles, education and governance. The findings of this report echo incidentally with those of other scholars and international organisations (Peter and Swilling, 2012; Vergragt and Brown, 2008) also bringing attention to the dangers or limitations of pursuing urban sustainability with uniquely techno-centric approaches.

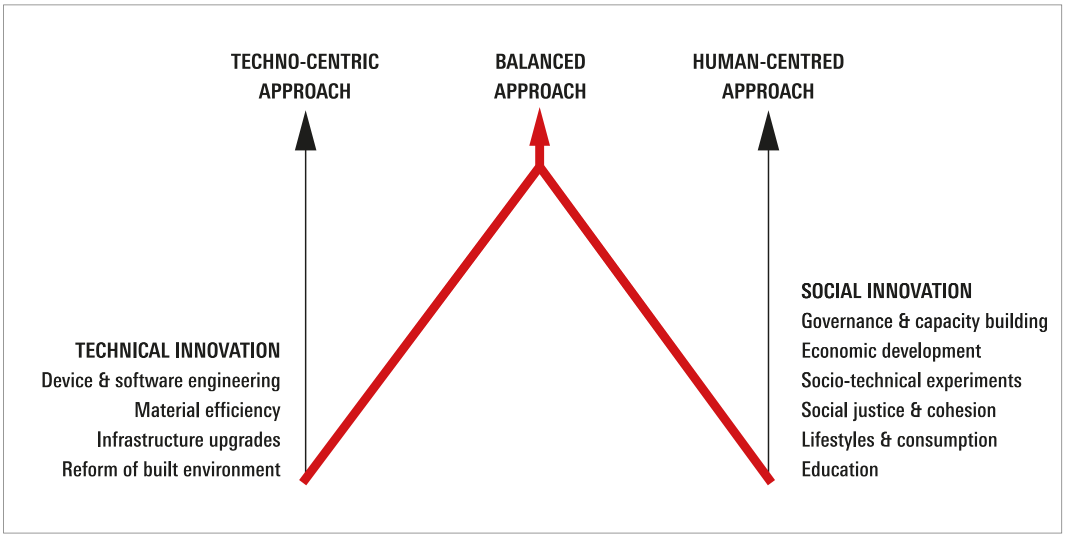

Figure 7.2 Three approaches to advancing sustainable urban transformations (own source)

As depicted in Figure 7.2 above, the lesson to be retained from the Swiss experiences and arguments of other scholars and organisations around the world is that techno-centric attempts to trigger societal transformations towards greater sustainability must balance their approach by integrating also the human dimensions of sustainability. To mention but a few, people-centred dimensions encompass areas such as lifestyles, consumption patterns, governance, education, economic development, poverty alleviation and social cohesion.

7.1.4 Potential institutional challenges and promotional strategies

The chief argument until now in this sub-chapter has been a call for the global promotion of the still emerging co-creative sustainability model. This has followed the ongoing analysis throughout this dissertation on the problems associated with the rise of the dominating model of technology transfer, and its inadequacies from the perspective of sustainability. A major step required for promoting the formation of co-creative partnerships for sustainability would be its institutionalisation—or mainstreaming—in academia. This argument comes from the recognition that when interpreted from the lens of transitions theory (see Chapter 2.2.5), the 70 cases identified for this study should be considered as no more than individual niches deviating from the dominant practices and ideologies of the 'regime'. In considering how the co-creative model could be promoted in academia, this sub-section explores firstly several institutional characteristics of academic science at odds with the approaches and practices of co-creative partnerships for urban sustainability transformations.

7.1.4.1 Internal institutional challenges in academic science

The 70 cases of co-creative partnerships identified for this study have all been formed in the explicit purpose of responding to the sustainability concerns of a specific location, group of stakeholders or societal sub-system. They are therefore solutions focused. The final outcome in many cases is not just limited to conventional outputs such as reports, publications or knowledge bases. Instead, the fruits of many co-creative partnerships are, or will be, transformations of interlinked and living social, technological, political and environmental structures and processes, in array to a whole array of technical or social solutions for exportation to other areas of society. Yet it is important to emphasise that this form of solutions-driven, place-based academic conduct is very much at odds with the historical tendency of the academy to identify and study—rather than attempt to solve—the problems of the world (Clarke and Dickson, 2003; Clarke and Holiday, 2006). It is also important to understand that the explicit focus on place, a set of stakeholders or a societal sub-system is in many ways at odds with another historical tendency of the university—that of disregarding place in its striving to generate universal truth (Arbo and Benneworth, 2007). It is for this reason that attempts around the world to tie academic research activities to the global sustainability agenda have emphasised the pressing need to bring the scale of academic enquiry (which is often national, international or even universal) to also encompass the local dimension. That is, to the unit of individual locations, organisations and decision makers (ICSU, 2002).

The ambitious cross-disciplinary cooperation behind many co-creative partnerships in this study should also be understood as a stark contrast to the way academic science is organised. As demonstrated by the socio-historical analysis of Ford (2002) in his genealogy of the modern university, for the past 200 years science has organised itself into individual disciplines and communities. The result of this ‘separation of labour’ model (Taylor, 2009) is that each academic discipline functions as its own 'intellectual universe', each with its own set of methodologies, norms and journals. The price of this is that inter-departmental competition will often reign at the expense of collaboration. Admittedly, the above-described disciplinary organisation of academic science and scholarship is, in many institutions and settings, beginning to change. Nonetheless, it must be understood that the inward and disciplinary focus of academic science is still frequently cited by scholars and critics as a major hurdle to the formation and promotion of cross-disciplinary partnership and to the co-creation of knowledge with external stakeholders (Crow, 2010; Ford, 2002; Nature, 2007; Taylor, 2009; Yarime et al., 2012).

Other institutional concerns in academia concern conventional reward and incentive systems. The place-based, time-consuming and above all *uncertain* process of collaborating with external partners and stakeholders to tackle real-world sustainability issues sits at odds with academic demands for concrete and measurable research outputs. As it now stands, the vast global enterprise of academic science and scholarship is geared to reward the steady output of journal publications, book chapters and academic conference presentations (Yarime et al., 2012). To promote the emerging co-creative sustainability model would be in effect to encourage academics to divert valuable time from these traditional outcomes—which are directly connected to promotion, salary increases and prestige. Results in both the macro and micro-level empirical analysis in Chapter 5 have confirmed the presence of such barriers in academia, with the author’s numerous interviews also shedding insight into this problem (see listing in Appendix 2). For example, several lead researchers of large-scale co-creative sustainability efforts in Europe and the US lamented that, despite devoting several years and immense personal energy to community-based work, the current academic incentive structures are incapable of rewarding such efforts. They stated that despite having brought about important contributions to regional sustainability and revitalisation, their efforts have done nothing for their careers or prestige in the academic system. It is for reasons such as these that many scholars and research communities across the world have called for the restructuring of academic promotion, tenure and reward systems to account for academic contributions toward external sustainability challenges (Dedeurwaerdere, 2013; Fadeeva and Mochizuki, 2010; Whitmer et al., 2010; Yarime and Tanaka, 2012; Yarime et al., 2012). The difficulty of this task is that the adjustment of academic reward systems would be inutile if achieved merely in one establishment. Given the global scale and interconnectedness of academic research, this must instead be carried out across a critical mass of institutions (Yarime et al., 2012).

The internal institutional factors described above thus represent a set of significant hurdles to any attempt to promote uptake of the co-creative sustainability model across the globe. The articulation of concrete strategies for reorganising the value-systems and reward structures of academic science falls outside the scope of this dissertation (however Section 7.4.2 loosely defines several policy options to this end). Instead, the above discussion was intended rather as a summary of future challenges for the still emerging and developing function of co-creation for sustainability. That said, the following paragraphs will look across to the still emerging academic field of sustainability science for insight into measures that could assist the mainstreaming and propagation of co-creative university partnerships for urban sustainability transformations.

7.1.4.2 Strategies for mainstreaming the co-creative sustainability model

An observation has been made earlier in Chapter 2.2.5 from the perspective of transitions theory. It was argued that the 70 individual cases identified for this study may be considered as ‘niches’ or deviations from the dominating practices and ideologies of the ‘third mission regime’. This was based on the awareness that the objectives and approaches of many co-creative partnerships are highly novel and differ significantly to the characteristics of conventional technology transfer trends. It also stemmed from the observation that the level of ambition and characteristics of many co-creative sustainability partnerships is unprecedented in that particular institution. This view from the perspective of transitions theory implies that it is inconceivable at this still early stage that the still developing trend of co-creation for sustainability could be immediately scaled up to a status capable of challenging the regime. That said, the transitions theory ‘sub-field’ of Strategic Niche Management has highlighted the importance of shared learning and interactions between various individual niches (Schot and Geels, 2008). From here comes the argument that future development of the university function of co-creation for sustainability can be significantly aided through the formation of either ‘niche-coalitions’ (Schneidewind and Augenstein, 2012) or a ‘global niche level’ (Geels and Raven, 2006) where localised projects and experiences are connected via a global field or community. The aim of this network building would be to generate a critical mass of knowledge and experiences to increase general understanding and appreciation of emerging forms of co-creative collaboration, which could then aid their development and further propagation. In reference to the more established model of university-industry collaboration through technology transfer, Cunningham and Harney (2006) emphasise that the publicity of the entrepreneurial model has been crucial in building a mass of awareness and successful models, which have then encouraged other faculty members and universities to engage in entrepreneurial behaviour.

In considering how a global niche-coalition of co-creative university partnerships for urban transformations towards sustainability could be achieved, the author would like to draw attention to the field of sustainability science. Although sustainability science is facing institutionalisation issues of its own (Dedeurwaerdere, 2013; Spangenberg, 2011; Yarime et al., 2012), the expansion of this discipline has clearly been fuelled by the formation of global networks, which in turn, have led to the establishment of dedicated journals such as *Sustainability Science* from Springer, the hosting of annual conferences and the creation of research and education institutions and funding channels (Miller, 2012). In the same way, propagation of the co-creative sustainability model must also encompass a dimension of community building and linking of experiences and activities. This could take place through the formation of networks across the wealth of academic institutions involved in such partnerships—many of which are highly influential research universities (see Table 4.4 in Chapter 4). Specifically, such networks could be created firstly via the formation of global learning communities. Through annual conferences, such networks would soon accumulate a knowledge base sufficient for the creation of a journal and publications dedicated to the subject of how university resources can drive cross-sector efforts to bring about the sustainable transformation of particular communities, cities and societal sub-sectors. The Elsevier journals of *Environmental Innovation and Societal Transitions*, *Cleaner Production* and *Environmental Science and Policy* are good illustrations of a high-level of international interest on closely related topics[83]. The creation of a dedicated journal would also have the effect of creating a critical mass of publications and knowledge from a vast number of partnerships across the world, which are at present, dispersed across a wide array of journals in the social and natural sciences. Despite the potential for such publication channels, academic conferences dedicated exclusively to the topic of university-led partnerships to drive sustainable urban transformations are still rare. From this perspective, in recent years the annual conferences of International Sustainable Campus Network (ISCN) may be considered as important preliminary steps towards the global diffusion and future development of the co-creative partnerships for sustainability. For example, the 2012 ISCN Symposium[84] at the University of Oregon focused on the 'power of partnerships' and off-campus sustainability initiatives (ISCN, 2012), with the upcoming 2014 gathering at MIT and Harvard also dedicated to the theme of 'collective action' and collaboration[85]. Furthermore, in consideration of the recently formed decade of the global Future Earth initiative[86], it can be said with a high degree of confidence that worldwide interest in co-creative partnerships will be heightened in coming years. This is due to an explicit focus on the 'co-design' and 'co-production' of knowledge, solutions and societal transformations for sustainability (Future Earth, 2013).

[83] It should be noted that none of these journals has an ongoing and explicit focus on university initiatives to spur urban sustainability.
[84] Two partnerships to feature at this conference were the Oberlin Project by Oberlin College and UniverCity by Simon Fraser University.
[85] See URL: http://www.international-sustainable-campus-network.org/2014-conference/iscn-2014-conference.html
[86] See section 7.4.6 for more details on the Future Earth initiative.

7.2 Redefining the third mission

This sub-chapter argues that the framing of the third mission needs to move beyond the narrow economic focus on technology transfer and economic development as the most desirable way for the university to contribute to society. Based on the awareness that global and localised sustainability challenges are challenging the logic of pursuing economic development alone, it asserts that the conception of a third mission for the university needs to be re-orientated. It calls for a redefinition that would take into consideration the broader development potential (for both the university and society) offered by the integration of environmental and social dimensions, as well as the transformative capacity of the emerging co-creative sustainability model. As well as allowing for simultaneous pursuit of economic, social and environmental development, the expanded definition would also ensure that a much broader activity base of the university is brought into alignment with local and regional needs. The proposed reinterpretation of the third mission thus seeks to address failures until now to adequately account for environmental and sustainability dimensions, as well as correct the over emphasis on the technology transfer model and economic contributions.

7.2.1 Expanding and reinterpreting the third mission

To reiterate an earlier made point, environmental or sustainability aspects have not been entirely overlooked by the global discourse on the third mission. Admittedly, a small handful of scholars and studies (Arbo and Benneworth, 2007; Culum et al., 2013; OECD, 2007) have acknowledged the potential of third stream activities to contribute to sustainable development and the tackling of local environmental challenges. Also aware of this possibility, some scholars have called for an expanded reinterpretation of the third mission (Fadeeva and Mochizuki, 2010; Yarime et al., 2012). Such calls have come from the perspective of attempting to correct expectations concerning societal contributions of the university away from economic development and towards the pressing task of tying education, research and outreach to local or regional sustainability agendas. Furthermore, Culum et al. (2013) have even proposed that Education for Sustainability (ESD) be used as a means of broadening and re-orientating the third mission. Yet, as argued in Chapter 2, such discussions remain highly marginalised. They are for the most part disregarded by dominating third mission debates from academic and government circles seeking to harness the creative powers of the university to the goal of driving economic growth in an increasingly knowledge-driven economy. That said, one major attempt has been made by European Indicators and Ranking Methodology for University Third Mission (E3M, 2012) to correct the excessive emphasis on technology transfer and economic dimensions by promoting university engagement efforts for social and civic development. Despite this, tenets relating explicitly to the environment and sustainability still lack from the field of vision. The 70 cases identified for this study, however, have demonstrated that mutual pursuit of economic, social, and environmental development is possible. Furthermore, several cases including ETH and Oberlin College have demonstrated that the pursuit of simultaneous economic, social and environmental transformations towards sustainable development is capable of constituting an institutional priority—or *mission*—for the university. From this perspective, the below discussion sets out the intellectual justification for an expanded reinterpretation of the third mission.

Table 7.3 Towards a new and expanded interpretation of the third mission

	ECONOMIC	SOCIAL/CIVIL	SUSTAINABILTY
Objective	Economic development	Social development	Sustainable development
Function	Technology transfer	Community engagement	Co-creation for sustainability
Activities	• Patenting and licensing • Spin-off creation • Technology parks • Industry consulting • Publications & conferences • Transfer of graduates	• Community development • Lifelong learning • Service learning/internships • Sharing of facilities • Community research and education	• Research (or R&D) • Knowledge diffusion • Socio-economic regeneration • Real estate development • Socio-technical experiments and demonstrations • Local/regional governance and planning
Product	Technical innovation	Social capital enhancement	• Technical and social innovation • Societal and environmental transformations • Governance frameworks
Core missions involved	Research	• Research • Education	• Research • Education
Main disciplines	Natural sciences and engineering	Social sciences	• Natural sciences • Social sciences • Humanities
Engagement modes	Technology transfer & economic development	Knowledge management	• Knowledge management • Governance and planning • Technical demonstrations and experiments • Technology transfer or economic development • Reform of built or natural environment • Socio-technical experiments
Narrow interpretation 1			
Narrow interpretation 2			
Broader interpretation			
NEW INTERPRETATION			

In Chapter 2 (see Figure 2.3), it was argued that two types of definition tend to dominate conceptions of the third mission. Namely; a narrow interpretation focusing solely on either economic or social aspects, with the second and least common being that taking into account both dimensions. All of these possible definitions have been integrated into Table 7.3 above. To re-emphasise a series of arguments already made elsewhere, it can be seen that in the economic interpretation (i.e. *Narrow definition 1*) where the objective is to drive economic development, the focus is predominantly on the technology transfer function. By consequence, this primarily concerns a very small array of activities (such as patenting, licensing and spin-off firm creation) and the research mission of the university. Such an interpretation thus chiefly corresponds to the natural sciences and engineering (particularly the life-sciences and software engineering). On the other hand, it can also be seen that the definition stressing social and civic aspects (i.e. *Narrow definition 2*) concerns the objective of driving social development and the university function of community engagement. It concerns an array of softer activities, of which the 'product' is social capital enhancement, a process involving more so the social sciences. The formulation and enactment of these contrasting conceptions of the third mission are driven by activities from different areas of the university (i.e. the hard and soft sciences). As explained in Chapter 2, there is much tension between these two interpretations in the literature (Culum et al., 2013). If integrating these two dimensions, however, a broader definition of the third mission becomes possible; one taking into account both economic and social/civic perspectives. For example, the definition offered by E3M corresponds with this broader and 'politically correct' interpretation (2012b):

> Generally, third mission activities comprise three dimensions performed by universities in relation to external environments: technology transfer and innovation, continuing education and social engagement.[87]

Yet it can be seen from Table 7.3 and the above E3M definition that the framing and enactment of a third mission based uniquely upon economic and social aspects is incapable of accounting for: a) the objective of pursuing sustainable development and addressing environmental matters; and b) the far broader spectrum of activity enabled by the co-creative sustainability model. Clearly, a third dimension is required to justify the insertion of co-creative activities for sustainability into the paradigm of the third mission. This is where the third tenant of *sustainability* comes into play. As can be seen from the last column in Table 7.3, the author is calling for an expanded interpretation of the third mission, one taking into consideration the possibilities and necessity of each of these three dimensions. From this perspective, the author would like to propose a new definition of the third mission:

> *Societal contribution through the simultaneous addressing of economic, social and environmental challenges in tandem with diverse local and regional stakeholders. This would be pursued in a way utilising not only the core missions of education and research, but equally the array of societal engagement modes and university functions falling outside of these existing missions.*

As can be seen, explicit in this reframing is Vorley and Nelles (2008) argument that the third mission should be viewed not as a distinct or add-on role, but more so as a way of linking teaching, research and community engagement activities in the aim of facilitating the mutual development of all these functions. The simultaneous pursuit of economic, social and environmental development is justified by the series of synergistic relations depicted below in Figure 7.4. As can be seen, the ensemble effect of these interactions can be the increased prosperity, resiliency and sustainability of the target area. Far from being limited to mere theory, several cases in the global sample have formed and organised their activities based upon an explicit understanding of these synergetic relationships. To mention but a few, such cases include the Oberlin Project, in addition to Sustainable Urban Neighbourhoods (SUN) by the University of Liege, SoMA EcoDistrict by Portland State University and the Corridor Manchester from the University of Manchester and Manchester Metropolitan University.

[87] A more specific definition from E3M (2012a, p. 6) is as follows: "We have adopted a classification of this 'Third Mission' into activities related to research (technology transfer and innovation, etc.), to education (lifelong learning/ continuing education, training, etc.), and to social engagement (public access to museums, concerts and lectures; voluntary work and consultancy by staff and students, etc.)".

The above discussion has thus laid out the conceptual justification for an expanded reinterpretation of the third mission. By using the powerful normative framing of an expanded third mission, the university would receive a valuable incentive to purse a much broader form of development more in align with the intersecting economic, social and environmental needs of this century. More importantly, it would by the same token receive the occasion to apply a much broader share of its activity base and resources to local and regional development, which is the ultimate goal of the OECD-driven ‘regional engagement’ discourse (Arbo and Benneworth, 2006; OECD, 1999; 2007). As well as contributing to greater prosperity, resiliency and sustainability in the target area, execution of an expanded third mission could increase the depth and breadth of the university’s societal interactions so that all three missions could simultaneously be realigned to better reflect local and regional needs. Ultimately, the mutual alignment and enhancement of these three missions in this way would also serve to drive the institutional development of the university (Vorley and Nelles, 2008).

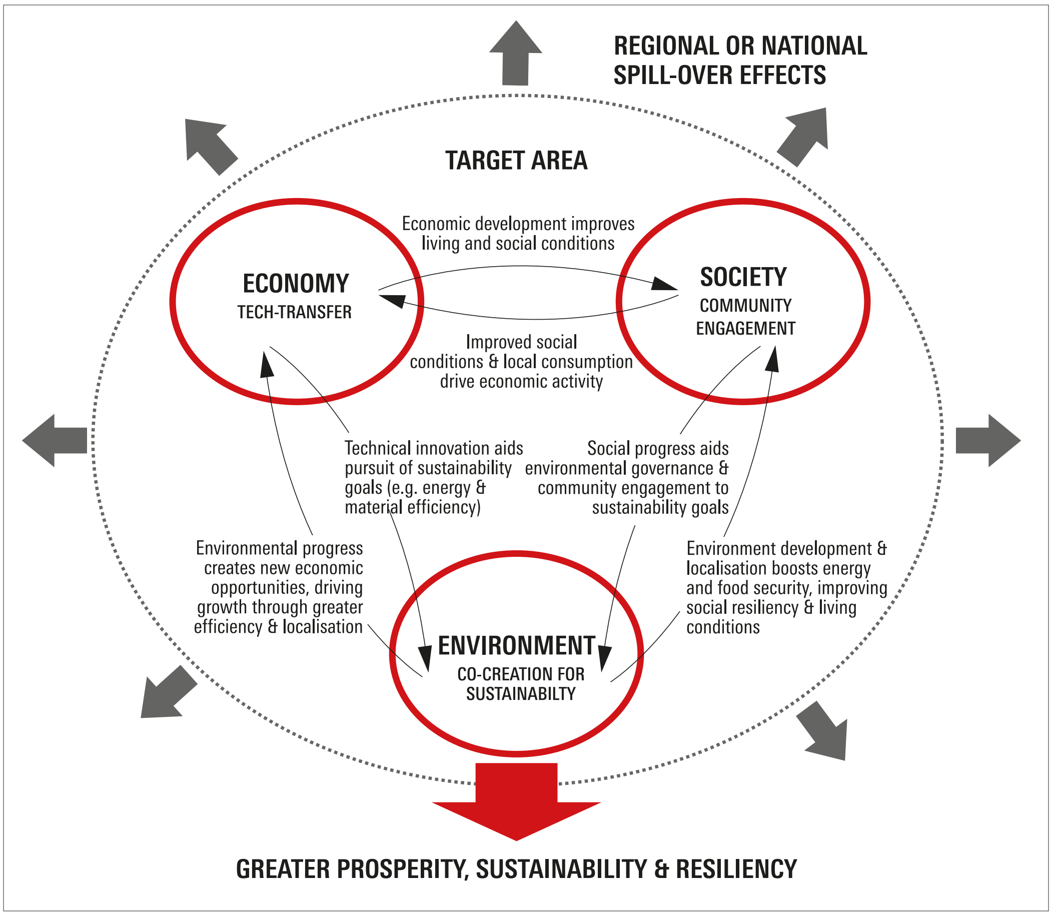

Figure 7.3 Synergistic relations of a reinterpreted third mission (own source)

7.3 Enhancing existing core missions of the university

The discussion until this point has been framed largely as a juxtaposition between the conventional model of technology transfer and the emerging function of co-creation for sustainability. Moving onto another perspective, this sub-chapter focuses upon how the co-creative sustainability model can enhance the effectiveness and societal relevancy of the first two missions of *education* and *research*.

7.3.1 Enhancing the first mission through co-creation for sustainability

This study has afforded particular attention until this point on how the research function of the university can be integrated into the co-creation for sustainability process. This has been for the reason that the vast majority of the 70 partnerships identified for this study contain a formal research or knowledge production element, with the majority of host institutions being research universities (see Chapter 4). On the other hand, the typology-based analysis of Chapter 4.3 has also shown co-creative partnerships performing the function of a *service-learning platform* are relatively uncommon. It was confirmed that the majority of cases using co-creative sustainability partnerships as educational platforms are disproportionately located in North America. One of the important findings hence to emerge from the macro-level empirical research was that, with the exception of a few settings in North America where service learning has a long and established history, the potential of co-creative partnerships to enhance the university's first mission of education is so far relatively unexploited. This yet to be seized opportunity to utilise co-creative sustainability partnerships as educational platforms therefore represents one of the key ways in which the utility of the co-creative sustainability model can be further expanded in academia. The following discussion is thus devoted to illustrating how the function of co-creation for sustainability can compliment the pedagogic function of the university.

The potential of utilising the educational function of the university to contribute to cross-sector urban transformation efforts towards sustainability has been highlighted by Molnar et al. (2011). Here, attention is brought to the 50-year history of the service learning model in the US and its proven track history of addressing socially pressing issues and specific community needs. In recent years, universities around the world are facing increasing pressures to tie the educational function to social, civic, environmental and regional development agendas (Arbo and Benneworth, 2007; Escrigas and Lobera, 2009). Of these inter-related concerns, it is the topic of sustainability that has received high priority on the global stage. In reflection of this is the formation of the United Nations Decade of Education for Sustainable Development (UN-DESD), directed under the auspices of UNESCO for the period of 2005-2014. In the greater cadre of a decade addressing itself to all forms of educational institutions, universities have been summoned to integrate community sustainability concerns into curricula and assist communities and stakeholders in transformative efforts toward sustainability. With the UN-DESD since sparking the birth of a global body of literature on Education for Sustainability (ESD), various scholars have advocated for the transformation of pedagogical approaches to integrate experiential, transformative, place-based and real-world forms of learning in undergraduate and graduate education (Brundiers et al., 2010; Fadeeva and Mochizuki, 2010; Rowe, 2007; Sterling, 2003, 2004).

Several of the 70 cases in the global sample have realised the important role that the education function can play in contributing to external efforts to promote urban sustainability. The various approaches employed by these cases have been collated into Table 7.4 below, with a more detailed discussion of the four model types appearing further below:

Table 7.4 Integrating the educational function into co-creative sustainability partnerships

Model	*1. Project-based learning*	*2. ESD*	*3. Service-learning*	*4. Internships*
Description	Students collaborate with faculty and external partners on real-world urban transformation projects.	Faculty integrate research and experiences from urban transformation effort and local sustainability needs into course content.	Students are led to conduct theoretical and research assignments by engaging with community settings and stakeholders.	Students are placed in formal work experience programs (paid or unpaid) in local municipalities, business and civic groups, or project headquarters.
Actor	Students & faculty	Students & faculty	Students & faculty	Students
Engagement with co-creation process	*Direct*	*In-direct*	*In-direct*	*Direct*
Contribution to co-creation	Student efforts contribute directly to the transformation of environmental or socio-economic systems.	Student comprehension of local environmental and social conditions is enhanced.	Student comprehension of local environmental and social conditions is enhanced, with interpersonal relations established between students and local stakeholders.	Students facilitate co-creative process through tasks such as administrative assistance, communications, data collection and management, and implementation.
Example cases	Alley Flat Initiative, City Studio Vancouver, Iowa Initiative for Sustainable Communities, Rust to Green, Sustainable City Year Program	City Studio Vancouver, Iowa Initiative for Sustainable Communities, Oberlin Project, Sustainable City Year Program	City Studio Vancouver, Iowa Initiative for Sustainable Communities, Oberlin Project, Sustainable City Year Program	City Studio Vancouver, Iowa Initiative for Sustainable Communities, Oberlin Project, Rust to Green, SoMA EcoDistrict, Sustainable City Year Program

1. *Project-based learning*

A highly pioneering case employing *project-based learning* in both undergraduate and graduate settings is City Studio Vancouver, headed by Simon Fraser University and Emily Carr University. Beginning in 2011, City Studio Vancouver aims to utilise formal undergraduate courses in 6 Vancouver higher education institutions as practical studios for researching, planning and implementing real-world projects designed to aid the City of Vancouver's pursuit of ambitious sustainability goals[88]. Students from the six institutions are provided with opportunities to participate in real-world implementation projects with the City by enrolling in a specially set-up capstone studio course called 'studio programme'. Running three times per year, this interdisciplinary course involves various activities such as research tasks, dialogue spaces, skill workshops, field-trips, interviews, proposal writing, and then finally, implementation (City Studio Vancouver, 2013). For the two-year period of 2011-2013, a total of 72 students have designed and implemented 19 student-conceived projects in a vast array of areas such as neighbourhood reform, wildlife conservation, urban forestry, land-use mapping, cycling and public engagement (City Studio Vancouver, 2013). Implementation

[88] Under the banner of 'Greenest City 2020', the City of Vancouver is aiming to become the greenest city in the world by 2020. To this end, it has fixed a series of aggressive sustainability metrics for the year 2020 in various areas such as carbon emissions, green economy, water, green buildings, transport, food and natural resources. More information is available at: http://vancouver.ca/green-vancouver/targets-and-priority-actions.aspx

costs of projects are covered by the City, who is using the *City Studio Vancouver* as one of its key strategies for achieving the Greenest City 2020 goals. As stated above in Table 7.4, *project-based learning* provides students with a direct and high-level of engagement with the co-creative process due to the central role that students perform in project planning and implementation, in collaboration with external stakeholders.

2. ESD (Education for Sustainable Development)

Another means by which students can be involved (indirectly) in urban transformations towards sustainability is through faculty incorporation of co-creative experiences and local sustainability needs into course content. As this can be carried out on an ad-hoc basis using existing resources (i.e. existing courses), the ESD-based approach is relatively easy to carry out. The Oberlin Project is one example of a co-creative sustainability partnership also being used as an educational tool. Key partnership actors from the Department of Environmental Studies at Oberlin College are working to enhance the social relevance of existing courses by integrating into undergraduate lectures personal experiences from the Oberlin Project, in addition to knowledge on local sustainability issues such as energy and food security, carbon emissions and economic development (Adelman, 2013; Shammin, 2013). The above-mentioned City Studio Vancouver partnership is also another example of existing course resources being used as a means of enlightening students on local sustainability challenges. 39 faculty from 6 institutions in Vancouver have been mobilised under the City Studio Vancouver framework to incorporate dimensions related to local sustainability needs into existing courses (City Studio Vancouver, 2013). This vast network of courses encompasses undergraduate and graduate courses ranging from the creative arts and applied sciences to humanities and social sciences. As well as local sustainability challenges shaping teaching content, many of these partner courses also contribute to the City Studio Vancouver platform through *project-based learning* and *service learning.*

3. Service-learning

An additional means of inserting students into the co-creation process is through *service-learning*. In the context of this study, this term is used to signify other forms of out-of-classroom interactions with external stakeholders not involving an explicit dimension of project implementation or interventions on environmental or socio-economic systems. Concretely, this can include theoretical and research assignments that guide students to engage with and learn from community settings and external stakeholders. Again, the Oberlin Project is another example of a co-creative partnership experimenting with service-learning approaches to enhance the pedagogical experience. Faculty in the Department of Environmental Studies at Oberlin College are pushing students to utilise formal assessment tasks as a means of engaging with the Oberlin Project platform and local stakeholders. Several students to date have conducted research assignments on specific themes such as local food production and local rooftop solar potential. By choosing areas of direct relevance to the goals of the Oberlin Project, these students were able to interact directly with Oberlin Project staff and stakeholders, who also became key targets for the findings that ensued these studies. This occurred as assignment results were then used by Oberlin Project staff to inform future projects, as well as transfer to key community stakeholders. The value of these learning interactions is that scholarship from undergraduate courses at Oberlin College became something useful in the community (Shammin, 2013) and a contribution to the co-creative process.

4. Internships

Co-creative partnerships for urban sustainability transformations are able to provide valuable internship opportunities to students in two manners. The first is by functioning as a recruiting platform where students are referred to interested host organisations amongst the partner members. These may include local government offices, businesses, NGOs and civic groups. The second way of providing internship opportunities is by allowing students to engage directly in project co-ordination, data gathering and implementation tasks via placement programmes at partnership headquarters. Several partnerships in the global sample are providing formal internship opportunities in this fashion (both remunerated and non-remunerated). To mention but a few, these include City Studio Vancouver, the Oberlin Project, Rust to Green and SoMA EcoDistrict. The win-win situation offered by internship opportunities in these partnerships is that students are provided firstly with valuable hands-on training and contact with external stakeholders and real-world sustainability challenges. Conversely, host organisations are supplied with a young and often highly skilled and motivated work force on an at-need basis. For co-creative sustainability partnerships restrained by staff, time and financial issues, the provision of student interns can have a significant accelerator effect on certain projects and activities.

Table 7.5 Potential benefits of integrated education and co-creation for sustainability

Students	Educational function	Community stakeholders	Co-creative process
• Acquirement of collaborative skills • Opportunity to test and supplement theory with practice • Exposure to different values and perceptions • Development of interpersonal and practical skills • Access to job- and career-building opportunities • Enhanced civic mindedness and social responsibility	• Boosted social relevancy of course contents by tying educational agendas to local situations • Provision of stimulating and engaging learning • Improvement of university and community relations	• Access to academic expertise • Provision of external knowledge, creativity and manpower	• Accelerated progress to partnership goals through increase of actor numbers and expanded knowledge and skill base • Heightened connectivity between university education, local sustainability needs and co-creative efforts

The above analysis has summarised four commonly observed approaches by which frontrunner institutions are experimenting with co-creative platforms to enhance the effectiveness of the educational function. The benefits of such approaches in student learning are well documented in the literature (Brundiers et al., 2010), nullifying the need for a detailed discussion here. Yet to summarise some of the more pertinent aspects by which the educational function of the university can be enhanced by engagement with co-creative sustainability partnerships, Table 7.5 above summarises key insights obtained from the literature and interviews with key faculty members in Rust to Green and the Oberlin Project (see Table 3.11 and Appendix 2 for interviewee listings). As can be seen, potential pay-offs concern not only students and the university's first mission of education, but also community stakeholders and the process of co-creation for sustainability itself.

7.3.2 Enhancing the second mission through co-creation for sustainability

In the macro-level empirical research of Chapter 4 it was established that the vast majority of cases identified for this study are driven by research-intense universities (Table 4.4). Analytical Framework [A] then established that faculty and researchers are the most common university actors involved in the formation and implementation of co-creative partnerships. This was in addition to a typology-based analysis revealing that the majority of cases in the global sample contain a formal knowledge production or research element[89]. This overwhelming presence of research activities taking place in the wider cadre of cross-sector efforts to co-create sustainable urban transformations is clearly illustrating a widespread recognition that the function of co-creation can significantly enhance the university's second mission of research. To illustrate how this can be achieved, the following discussion draws back upon several key attributes of the co-creative sustainability model identified in Section 7.1, in addition to insights from the case studies, interviews (see Appendix 2) and relevant literature. It presents potential benefits for university research from the perspective of two defining properties of the co-creative sustainability model. Firstly, the shift from the traditional laboratory to the 'urban' or 'living' laboratory, and secondly the utilisation of a wide array of societal engagement modes.

1. *Benefits of the living, urban laboratory*

One of the key metaphors used to describe the global flourishing of academic interventions on urban landscapes in the context of sustainability is the notion of a 'living' or 'urban laboratory'. The recent emergence of this term portrays a radical shift in the scientific innovation process; a move from the traditional laboratory or closed corporate-model of R&D to an open-collaborative style where innovation occurs in the context of a specific location and set of stakeholders (Konig and Evans, 2013). It is argued that this paradigm shift is reflecting a broader transition in science towards pragmatic epistemologies and research agendas with greater societal relevance (Evans and Karvonen, 2011). In the literature, this transition is often described as a move from 'mode 1' to 'mode 2' type knowledge production where knowledge is increasingly produced in application and in response to stakeholder needs (Etzkowitz, 2002; Nowotny et al., 2001). Such a shift is also signalling a growing awareness that greater innovation can occur in collaboration and open networks (Gorman, 2010; Schaffers and Turkama, 2012; Shrum et al., 2007). These arguments are of course not to undermine the value of the traditional laboratory setting, which is essential for many scientific fields conducting early stage fundamental research. Knowing that such endeavour still requires controlled conditions of the traditional laboratory, the role of the urban laboratory is therefore seen instead as a more suitable setting for applied research and collaborations between various societal sectors. Although the shift from a bounded and controllable space to an open and living system challenges the suitability of the word 'laboratory' (Evans and Karvonen, forthcoming), the greatest value of the urban laboratory is that it functions as an interaction arena between socio-technical interventions and scientific knowledge (i.e. the *experiment*) and living human and environmental systems (i.e. the *subject*).

The numerous ways in which knowledge gained from demonstrations and interventions on living, urban laboratories can enhance the university research function has been signalled by

[89] This was established by the high presence of cases demonstrating characteristics of a *research/knowledge exchange platform* (see results of the typology-based analysis in Chapter 4.3).

co-creative actors in both cases. Researchers at EMPA (Swiss Federal Laboratories for Materials Science and Technology) are acutely aware of the multiple benefits that ensued the series of mobility demonstrations in the urban laboratory of Basel. In reference to the hy.muve project (see Chapter 6.1.3.3), Bach (2013) explains that his team was able to obtain valuable feedback and data from the uncontrollable real-world conditions that cannot be obtained in the laboratory. Although Bach admits that the hydrogen drive-train technology was more or less proven when the project was implemented. The real value of the integration of the hy.muve vehicle into the City of Basel's street sweeper fleet was therefore the learning that ensued interaction between different components in the hydrogen mobility system (i.e. the vehicle, fuelling station and the City workers). In other words, the most valuable knowledge obtained was that concerning the real-world interplay between technological and social dimensions. Concretely, this involved technical aspects of the fuelling infrastructure required to support hydrogen vehicles, in addition to human dimensions such as driver behaviour, acceptance levels and economic feasibility. It was also added that the hy.muve project allowed this learning to occur between various research teams in the ETH domain who usually would not have the opportunity to work together (Bach, 2013).

On the other side of the Atlantic, faculty at Oberlin College have also reported the way in which the Oberlin Project platform has enhanced research activities. A faculty member working on psychological behavioural dimensions in connection to energy consumption patterns of building users was highly appreciative of the ability of the urban laboratory to allow verification of theory in real-world settings. In reference to research projects accompanying the installation of dynamic visual feedback systems for water and power consumption in buildings throughout Oberlin (see Chapter 6.2.1.6), Frantz (2013) affirmed that data obtained from actual building usage was of far greater use in validating psychological behavioural hypothesises than simulated data (i.e. that obtained through simulated behavioural questionnaires). For this faculty member, the greatest value of the urban laboratory realised through the Oberlin Project framework was enhanced understanding of 'truths' that surfaced only after "theoretical reality" interacted with the "messy reality" of the real-world (Frantz, 2013).

2. Benefits of co-creative engagement modes

Chapter 3 has identified and discussed six societal engagement modes by which university actors may attempt to create societal transformations to advance the sustainability of a particular urban location or societal sub-sector. Some of these engagement modes represent highly novel and still emerging mechanisms for academics to engage with society, with some involving a high-degree of societal intervention (i.e. *socio-technical experiments* and *reform of built or natural environment*). The ensemble of these engagement avenues harbours a strong potential to enrich the university's research function. This can occur as university research activities are expanded into roles and realms not traditionally part of scientific conduct, thereby increasing opportunities for university actors to learn from real-world settings and engage in knowledge co-creation with external stakeholders. They also lead to precious opportunities to interact with other university actors and disciplines, as well as obtain feedback on the sustainability impacts of human interventions on various social, technological, economic, political and environmental systems. Table 7.6 below offers a non-exhaustive summary of potential ways by which the six societal engagement modes characterising the process of co-creation for sustainability can enhance the university's second mission of research.

Table 7.6 Benefits of co-creative engagement modes for university research

Societal engagement mode	Potential benefits and opportunities
Knowledge management	• Enhance social relevance of research by addressing local challenges and co-formulating agendas with stakeholders • Gain knowledge and feedback from other stakeholders • Maximise societal impacts of research through diffusion and translation of results
Governance and collaborative planning	• Translate academic research into policy and planning, maximising societal impacts • Learn from government practitioners
Technical demonstrations and experiments	• Learn from real-world settings and interaction of technical and human systems • Increase the visibility of scientific research and opportunities to export results • Supplement theory with application
Technology transfer or economic development	• Increase the societal impact of research results through commercialisation and diffusion • Learn from industry experts
Reform of built or natural environment	• Increase the societal impact of sustainability knowledge through integration into architectural planning • Utilise interventions on built or natural environment as data gathering sites
Socio-technical experiments	• Learn from real-world settings and small-scale experiments with new configurations of socio-technical systems • Increase the visibility and impact of scientific research • Supplement theory with application

7.3.3 Simultaneous enhancement of education and research

The discussion to this point has considered the potential of the co-creative function to enhance the university's core missions of education and research. Although these benefits were considered in isolation, the author would like to bring attention to the potential synergetic relationship that can simultaneously occur between the educative, research and co-creative function. These synergistic flows are depicted in Figure 7.4 below, which displays education, research and co-creation as separate functions for the sake of simplification. In reality however, much overlap can occur between these three areas of activity (Trencher et al., 2013b). Although the case studies did not allow a detailed analysis on the interaction of these three functions (particularly education), it is worth noting that the Oberlin Project and several other frontrunner cases[90] in the global sample are currently experimenting with the synergistic relations that can potentially arise in this manner. In the view of the author, this mutual development and reinforcement of the university's more established core missions with the co-creative function holds much potential for institutional development of the university, and its future relationship with society.

[90] To mention but a few, these include the City Studio Vancouver by Simon Fraser University, Emily Carr University and partners, Iowa Initiative for Sustainable Communities by the University of Iowa, Sustainable Neighborhood Lab by Boston University, Rust to Green by Cornell University, and the Sustainable City Year Program by the University of Oregon.

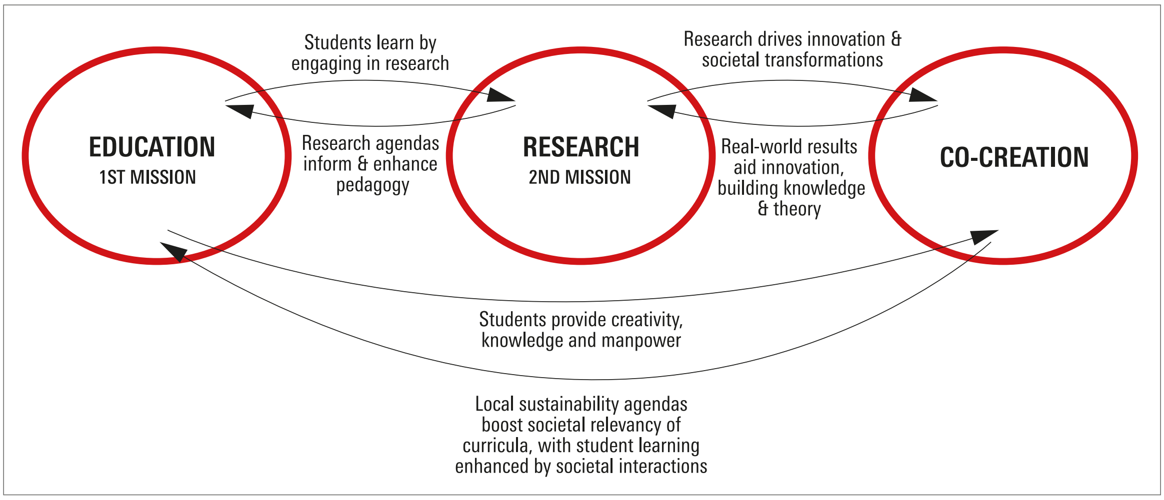

Figure 7.4 Synergistic relations between education, research and co-creation

7.4 Implications of co-creation for sustainability

This sub-chapter seeks to draw out the major implications raised by the emerging phenomenon of co-creative university partnerships set up in the goal of triggering socio-economic, technological, political and environmental transformations towards greater sustainability. The discussion will unfold from several levels. Firstly, some policy implications will be compiled for government decision makers. These will begin with specific ramifications drawn from each of the two co-creation models (i.e. for innovation and for regeneration) explored in the case studies. Secondly, some policy avenues will then be outlined as suggestions to re-orientate third mission activities and promote the formation of co-creative partnerships for urban sustainability. The third section will then extract policy implications for Japan (the nation from within which this research was conducted), with the fourth section summarising implications with regard to university governance and leadership. The fifth section discusses possible consequences of the co-creative sustainability model for our perceptions of the modern research university and the range of functions it is expected to assume in society. It is contended here that the global emergence of the function of co-creation for sustainability is possibly signalling the birth of a new type of institution—the 'co-creative university'. Finally, the last section will explore scientific implications of increased co-creative activity for urban sustainability in academic establishments around the world. It argues that the co-creative sustainability model is highly aligned to principles called for by the international scientific community for re-structuring scientific activities in accord with the demands of the global sustainability crisis.

7.4.1 Policy implications

This sub-section outlines key policy implications for the emerging model of co-creation for sustainability. It draws out key ramifications for the two specific forms of co-creation for urban sustainability identified in Chapter 6: co-creation for innovation and co-creation for regeneration.

7.4.1.1 Policy implications of co-creation for innovation model

The case from ETH has demonstrated that industrial innovation and societal progress towards sustainability can be driven *without* reliance on IPRs and income generation. This was demonstrated by a range of societal engagement modes such as *governance and planning*, *technical demonstration and experiments* and *reform of the built or natural environment.* The implication of this is therefore that:

> *National governments must move beyond calls for economic contributions via technology transfer. They should create incentives for universities to engage with industry to pursue sustainable development at the local or regional scale.*

Starting with the US Bayh-Dole Act from 1980 and the wave of imitation policies triggered by this reform, national-level policies are in place all over the world to encourage universities to focus more efforts on contributing to economic development via technology transfer to industry and the commercialisation of research results. Efforts therefore need to shift beyond narrow conceptions of societal contributions via technology transfer and create policy incentives for university administration and departments to promote other forms of stakeholder collaboration in the context of pursuing sustainability. The Swiss case has demonstrated that although direct economic impacts may not immediately ensue co-creative interactions with society in the context of advancing urban sustainability, indirect—and therefore immeasurable—economic impacts would be far from nil. These would include the acceleration of industrial and government innovation towards long-term, science-based sustainability targets, and the immense *social* impacts of concrete progress towards lower energy requirements and environmental sustainability.

Also related to this, implications for urban governance have also been demonstrated by the Swiss case. Here it was proven empirically that combined scientific and industrial innovation for sustainability can be a key strategy for governing long-term urban sustainability challenges at a city-level, with national spillovers. The implication of this is therefore that:

> *Local governments should create collaboration opportunities with university and industry actors and shape policy making and long-term planning with combined scientific and industrial knowledge.*

This call also corresponds with recommendations from the OECD (2007) that local and regional governments must also become pro-active in creating more opportunities for collaboration with universities and industry in social, economic and environmental development and planning.

7.4.1.2 Policy implications of co-creation for regeneration model

The distinctive case from Oberlin has also generated implications for the conventional technology transfer model. Firstly it has demonstrated that co-creation for sustainability can function as a paradigm for forging stakeholder collaborations in *declining* socio-economic conditions and *non-*research universities. This is a significant added value from the emerging model as conventional technology transfer practices have so far only been successfully demonstrated in prosperous socio-economic conditions and in research-intense universities. This therefore implies that:

> *Co-creative partnerships for urban sustainability can be a suitable model of stakeholder engagement in non-research universities in declining socio-economic conditions.*

Furthermore, with the College President becoming an official partner in the Oberlin Project and the commitment of College resources (endowment funds, real estate assets and development, cooperation of top-level administration staff etc.) to pursuing project goals, another implication emerges:

> *Co-creation for sustainability can function as a core mission for the university.*

Naturally, this implication is articulated in full understanding that the case of Oberlin was highly unique and pioneering. It is acknowledged that the elevation of the goal of creating societal transformations towards enhanced sustainability and economic prosperity to an institutional priority would not be possible in many other institutions due to differing missional focuses and restrictions of resources.

The Oberlin case also harbours implications for urban governance. The analysis has demonstrated that universities are intervening in unprecedented ways on public policy. It has shown that traditional roles between academia, government and civic sector are blurring, with co-creative partnerships creating new spaces for sustainability governance. This implies that:

> *Local governments should seek to perform sustainability governance with university and civil actors and urge universities to contribute to local sustainable development through their multiple functions.*

In the case of Oberlin the local municipality was facing severe financial restrictions imposed by a deteriorating economy. The City of Oberlin therefore is benefiting highly from its involvement in the Oberlin Project. This comes from exposure to outside knowledge and best practices, funding assistance to prepare climate strategies and inventories, the improvement of physical and social conditions—all of which is leading to accelerated progress towards existing government goals and priorities.

7.4.2 Policy options for re-orientating third mission activities

Section 7. 2 above has laid out the intellectual justification for a reframing and reorientation of the third mission. The discussion below is given to proposing two policy avenues for national and state government decision makers. As already argued, many federal governments around the world have established policies to emulate the perceived success of the Bayh-Dole Act and promote technology transfer activities (Mowery, 2007), often aided by ideological tools such as the concept of a third mission or entrepreneurial university. The task of correcting this over emphasis on economic contributions as the most desirable form of contributing to society would therefore encounter much tension. Knowing this, this section sets out some strategies for government decision makers seeking to modify the incentives that influence university behaviour. The first set of policy actions concerns university performance evaluation methodologies. It calls for the development and utilisation of a set of indicators to promote the accountability of universities towards the interconnected economic, social and environmental needs of their surrounding communities and regions. The second recommendation is related to research funding programmes and more specifically the reform of project selection criteria. It is argued that the combination of these measures could serve to a) re-orientate perceptions on the desired focus and purpose of the third mission and b) encourage the fostering and implementation of co-creative activities based upon this renewed understanding.

7.4.2.1 Reforming national-level university appraisal criteria

It is well known that university performance appraisal systems can be highly influential in modifying university behaviour and priorities (Fadeeva and Mochizuki, 2010; Marginson, 2007; Yarime and Tanaka, 2012). As a general trend, the most influential appraisal systems around the world seek to evaluate 'excellence'. Although methodologies vary, ranking systems typically have an explicit focus on research outputs that can be measured by various quantitative proxies such as the number of research papers published, citations received and patents issued during a particular period. Some of the many concerns directed at existing ranking systems include: the contention that the dominating models are not designed to measure the type of competencies and activities relevant to society's complex sustainability needs (Dedeurwaerdere, 2013; Fadeeva and Mochizuki, 2010); the observation that third mission activities (in the broad economic and social sense) are not currently considered (Montesinos et al., 2008); and finally, that existing sustainability ranking systems (which are mostly focused on campus management) fail to heed enough attention to research, education and collaborations with stakeholders (Yarime and

Tanaka, 2012). A need has therefore been voiced from various scholars and organisations around the world for the development of a set of performance indicators for measuring a) third mission activities and b) societal interactions and stakeholder collaborations related to sustainability.

Recently, there has been some progress to fill this gap. The earlier-mentioned European Indicators and Ranking Methodology for University Third Mission network (E3M, 2012) is in the process of finalising a set of indicators designed to measure third mission activities in European universities. These will have a specific focus on three dimensions of continuing i) education, ii) technology transfer and iii) innovation and social engagement. In the same vein, Montesinos et al. (2008) have also called for a set of third mission performance indicators that would measure and benchmark institutional performance in the areas social engagement, entrepreneurialism and innovation. Despite such attempts, dimensions related to the environmental and sustainability are missing from both of these studies. As such, the three-fold linking of university appraisal systems, sustainability and third mission performance indicators is yet to be achieved. To fill this gap, the author would like to suggest the following avenues to national government decision makers:

1. *Existing national-level university appraisal systems need to take into account and create performance indicators for stakeholder collaborations, research and outreach efforts in the field of sustainability.*

2. *Indicators need to be developed and integrated into national-level benchmarking systems for specifically measuring and appraising third mission activities. Such indicators should be founded upon a holistic interpretation of the third mission as signifying the simultaneous addressing of economic, social and environmental challenges in tandem with diverse local and regional stakeholders. They should also recognise that such activities would involve various functions of the university such as education, research, technology transfer, outreach and campus development.*

Regarding recommendation (1), there is ongoing work in this field. One project is the Alternative University Appraisal (AUA) developed by Promotion of Sustainability in Postgraduate Education and Research Network (ProSPER.Net)[91]. It must be emphasised however that the focus of this model is currently on measuring activities related to ESD, which represent only one part of the broad spectrum of activities and possibilities in the co-creative sustainability model. As for recommendations (1) and (2), an emerging initiative with rich implications for the development of performance indicators for areas such as societal and environmental impacts of research is the Research Excellence Framework (REF) by the UK Collaborative on Development Sciences. Designed as an evaluation system of UK higher education institutions to decide the allocation of research grants, REF has made an epoch-making decision to integrate economic, social and environmental impacts into the evaluation criteria (UK-CDS, 2013).

It is the view of the author that the above actions would serve several ends. Firstly, they would contribute to a broader and renewed understanding of the university's third mission. They would thereby make universities accountable to the interrelated economic, social and environmental needs of their surrounding communities and regions, subsequently encouraging the fostering and

[91] The AUA model is currently headed by Hokkaido University in Japan. It seeks to act as the self-review mechanism for Asian members of PropSPER.NET in regard to education and research activities in related to ESD.

implementation of co-creative activities based upon this understanding. Secondly, the creation of benchmarking systems could serve to heighten a sense of competition between differing institutions, also fostering the identification of best practices and mutual learning.

7.4.2.2 Reforming research funding criteria

The issue of external research funding has emerged at various points throughout this dissertation. It was found in the application of Analytical Framework [B] in the macro-level empirical analysis (Chapter 5) that the *external funding* factor can constitute both a driving and hampering force on the formation and implementation of co-creative university partnerships for urban sustainability. More specifically, survey results confirmed that the *availability* of suitable funding programmes was relatively more of an issue than the length or amount. It was also noted that these findings coincide with the literature, where other scholars (Dedeurwaerdere, 2013; Zilahy and Huisingh, 2009) have cited limited access to funding opportunities as a major barrier to the implementation of cross-sector university partnerships for sustainability. In a bid to remedy this situation, the author proposes the following policy actions. In effect, project applications for various existing and new funding programmes would be guided to assume many of the key attributes identified in co-creative university partnerships for sustainability (see Table 7.1 of this chapter). Such recommendations also reflect varying arguments of Dedeurwaerdere (2013), the OECD (2009) and Whitmer et al. (2010) in relation to how external funding programmes can be utilised as drivers of cross-sector sustainability or development initiatives at the local or regional level.

1. *The integration of the following priorities into selection criteria for a range of existing research funding programmes:* [92]
    - Projects must illustrate how they will advance the sustainability (i.e. mutual pursuit of economic, social and environmental development) of a specific location, region or societal sub-system, with an explicit focus on creating visible societal and environmental transformations.
    - Projects must involve collaborations amongst diverse external stakeholders from government, industry and civic society, in both planning and implementation.
    - Academic members must involve collaborations across different disciplines and institutions, inclusive of, for example, the natural and social sciences, engineering and the humanities.

2. *The integration of the above selection criteria into the preparation of new funding packages to support collaboration periods of approximately four to five-years, with the possibility of renewal based on performance evaluation.*

3. *The integration of requirements that local or regional government actors applying for national funding in areas such as energy, transport, economic development and urban renewal etc. must collaborate with experts from academia, industry and civil society in planning and implementation.*

Regarding the first two policy options, the ongoing INTERREG Programme of the European Union is a successful instance of a funding programme serving as a driving force behind the formation

[92] It is envisioned that such measures could be taken in a vast array of funding programmes aimed at natural sciences, social sciences, engineering and the humanities.

of several cases in Europe[93]. This funding programme has been designed to promote innovation for sustainable development and cross-border cooperation across the EU. The score based project evaluation criteria contains several explicit requirements regarding various areas such as cross-sector collaboration, a focus on place and the simultaneous addressing of economic, social and environmental issues[94]. Furthermore, further guidance on project formation is provided in form of priority areas currently set in renewable energy, sustainable transport and climate mitigation and adaptation. In regard to the second policy option calling for the establishment of new funding packages, one such example can be found in Japan. Here the specially set-up *Social System Reformation Program for Adaptation to Climate Change* (FY2010-FY2014) from the Japan Science and Technology Agency was responsible for the fostering of two cases[95] in the global sample. This was due to requirements in the context of innovation for climate adaptation that candidate proposals involve cross-sector and cross-departmental collaboration, in addition to the targeting of a specific location and set of stakeholders.

Regarding the third policy option, this recommendation seeks to capitalise on the many existing funding programmes around the world set up to channel national funds to various development initiatives in regional and local government agencies. The stipulation that government actors receiving national funding assistance must work with other stakeholders in academia, industry and civil society would have a substantial effect on forcing relations and cooperation across these sectors in regards to specific projects in areas such as energy, transport, construction, economic development and urban renewal and so on. This suggestion corresponds with the OECD (2007, p. 203) proposal that local and regional authorities make more effort to involve higher education institutions into local and regional development agendas.

7.4.3 Policy implications for Japan

For the reason that this research has been conducted from within the nation of Japan, this sub-section draws out implications for national-level Japanese policy makers.

In Japan, efforts to propagate technology transfer and closer university exchanges with industry have been mostly top-down and governmental. Largely animated by the sentiment that Japan was "20-years behind the US" (NISTEP and UFJ Mitsubishi Research Institute, 2005, p. 1), they have been mainly in the form of national government-led policies designed to imitate the perceived success of the US entrepreneurial model and Bayh-Dole Act. Key measures have included the enactment of laws to facilitate the establishment of technology transfer offices in universities, government calls for heightened technology transfer activities, and legal reform to allow national universities to become independent legal entities; thereby providing them the right to manage and own intellectual property from publicly funded research (Jiang et al., 2007). The central focus of these reforms was on spurring university-driven technology transfer and economic development. A core term used as part of this process was the term *san gaku kan renkei,* literally translating as 'industry-academia-government partnership'.

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[93] To name but two, this includes SUN (Sustainable Urban Neighbourhoods) by Liege University and Hansa Energy Corridor by University of Groningen.
[94] For more information on the INTERREG Programme (currently in the INTERREG IVC 2007-2013 phase) see URL: http://www.interreg4c.eu
[95] These cases are: Urban Reformation Program for Realization of Bright Low-Carbon Society from the University of Tokyo and Green Society ICT Life Infrastructure by Keio University.

This term, which continues to shape government expectations on the most desirable way for universities to contribute to society, is semantically problematic for two reasons. Firstly, the term 'kan' does not refer to local government authorities, but instead to government research laboratories, from which the expected role is to participate in technical R&D efforts (MEXT, 2003). Secondly, the term does not fully incorporate the potential value of civic society participation in the collaborative innovation process. That said, science, technology and innovation (STI) policies outlined in recent years have started to acknowledge the need for civil society involvement in public policy planning (MEXT, 2011). As highlighted by both cases (and results of the global survey in Chapter 4.2.5), both actors from local government and civic society groups are an essential element of place-based stakeholder collaborations set up to advance sustainable development. As well as a technical dimension, such alliances ideally must include a *social* dimension. The implication that thus emerges is:

> *Policies and government discourse need to be reformed to reflect the important role that local government and civic society groups can both play in cross-sector university collaborations—especially in the context of advancing both technical and social innovation towards sustainability.*

Despite the overwhelming focus of federal discourse on techno-centric industry and government laboratory linkages, some cases of stakeholder collaboration have emerged of which the *structural complexity* (i.e. cooperation with industry as well as local municipalities and civic society) and *objective* (to drive place-based low-carbon development, climate change adaptation and resiliency) do not confirm to dominating conceptions of 'san gaku kan renkei'. Future efforts towards the fostering of more such partnerships must be on the expansion of special funding programmes such as *Social System Reformation Program for Adaptation to Climate Change* (FY2010-FY2014). As mentioned above in 7.4.2.2, such programmes have stipulated cross-sector collaboration and the transfer of scientific innovation to regional efforts to advance sustainability and address climate change. They have thereby successfully brought into fruition two cases[96] in the Japanese sample. Steps therefore need to be taken to evaluate these partnerships, to determine which aspects were successful and which were not, and then integrate this learning into future funding and policy initiatives to encourage further formation of co-creative university partnerships for urban sustainability.

7.4.4 Implications for university governance

To this point, the discussion on implications evoked by emerging forms of co-creative university partnerships for transformations towards urban sustainability has focused on government policy. However, place-based sustainability challenges and emerging forms of co-creation for sustainability not fitting dominating conceptions or expectations on desirable forms of societal contributions also pose a significant challenge to university governance and leadership. The implication for university governance that emerges is:

> *Efforts to expand narrow interpretations of a third mission based on technology transfer and foster co-creative partnerships for local and regional sustainability challenges must also be taken up by university leaders.*

[96] Urban Reformation Program for Realization of Bright Low-Carbon Society from the University of Tokyo and Green Society ICT Life Infrastructure by Keio University.

The notion of who exactly can be a university leader is central to this argument. In the US, strong leadership from university presidents and provosts in the context of sustainability is a marked characteristic of the shift in practices of the higher education sector towards sustainability. One influential leader to have emerged is Michael Crow, the president of Arizona State University and the vision of a 'New American University' (Macilwain, 2007). Key characteristics of this vision are commitment to principles such as sustainability, inter- and transdisciplinarity, use-inspired research, incorporation of place-based needs and creation of societal transformations (Crow, 2010). Also in the US, presidents from other leading-edge institutions such as MIT and Harvard are following suite and responding to local sustainability challenges by engaging in institution-level partnerships with municipalities and industry[97]. In the same vein, some university chancellors in Europe, such as from the University of Liege, are playing a key role in regional economic regeneration through the forging of co-creative partnerships for sustainable development and innovation.[98] The importance of university leaders making commitments in this direction is twofold. Firstly institutional level engagement sets an example and supportive culture for other similar partnerships that may subsequently form. Conversely, it contributes to the formation of a 'new normal' (Crow, 2011) in the national and international networks to which such leaders belong. Clearly, a key strategy that must also accompany leadership is the establishment of internal incentive schemes. These must be capable of encouraging faculty to divert time from conventional research activities to time-consuming and uncertain collaborations with external stakeholders, which are not currently valued by academic reward systems. A core challenge for pioneering university leaders is therefore the establishment of such incentives and rewards.

In parallel, in other academic institutions around the world leadership will come not from the top but from influential professors or departments. The nation of Japan is one example where this is the typically case[99]. In these cases where individual 'frontrunners' (Loorbach and Rotmans, 2010) initiate novel forms of stakeholder collaboration for sustainability not conforming to conventional notions of academic research or a third mission through technology transfer, it is imperative that experiences are shared and the visibility of such efforts raised. This would be to facilitate internal learning and encourage other faculty and university actors to follow suite—a prerequisite if a collective mass of co-creative initiatives for sustainability is to emerge across academia.

7.4.5 Implications for the university: The birth of a new 'species'?

To reiterate a core argument of this study, it has become extremely clear that the qualitative characteristics of the emerging university function of co-creation for sustainability differ significantly to those of the conventional technology transfer model. As discussed already, the model of technology transfer has been explicitly linked to the idea of an entrepreneurial university; an ideology-driven model permeating academia around the globe. Today it continues to dominate perceptions on the most desirable model of a societally engaged research university. However, if subscribing to the view that the university is also a 'living' institution and a mirror of societal expectations and socio-political conditions at that time (Ford, 2002; Martin, 2012), it is reasonable to assume that the birth of the entrepreneurial model would not constitute the final chapter in the almost 1000-year history of the modern research university.

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[97] See Compact for Sustainable Future in Appendix 1.

[98] For example, the recteur of the University of Liege is playing a core role in Verdir (see Appendix 1).

[99] The author is indebted to Yasunori Baba at the University of Tokyo for pointing this out.

The twin cases from ETH and Oberlin College have demonstrated an alternative model of societal collaboration that cannot be fully understood through the lens of an entrepreneurial university or technology transfer. Along with the other 68 cases in the global sample, they have both testified that localised repercussions of global sustainability challenges are prompting a deviation from the logic and practices of the conventional technology transfer model. An alternative societal collaboration model has thus emerged, founded upon a radical paradigm shift in the academy. A move from the objective of simply contributing to economic and societal development via technology transfer to actually transforming and co-creating society in the pursuit of sustainable development via a much broader range of engagement modes, approaches and actors.

It is important to note that such a goal was elevated to an institutional priority—or *mission*—in both the ETH and Oberlin case. This was affirmed from the involvement of top-level university decision makers in each case, the provision of supporting infrastructures, and in the case of Oberlin, the realignment of institutional activities such as purchasing, campus management and real estate development in accord with the goals of the partnership. Furthermore, there is growing evidence that other research universities around the world are also following suite. Although the majority of co-creative cases identified for this study correspond with faculty- or department-level initiatives, other partnerships are the product of local and regional sustainability agendas being incorporated into top-level institutional commitments. For example, two recently formed partnerships from MIT and Harvard (Community Compact for a Sustainable Future) and the University of Liege (Verdir) are endorsed and driven by presidents from each institution.

Coupled with earlier observations from Chapter 4 that co-creative university activities are geographically and temporally well established and set to further develop around the globe, it seems there is enough empirical evidence to suggest that a new type of university is emerging—the 'co-creative university'. Just as "identifying, creating and commercialising intellectual property have become institutional objectives" in the entrepreneurial university (Etzkowitz et al., 2000, p. 313), the co-creative university is characterised by the elevation of the goal of co-creating societal transformations towards sustainability to an institutional priority—or *mission* (Trencher et al., 2013b*)*. To bring attention this way to a potential new 'species' of university (Martin, 2012) is to frame the emergence of the co-creation for sustainability phenomenon in accord with calls from the literature. That is, numerous scholars have long been calling for the development of a new model of university whose missions and activities sit more in accord with the pressing social and sustainability concerns of this century (Crow, 2010; Fadeeva and Mochizuki, 2010; Ford, 2002; M'Gonigle and Stark, 2006; Orr, 1994; Taylor, 2009; Yarime et al., 2012). From the same perspective, others still have called for an accelerated evolution from the so-called 'second academic revolution', which sparked the birth of the entrepreneurial university, to a 'third academic revolution'. In this third phase, the focus would be on creating societal transformations with diverse societal stakeholders in the goal of materialising sustainable development in surrounding communities and regions (Dedeurwaerdere, 2013; Yarime et al., 2012).

This evolutionary conception of the modern research university is depicted overleaf in Table 7.7 and Figure 7.5, both of which portray the university as a mirror of societal expectations and conditions at the time. As can be seen, the birth of the modern research-orientated university in 1810 ensued the 'first academic revolution' (Etzkowitz, 2001, 2002; Etzkowitz et al., 2001). This development was prompted by the scientific revolution and the emergence of the state as a principle stakeholder (Ford, 2002; Wittrock, 1993). The expected role of the university thus evolved from mere knowledge transmission, as was the case in the medieval model—to a new task of creating knowledge by conducting scientific research (Arbo and Benneworth, 2007). With the University of Berlin and other German research institutions thus setting the global prototype of a university *par excellence* for the best part of 100 years (Ueyama, 2010), the modern university underwent a second academic revolution, accelerating since the 1980's (Etzkowitz, 2001, 2002; Etzkowitz et al., 2001). Now responding to the expectations of a new stakeholder (i.e. industry), the birth of the global knowledge economy (Etzkowitz, 2002) and the spread of policies based on market logic and neo-liberalism (Slaughter and Rhoades, 2004; Washburn, 2006) the modern research university has seen the birth of a new role—the pursuit of a third mission via technology transfer. The expected function of this new entrepreneurial university is to generate income for both itself and industry through the identification and commercialisation of intellectual property. By doing so, this should contribute to the wider goal of driving economic growth in the knowledge economy (Etzkowitz, 2000). Regarding the latest evolutionary development in this genealogy (i.e. the third revolution), the university must now respond to the expectations of society (the missing element in the triple-helix), which have transformed in response to sustainability related threats to human well-being. Guided by the principle of sustainability, the still emerging co-creative university is now expected to assume another role in addition to its core missions of education and research. As can be seen, it must now respond to local or regional repercussions of the global sustainability crisis by applying its resources and activities to stakeholder coalitions assembled for the purpose of co-creating societal transformations towards greater sustainability.

An important message portrayed by the evolutionary trajectory of Table 7.7 and Figure 7.5 is that in each academic revolution, the newly emerged university will retain the features of the former model, whilst integrating the characteristics of the new. The emergence of the co-creative university therefore signifies a type of institution that has grown considerably in complexity as it adjusts its functions in accord with stakeholder expectations and external conditions in society at large. Also, it should also be emphasised that the author does not regard the emergence of the co-creative university or function as complete. One of the major assumptions of this study (which is significantly supported by empirical findings from Chapter 4.1.1) is that the co-creative sustainability model is still in the processing of developing and propagating across academia. Therefore, rather than depicting a completed prototype, the consideration of Oberlin College and the ETH domain as frontrunner co-creative universities is therefore intended only as an attempt to draw attention to the pioneering qualities of each. Finally, it should be recalled that the phenomenon of an entrepreneurial university primarily concerns a privileged set of prestigious research universities—mostly boasting medical schools and concentrated in the US (Mowery, 2007; Yusuf, 2007). In the same way, the emergence of a so-called co-creative university, where the goal of co-creation for sustainability is elevated to an institutional mission, should not considered a universal event. Instead, it is a development occurring within a few frontrunner institutions. Yet the significance of this event is reflected by the awareness that the trajectory of the global research university today has been shaped continuously by countless frontrunner institutions throughout history (Ford, 2002).

Year	Revolution	Stakeholder(s)	Paradigm	Mission(s)	Expected roles	Societal trigger	Prototype or frontrunner(s)
1150-1170		Catholic Church	Catholicism	Education	Knowledge transmission	Expansion of Church	University of Paris (Medieval model)
1810	First	State	Scientific worldview	Education Research	Knowledge creation Knowledge transmission	Scientific revolution	University of Berlin (Modern model)
Since 1980's	Second	Government Industry	Market logic Neo-liberalism	Education Research Technology transfer	Knowledge creation Knowledge transmission Economic development	Knowledge economy	MIT and Stanford (Entrepreneurial model)
Since 2000	Third	Government Industry Society	Sustainability	Education Research Co-creation for sustainability	Knowledge creation Knowledge transmission Sustainable development	Sustainability crisis	ETH and Oberlin College (Co-creative model)

Table 7.7 Genealogy of the modern university

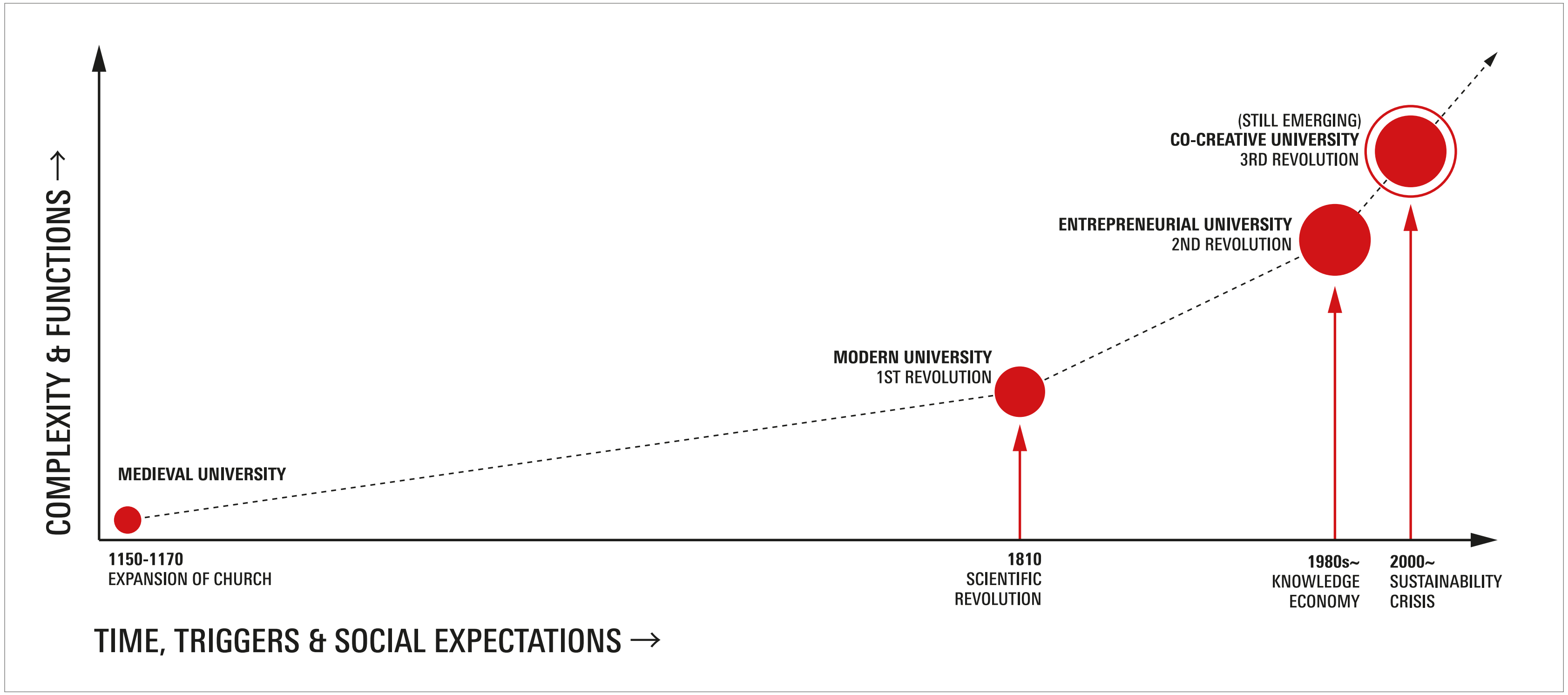

Figure 7.5 Evolutionary trajectory of the modern university

7.4.6 Implications for science: The significance of co-creation for sustainability

The worldwide emergence of the university function of co-creation for sustainability also harbours vast implications for science itself. As the global ramifications of sustainability challenges such as climate change, eco-system deterioration, resource shortages and food, water and energy security gather in severity, several grand attempts have emerged from within the scientific enterprise to bridge the gap between scientific activities and the sustainability concerns of humanity. It has been widely recognised that science will have a major role to play in reconciling the relationship between natural and human systems through the contribution of knowledge and innovation (Cash et al., 2003; Clark and Dickson, 2003; ICS, 2002; NRC, 1999; UNEP, 1992). However, it has also been acknowledged that many traditional practices and attributes must be transformed in order to enhance science's ability to address the global sustainability crisis. To mention but a few, some chief concerns raised by scientists around the world include disciplinary and reductionist approaches favouring specialisation and thereby preventing the holistic viewing of phenomena and creation of comprehensive solutions (Crow, 2010; Komiyama and Takeuchi, 2006); the historical tendency of scientists to 'study' the problems of the world rather than generate concrete and working solutions (Clark and Dickson, 2003; Clark and Holiday, 2006); and also, the undervaluing of place-based and context-specific research in favour of uncovering universal truth (Crow, 2010; ICS, 2002). Against the backdrop of this growing awareness of the limitations of modern science vis-a-vis the complex sustainability concerns of the new century, two noteworthy movements have gathered momentum in a bid to re-align science with the goal of sustainability. Namely, the emerging discipline of *sustainability science* and the international transdisciplinary network *Future Earth*.

The field of sustainability science requires no detailed discussion here due to the wealth of literature available on its worldwide development (Clark and Dickson, 2003; Komiyama and Takeuchi, 2006; Miller, 2012; Spangenberg, 2011; Yarime et al., 2012). However several principles driving the formation of this still evolving discipline deserve special emphasis. That is, the literature on sustainability science contends that in order for scientific research to rise to the challenge of sustainable development, science must be re-configured according to the following principles: (i) explicit focus on linking knowledge to action and generating solutions (Matson, 2009) (ii) place-based and solution-driven (Clark and Dickson, 2003; NRC, 1999; Miller 2012) iii) commitment to inter- and trans-disciplinary approaches (Spangenberg, 2011; Komiyama and Takeuchi, 2006) (iv) commitment to framing problems and co-producing knowledge in tandem with stakeholders (Cash et al., 2003; Clark and Dickson, 2003).

Another example of a large-scale attempt to re-orientate science is the *Future Earth* initiative. Launched in 2010, this global-level initiative from an alliance of international research organisations[100] has fixed itself the ambitious resolve to: "mobilize the international scientific community around a focused decade of research to support sustainable development in the context of global environmental change" (Reid et al., 2010, p. 917). Again, several principles guide the research design of Future Earth deserving particular emphasis here: (i) *Integration:* a commitment to sourcing and integrating knowledge from the natural sciences, social sciences

[100] These include: International Council for Science (ICSU), International Social Science Council (ISSC), Belmont Forum, UN Educational Scientific Cultural Organization (UNESCO), UN Environment Programme (UNEP), UN University (UNU) and the World Meteorological Organization (WMO).

and engineering and the humanities; (ii) *Co-design and co-production*: the co-design and co-production of research agendas and projects in collaboration with stakeholders from government, industry and civil society (iii) *Solution orientated:* research must contribute directly to solutions for environmental and sustainability problems (Future Earth, 2013).

Table 7.8 Re-structuring science towards sustainability

	Traditional science model		Desired scientific model
Paradigm	Reductionism	➔	Holism and sustainability
Scope	Universal	➔	Place- and stakeholder specific
Goal	Generate new knowledge	➔	Generate solutions
Approach	• Exclusive and insular • Low stakeholder involvement	➔	• Inclusive and open • High stakeholder involvement with research co-design and co-implementation
Integration	Mono-disciplinary	➔	Inter- and transdisciplinary, integrating natural sciences, social sciences, engineering and humanities

To tie together the commonalties of these two international movements to re-structure scientific conduct, Table 7.8 above summarises the chief properties called for to raise the capacity of the scientific enterprise to address the sustainability crisis. If comparing the desired model scientific model on the right with the key attributes of the co-creative sustainability model identified earlier in Chapter 7.1, it can be seen that the similarities are striking. That is, the above-described commitment to place, inter- and transdisciplinarity, co-design and co-production with stakeholders and the objective of creating concrete solutions for environmental and sustainability problems are all properties explicitly present in the 70 cases identified for this study—whether this be by design or default. Clearly, the scientific importance of the emerging university function of co-creation is far from insignificant. Firstly, by the potential to address many of the concerns associated with the spread of conventional technology transfer activities in academia. Secondly, the co-creative model is harbouring a precious opportunity for university actors (both academic and non-academic) to engage in a new type of scientific knowledge production closely aligned not only to the contemporary needs of society, but just as importantly, to the grand re-invention project that has arisen from within the realm of science itself.

7.5 Summary of chapter

A case has thus been laid out in this chapter for a reframing of the university's third mission and a promotion of the co-creative sustainability model. The significance of this emerging type of stakeholder collaboration has been argued from multiple perspectives. Firstly, it has been shown that this broader form of societal engagement can address an array of problems and limitations identified in the conventional model of technology transfer. It has also been highlighted that the attributes of the co-creative model correspond closely with principles called for by the international scientific community concerning the shape that scientific activities must take in response to the demands of global sustainability. As well as the societal benefits that can potentially ensue the university's participation in cross sector partnerships for urban sustainability, this chapter has also illustrated how the co-creative function can enhance the core university missions of education and research. It has also been argued that the expansion of cross-sector sustainability activities to co-create societal transformations towards sustainability is possibly heralding the emergence of a new 'species' of university—the co-creative university. Just as the identification and capitalisation of intellectual property for income generation and economic development is an institutional goal of the entrepreneurial university, the co-creative university will fix itself the objective of collaborating with diverse stakeholders to create societal transformations towards sustainable development.

Technology transfer represents just one strand of a vast spectrum of possibilities through which the university can contribute to society. This entrepreneurial model can and will continue to play an important role in contributing to industrial innovation and ensuring that the fruits of academic research are passed onto society. Yet the logic of defining a third mission for the university based upon a narrow conception of economic development is being challenged by the growing severity of local and global sustainability challenges. The development needs of humanity in the 21st century are much broader and are situated at the intersection of economic, social and environmental development. Furthermore, the sustainability dilemmas of contemporary humanity are characterised by the urgent need to create rapid and drastic societal transformations to correct the system failures at the root of the sustainability crisis. Although important, technology transfer alone cannot cater to these needs. The pathway to ensuring the continuing relevancy of the university's role in society this century will therefore be the nurturing of the transformative potential of the broad spectrum of co-creative activities arising from within the university for this purpose. The time has therefore come to move beyond a third mission defined principally by technology transfer and economic contributions. It is time to encourage the university's much broader and still growing potential to simultaneously pursue economic, social and environmental progress. By the same token, this would be to facilitate the mutual development of the university's other missions of education and research, and its embodiment in the surrounding society.

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Chapter 8
Conclusion

8.1 Synthesis of main conclusions

This section will summarise and then discuss the significance of key findings from the three sub-objectives and specific research questions dealt with in previous chapters. This synthesis of main conclusions and arguments will be conducted to address the core research objective:

Main objective: Examine the distinguishing features and mechanisms of co-creative university partnerships for urban transformations towards sustainability with special regard to the conventional technology transfer model.

To achieve this in a systematic way, main arguments and findings will be organised around the three sub-objectives, which are listed in the preceding paragraphs.

University-industry collaboration via technology transfer represents but one of a myriad of possible ways for the university to partner with external stakeholders and contribute to society. Closer collaborations with industry and the transfer of innovation and scientific research results can play an important role in aligning university research agendas with market and societal needs. Further, the prospect of generating income for both the inventor and the university, as well as the wider potential to contribute to regional or national economic development, can provide valuable incentives for university actors to make the extra efforts required to maximise the commercial and social utility of fruits flowing from university research programmes. However, this study has underscored that the dominating paradigm of technology transfer through patenting, licencing and spin-off firm creation concerns only a very narrow activity base of the university. That is, research-intense universities (usually with medical schools) mostly concentrated in the US (yet expanding to Europe and Asia) and a select set of fields such as the life sciences, software engineering, with some overlap into the broader field of applied engineering. Attention was brought to a host of concerns raised by scholars in regard to this model's potential to impede traditional innovation transfer channels such as publishing, conferences, liberal sharing of results and open interaction with fellow researchers. This study has emphasised that the driving paradigm of market logic and narrow pursuit of economic progress through technological innovation is at odds with the type of stakeholder collaborations required to address the local and global dimensions of the sustainability crisis. The field of sustainability science and the emerging Future Earth initiative[101] have stipulated the type of societal engagement required to address the complex and worsening sustainability concerns of humanity this century. That is, partnerships combining resources of natural and social sciences, humanities and engineering; the co-design of research agendas and the co-production of knowledge and projects with a broad array of external stakeholders; and a focus on generating solutions for place-specific sustainability needs

[101] The principles of this global initiative are explained in Chapter 7.4.6.

(Cash et al., 2003; Clark and Dickson, 2003; Future Earth, 2013; Komiyama and Takeuchi, 2006; NRC, 1999; Matson, 2009; Miller 2012; Spangenberg, 2011; Yarime et al., 2012).

This dissertation has brought attention to an emerging and novel form of stakeholder collaboration. In this function that the author has termed ‘co-creation for sustainability’, there is a shift beyond attempts to merely transfer technical innovation to industry in pursuit of income generation and economic development. The goal becomes that of collaborating with a broad array of societal actors to address local or regional needs and co-create societal, technological, environmental, political and economic transformations towards greater sustainability. As another marking characteristic, in co-creative university partnerships there is typically a merging of more established societal engagement paradigms such as transdisciplinarity, regional development, neighbourhood improvement through real estate development, participatory research, living laboratories and technology transfer, to name but a few.

8.1.1 Summary of findings for first sub-objective

Sub-objective 1: To determine from a global perspective key attributes, commonalities and differences characterising co-creative university partnerships for urban transformations towards sustainability.

The above sub-objective was addressed in Chapter 4. Here a series of analytical tools (Analytical Framework [A] and typology-based analyses) were applied to the global sample using data obtained from quantitative surveys. The results of this statistical analysis shed further light on how the still developing and evolving co-creative function distinguishes itself from the more established technology transfer model.

Findings firstly confirmed that co-creative partnerships for urban sustainability transformations are significantly widespread around the world. With activities from the 70 cases in the global sample dispersed over scores of cities and nations in Europe, Asia and North America, it was also confirmed that many lead institutions are influential research universities on the global stage. It was observed too that the majority of cases were formed since 2010—with many scheduled to continue indefinitely as long as required resources are made available. It can therefore be argued with confidence that the phenomenon of co-creative university partnerships for urban sustainability is a global, yet still emerging trend, possibly poised to continue expanding in magnitude across academia in the years to come.

The statistical analysis demonstrated several key attributes contrasting to the dominating model of technology transfer. These include a distinct focus on a specific place (mostly at the local or city-level) and set of stakeholders, more often than not with the involvement of actors from local or regional government and civil society (both expert and non-expert). As for partnership objectives, all though these vary highly across the global sample pool, overall, co-creative partnerships are characterised by the simultaneous pursuit of environmental, social and economic development. More specifically, results revealed a global tendency to pursue sustainability by focusing on the *built environment* and *energy*, but also on *governance and planning* and *human and social systems.* The holistic development agendas of co-creative partnerships were also verified by findings that the majority of partnerships in the global sample are simultaneously attempting to advance the sustainability of multiple urban sub-systems. Regarding motivational factors, although co-creative university partnerships for urban transformations towards sustainability are formed for multiple reasons, two factors emerged of particular importance. The first was an internal university motivation to enhance research and scholarship by engaging with local stakeholders and learning from real-world settings. The second related to external societal conditions and the desire to respond to local or regional sustainability challenges by strategically reforming development trajectories in the target area. Further, a finding with policy implications was that the procurement of external *funding* was also a key motivating factor for the formation of many partnerships. This study also highlighted six specific mechanisms—or 'societal engagement modes'—used by co-creative partnerships to drive societal transformations towards urban sustainability. Of these, the most commonly utilised were activities related to *knowledge management* and *governance and planning*. Overall, a bias towards techno-centric approaches was identified (especially in Asia) with a reluctance (or perhaps inability) to pursue social innovation avenues. On the other hand, the societal engagement mode of *technology transfer or economic development* was shown to be the least significant means by which cases around the world seek to advance urban sustainability.

Finally, additional typology-based analytical exercises established that the vast majority of partnerships in the sample are performing a core partnership function related to *research, demonstrations or knowledge exchange.* This indicates that the bulk of the global sample contains a formal research and knowledge sharing component, mostly being cross-sector platforms set up for purposes such as collaborative research, early-stage R&D, knowledge exchange and scientific demonstrations. On the other hand, partnerships performing other functions such as *socio-economic transformations, physical environment transformations* and *service learning* were found to be less common. In particular, it was shown that with the exception of several cases in North America, there was an unexploited global potential for co-creative partnerships to be used simultaneously as research and educational platforms. A further plot-based typological exercise then revealed two key sets of cases in the global sample: one involving a low-level of civic society participation and an orientation towards a core function of *research, demonstrations or knowledge exchange*, the other with a high-level of civic involvement and objective closer towards *socio-economic transformation*. The identification of these two clusters thus determined the selection of case studies, which took a pioneering example from each group to explore two contrasting representations of co-creation university partnerships for urban sustainability.

8.1.2 Summary of findings for second sub-objective

Sub-objective 2: To determine from a global perspective commonly encountered drivers and barriers, assessing overall effectiveness and impacts.

This sub-objective was addressed in Chapter 5 where Analytical Framework [B] was applied to 55 cases from which questionnaire results were obtained.

Results show firstly that on both a global and individual regional level the most important driving factors are *synergy* occurring from cross-sector combining of knowledge and resources, as well as *strong leadership.* Interestingly, both of these factors relate to internal project dynamics. Qualitative responses suggested that strong leaders enhance partnerships by: "leading, pushing and driving the collaboration"; ensuring that the strength, expertise and experience of each partner and sector is fully exploited; mustering external support and recruiting other leaders and change agents; and also, instilling a common vision and set of values amongst various partners—

an essential factor in maintaining partnership synergy. *Funding* also emerged as a key driver. Qualitative responses suggested that this was because the procurement—or prospect of procuring—funding was helpful in securing participation and driving action from private and government partners.

Frequently cited barriers were human rather than technical in nature and mostly related to internal partnership dynamics such as *time restraints*, *lack of unity and harmony* and *communication difficulties*. These findings highlight the need for effective project management and dedicated supporting staff and backbone infrastructure such as project offices and supporting staff, which can serve to alleviate the time restraints barrier. Another significant obstacle was lack of *funding*—in particular the *availability* of suitable funding programmes. It was reported that when securing of sustained funding is a constant concern, valuable time is snatched from core activities as faculty are forced to pursue funding sources. It was also confided that lack of financial resources tends to reduce the societal impact of projects and ability to secure external partners. Another factor brought into light was the finding that traditional academic incentive systems and norms was proving in numerous cases a hampering force on the formation and implementation of co-creative partnerships. Lastly, qualitative responses then brought to attention potential tensions that can arise between differing 'worldviews', incentives and timespans influencing operating cultures in local government and academia.

From another perspective, results also showed overwhelming agreement around the globe regarding the view that the presence of various societal sectors has a positive impact on a partnership's ability to pursue its objectives (i.e. *synergy*). Widespread recognition in the literature that cross-sector collaboration is necessary to tackle sustainability challenges was thus confirmed by co-creative actors working 'on the ground'. However, when it comes to translating this potential into results, findings showed that several cases were deemed to have fallen short of expectations. Nevertheless, around two-thirds of the 55 partnerships represented indicated strong agreement regarding progress towards attaining initial objectives

Regarding potential impacts of co-creative partnerships, findings uncovered widespread confidence in regards to positive impacts for *environmental, social* and *sustainability* dimensions. On the other hand, they also demonstrated far less confidence regarding the capacity of individual partnerships to contribute to *economic* development. These findings call into question the logic of focusing upon economic development as the most desirable means of contributing to society through cross-sector collaborations. They suggest that expectations with regard to potential impacts from co-creative partnerships should be centred instead on those areas where cases are making the most progress; namely environmental, social and sustainability impacts.

8.1.3 Summary of findings for third sub-objective

Sub-objective 3: To build an in-depth, qualitative understanding on contrasting types of co-creative partnerships initiated by frontrunner institutions with a special regard to: motivating factors, stakeholder type and roles, partnership mechanisms, sustainability impacts attained, drivers and barriers encountered, and lastly, strengths and weakness of the approach.

Micro-level case study results in Chapter 6 demonstrated the potential of the emerging co-creative model to cater for highly contrasting institutional characteristics, motivations, socio-economic conditions and societal needs. The 2000 Watt Society Basel Pilot Region illustrated a case unfolding in thriving socio-economic circumstances, led by a research-intense institution. This partnership aimed to implement the scientific vision of a ‘2000-watt society’ and trial emerging technologies for long-term energy efficiency targets in mobility and the built environment. These motivations and objectives shaped the partnership structure, calling for a hybrid type of partnership performing a dual function of *research, demonstrations and knowledge exchange* on the one hand, and *physical environment transformation* on the other. This partnership was driven principally by research and a technical approach, with key partners from local government and large industry. In contrast, the Oberlin Project illustrated a case emerging in circumstances of severe socio-economic decline, from a liberal arts institution desiring to improve social and physical conditions to ensure long-term competitiveness and resiliency towards climate change and sustainability challenges. Ambitions of spurring post-carbon economic regeneration required civil society engagement and a social innovation approach with real estate development. These factors influenced the dual partnership function of *socio-economic transformation* and *physical environment transformation.*

A key finding in the cases was that socio-economic conditions and institutional motivations and characteristics strongly influence the model of co-creation. Two distinctive models of co-creation for urban sustainability were thus defined—one for *innovation* and the other for *regeneration.*

Co-creation for innovation would be expected to emerge from prosperous socio-economic circumstances and research-intense universities with strengths in engineering. Objectives would be to drive urban sustainability through technical innovation, demonstrations and implementation projects with scientific value. This model would appear relevant to internal actors such as faculty and researchers form the hard sciences, and external partners such as large industry and local government. The role of large industry would be to participate in R&D, provide resources such as knowledge, funding, demonstration car fleets and buildings and so on, and then integrate scientific knowledge into operations. The role of government would also be to provide the same resources, as well as integrate scientific research results into policy and long-term planning. Societal engagement modes involved by this type of co-creation would be chiefly *knowledge management* (e.g. publications, public forums and diffusion of results), *technical demonstrations and experiments* (e.g. long-term field tests of emerging technologies), but also additional activities in *governance & planning* (e.g. reform of construction industry governance systems and policy making) and *reform of the built natural or environment* (e.g. establishment of demonstration buildings and fostering of innovation in construction and urban planning).

It was then demonstrated that the above conception of co-creation for innovation corresponds closely with several other cases in the global sample (see Table 6.23). Observations from these partnerships, coupled with findings from the cases, suggest that potential impacts of this model could include: integration of scientific knowledge into real-world implementation projects and long-term government planning; verification of both technical and social aspects of emerging technologies in urban laboratories; and the creation and export of technical tools such as new technologies, decision making instruments and socio-technical systems (e.g. low-carbon car fleets) for driving wider societal transformations. Other outcomes could include changes in industry practice via science-backed reform of governance frameworks and the transfer of innovation to industry and local government—with or without patenting. Case study results suggest that strengths of this model would include the use of scientific research to shape public policy and influence industry behaviour, whilst measuring and guiding societal progress towards long-term sustainability targets. Potential limitations could arise from incapacity to tackle lifestyles due to overwhelmingly technical approaches and absence of civil society actors. Other difficulties could include tensions when aligning long-term scientific research agendas with local government priorities in short-term implementation projects. This highlights the need for strategies to co-design projects in 'middle ground' to generate value for both academic and government actors.

On the other hand, co-creation for regeneration could be expected in deteriorating socio-economic and built environment conditions. It could emerge from less research-intense institutions with motivations in improving social and environmental conditions and developing real estate assets in the neighbouring community. Objectives would be to drive socio-economic regeneration via sustainable development, largely through a social innovation approach, with less emphasis on scientific research. This model would be expected to be relevant to both faculty from a broad range of disciplines (also encompassing the social sciences and humanities) and administration, with potential for involving students. Core external partners would be diverse stakeholders from civil society, together with local government. Civil society's role would range from knowledge contribution, to project co-ordination and implementation. Local government's major role would include the shaping of policy and planning in accord with knowledge obtained from external examples of best practice and results of various experiments conducted. As was the case in the Oberlin Project, the breadth and ambition of this model would most likely call for an activity base through several—if not all—societal engagement modes. That said, *socio-technical experiments* would play a special role, as new configurations of social, economic and technical systems were trialled (carbon funds, local food networks etc.), together with an important role for *governance and planning* (e.g. efforts to influence public policy and planning via community consensus building and political advocacy).

It was then argued that the above definition of a model of co-creation for regeneration corresponds closely with characteristics of several other cases in the global sample (see Table 6.24). Observations from these, together with case study findings, suggest that potential impacts would encompass: advancement of the human dimensions of sustainable development such as community engagement, capacity building and fostering of social entrepreneurship; the institutionalisation of sustainability-based decision making into government policy; societal transformations or prototypes of new configurations of energy, transport, carbon finance and food systems and so on; significant improvements and sustainability gains in infrastructure and the built environment through low-carbon real estate development; and lastly, potential economic regeneration achieved via increased economic activity, reduced leakage (i.e. expenditures on imported energy, goods and services) and creation of new low-carbon businesses and employment. Strengths of this model would include the potential to generate widespread social engagement around sustainability due to a high civil sector involvement and linkages with existing grassroots initiatives. Challenges would be encountered however in seeking to drive economic growth due to the complexity and time required for this task in a contracting economy.

8.1.4 Summary of implications

This study has been framed predominantly as a juxtaposition of emerging models of co-creation for sustainability against the more established model of technology transfer. Yet an attempt has also been made in Chapter 7 to show how the emerging co-creative model can enhance the university's base missions of education (i.e. the first mission) and research (i.e. the second mission). Based upon lessons from the case studies and multiple interviews with co-creative partnerships around the world, core benefits emerging for the research function were: the potential for faculty to learn from real-world settings allowing an interaction of technical and human systems, increased visibility of scientific research and opportunities to export results, and also, the opportunity to enrich research by supplementing theory with application. As for the education function, for students engaging in co-creative partnerships through either course work or internships, this can enable the acquirement of collaborative skills, the opportunity to test and supplement theory with practice, exposure to different values and perceptions, development of interpersonal and practical skills and access to job and career-building opportunities. For teaching faculty, the integration of courses into wider co-creative sustainability efforts in the community can bring advantages such as boosted social relevancy of curricula and the provision of more stimulating and engaging learning. Despite such potential benefits for the education function, it should be recalled that only a small portion of partnerships in the global sample (mostly concentrated in the North America) are experimenting with the utilisation of co-creative sustainability partnerships as service learning platforms. The integration of undergraduate and graduate education programmes into real-world efforts to co-create societal transformations towards sustainability therefore represents a key area for potential development in the future.

This said, findings suggest that co-creative partnerships in the context of urban sustainability can potentially bring into play a much larger activity base of the university than technology transfer alone (which concerns essentially research activities in the life sciences, software engineering and some areas of applied engineering). Empirical results suggest that co-creative partnerships formed in the goal of responding to local sustainability needs can potentially generate opportunities for internal collaboration in the university. It can thus facilitate cooperation between differing sectors such as faculty/researchers, students, administration and bridging organisations, as well as across other departments and academic institutions. As illustrated by the Oberlin Project and other cases in the global sample, in this way co-creative partnerships can provide a framework and common purpose to justify the merging of university several functions such as research, education, outreach, technology transfer and real estate development to the common goal of contributing to societal progression in the surrounding area. The emerging function of co-creation for sustainability can therefore provide the occasion for universities to align simultaneously their various activities to better reflect the needs of neighbouring environments.

This vast spectrum of co-creative potential justifies the call for a re-interpretation of the third mission away from narrow conceptions of economic growth achieved predominantly through technology transfer. This study advocates for an expanded interpretation of the third mission; one focused upon sustainable development (therefore inclusive of economic, social and environmental progress). By doing so, the ‘product’ of societal interactions through third stream activities would expand from technical innovation from the life sciences and areas such as software engineering (i.e. early stage prototypes of medical devices, drugs, genetic techniques and software programmes) to also encompass social innovation, societal and environmental transformations, and also, the creation of governance frameworks for innovation and steering societal progress towards long-term sustainability objectives.

To foster an expanded re-interpretation of the third mission and a wider appreciation of the potential of co-creative partnerships would not be easy. Starting with the US Bayh-Dole Act of 1980, policies are in place all around the world to facilitate the identification and transfer of intellectual property to industry and encourage entrepreneurial behaviour in academia. Policies are therefore required to nurture the emerging co-creative function in the same way. This study has suggested two avenues for national governments. The first involves the reform of existing national-level university appraisal systems so they take into account and create performance indicators for stakeholder collaborations, research and outreach efforts in the field of sustainability. An additional measure would be the development and integration of indicators into national-level benchmarking systems for specifically measuring and appraising third mission activities. Such indicators should be founded upon a holistic interpretation of the third mission as signifying the simultaneous addressing of economic, social and environmental challenges in tandem with diverse local and regional stakeholders. The second course of action would involve a restructuring of selection criteria for existing funding programmes so that faculty and researchers would receive a 'market signal' that place-based sustainability collaborations are valued. As well as echoing arguments from other scholars (Dedeurwaerdere, 2013; Whitmer et al., 2010), this recommendation seeks to address the finding from Chapter 5 that funding—especially the *availability* of suitable programmes—constitutes a major barrier to co-creative initiatives in academia. The author's proposal for modifying funding policies was therefore that selection criteria in a range of existing programmes be modified to demand principles such as collaboration with external stakeholders and other disciplines, addressing of local societal problems, transfer of research results to potential users, and most importantly, a demonstration of how the proposed research can contribute to a mutual pursuit of economic, social and environmental development.

An argument has hence been laid out in this dissertation for expectations regarding societal contributions from the university to move beyond a third mission conceived primarily in terms of economic development through technology transfer. As a planetary-level ecological crisis marked by climate change, environmental degradation and resource depletion combines with localised challenges such as socio-economic decline, fossil fuel dependency and deteriorating built environments, the physical operating space for economic activities and future well-being of many urban settlements is in jeopardy. A new paradigm of stakeholder collaboration for innovation and creating societal transformations is required that can rise to these challenges. This study has argued that sustainability can serve as this guiding principle or *leitmotif.* As well as ensuring the continued societal relevance of the university's various functions, this study has shown that the co-creative model can potentially bring a broad activity base of the university into alignment with societal needs in a way that also allows the university to pursue its own goals and enhance core missions of education and research. More importantly, this study has shown that the type of knowledge and innovation that can be 'transferred' to society through the co-creative model is much broader in nature than that occurring in dominating enactments of technology transfer.

In closing, several prestigious institutions around the world—now including MIT and Harvard[102]—are entering into Memorandum of Understandings with local municipalities and the private sector to collaboratively tackle local sustainability challenges through research, education, community development and technology transfer. It appears therefore that the birth of the entrepreneurial university was not to signify the last chapter in the evolution of the modern research university. It seems that the sustainability crisis and changing societal expectations are prompting the birth of a new 'species' of institution. A co-creative university is emerging, one seeking to contribute to society in more ways than just technology transfer and economic development.

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[102] Harvard and MIT signed a MOU with the City of Cambridge and several industrial partners in May of 2013. See Compact for Sustainable Future in Appendix 1.

8.2 Reflection on methodology and research limitations

This section deals with the limitations and challenges encountered when designing and implementing the study, in addition to a critical reflection of the methods used. As the issues relating to data quality were discussed already in Chapter 3.5, they will not be revisited here.

8.2.1 Limitations and major challenges encountered

A major hurdle encountered in building global-level knowledge on co-creative partnerships for urban sustainability has been the lack of an existing database—to the best of the author's knowledge—devoted specifically to university-driven cases. Consequently, the author has had no choice but to identify samples singlehandedly, in an attempt to map out the worldwide emergence of the university function of co-creation for sustainability. The sampling method employed to locate 70 cases satisfying the criteria outlined in Chapter 3.5 could be criticised as not being sufficiently systematic. This would be a valid criticism in the event where a large-*n* database of suitable partnerships existed. In all fairness, upon advice of other scholars the author did try to make a systematic attempt to determine the extent of which place-based co-creative partnerships for sustainability have proliferated in academia. This was done by sending email requests to sustainability offices and faculty connections in the top 100 research universities featuring in the Academic Ranking of World Universities[103]. This sampling method, however, proved unsuccessful. The problem was two fold. Firstly, many universities did not respond, most likely for workload and time-related reasons. Secondly, it became quickly apparent that many sustainability offices and researchers in universities around the world are not aware of place-based sustainability initiatives taking place within their own institution. This is a problem of both internal communications and the sheer complexity and volume of activities in large-scale research universities. As a result, the author abandoned this systematic sampling technique and adopted that outlined in Chapter 3.5.3. Although this method proved sufficient for identifying 70 cases fitting the scope defined for this study, this sample is still incapable of indicating the real extent to which co-creative activity in the context of urban sustainability is flourishing around academia. A global database is thus required to both elucidate this point and enable shared learning across institutions and borders.

A second hurdle experienced in this research was the extreme difficulty in understanding partnership structures and processes, establishing cause-and-effect mechanisms and identifying progress towards greater urban sustainability in the case studies. Essentially there were two reasons for this. The first stems from the short timespan during which this research was conducted. This research has unfolded during a period of approximately two and half years (April 2011 to November 2013). Fieldwork conducted for each case took place over a much shorter time span, involving one visit over approximately ten days to each of the target regions. Yet both of the cases chosen for this study involve collaboration periods of several years (over a decade for the Swiss case and around five to six for the Oberlin case) and pursuit of extremely long-term sustainability targets. Will the Basel Pilot Region prove sufficient enough for the City of Basel to attain the 2000-watt and 1-tonne-CO2 per capita goal by the current target year of around 2075? Will the Oberlin Project allow the City of Oberlin to attain 70% food sufficiency by 2030 and

[103] See URL: http://www.shanghairanking.com

carbon neutrality by 2050? The two and a half years spent researching this topic was clearly insufficient for gaining detailed insights into the long-term workings of co-creative partnerships and the extremely complex process of collaboratively bringing about societal transformations towards greater urban sustainability. The second factor rendering difficult the establishment of cause-and-effect mechanisms was the blurring of roles and boundaries between the societal sectors participating in each partnership. Although each case was initiated by university actors, with time each grew in complexity and involved a greater number of partners, stakeholders and activities. As a result, cause-and-effect linkages became increasingly difficult to determine due to the overlapping of roles and responsibilities across each of the societal sectors. Sustainability impacts on one end thus become increasingly hard to trace back to a particular set of actors or specific societal sector. The combination of these two limitations highlights the need for longer field visits and research periods for investigating particularly the qualitative dimensions of co-creative partnerships for urban transformations towards sustainability.

8.2.2 Reflections on research methods and approach

This study has employed a mixed-methods methodology that has resulted from allowing the research objectives to dictate the methods employed. If starting all over again, the author would again opt for a similar qualitative and quantitative approach without hesitation. This is because the qualitative dimensions of this study (i.e. the macro-level research) have addressed the overwhelmingly descriptive tendency of the literature on the subject of cross-sector university partnerships for sustainability. It has also allowed what the author believes is the first global-level appraisal of specifically university-driven partnerships. Although the sampling method employed for this study is far from perfect, it has at very least served to identify key global trends and provide a snapshot of the overall universe of co-creative activity around the world. Insights and knowledge from future detailed case studies around the world may hence be contrasted against the global-level survey and statistical analysis carried out by this study.

That said, the case-selection criteria created for the macro-level of this study (see Chapter 3.2) has resulted in a global analysis of 70 cases with highly diverse objectives, characteristics and socio-economic contexts. In retrospect, I could be faulted for having too many types of 'fruit' in the basket. Therefore, as a future pathway for further research, it would be equally possible to conduct a similar study to this by focusing on just one of the four partnership types (i.e. *physical environment transformation project, socio-economic transformation project* etc.) or on one of the contextual applications of these partnership types (i.e. co-creation for regeneration and co-creation for innovation). Although this may produce a more detailed understanding of that particular partnership type or socio-economic application, it would on the other hand only represent a small fractal of the entire spectrum of possibility harboured by the university function of co-creation for sustainability.

Lastly, the author's detached positionality as an observer was surely helpful in identifying and analysing many qualitative characteristics in each of the two cases. In retrospect, however, a participatory action research role where the author was involved directly in the case in question would have been highly insightful and undoubtedly more conducive to the acquirement of knowledge concerning the exact cause-and-effect linkages driving university initiated sustainability partnerships. This has been demonstrated by participatory action research approaches to conducting case studies by other scholars such as Van den Bosch (2010) for ‘transition experiments’ and Hopkins (2010) for the case of Totnes as a ‘transition town’. However the trade off here would be deeper knowledge at the price of impartiality—as acknowledged by the authors of both these studies.

8.3 Suggestions for further research

This dissertation was conducted from the assumption that the trend of co-creative university partnerships for urban transformations toward sustainability is a still emerging phenomenon, not yet fully understood by the literature and existing analytical frameworks. This research has thus sought to build the theoretical and empirical foundations for what the author believes is an important area of research deserving further analysis from other scholars. This sub-chapter will thus suggest some potential areas to be addressed by future studies.

A major area meriting future investigation is the potential of the co-creative model to assist collective efforts to advance urban sustainability in non-industrialised nations. This potential has been purposely overlooked by this study due to the scope of the selection criteria outlined in Chapter 3.2.1. As already explained, the geographical and industrialised nations focus was designed to ensure a balanced representation of socio-economic and political conditions for the 70 cases in the global sample. However urban areas of developing and emerging economies are posing a formidable and mounting challenge to the global quest to curb greenhouse gas emissions and re-orientate urban settlements towards greater sustainability (Peter and Swilling, 2012; UN Habitat, 2008). It is therefore a pressing issue to explore alternative ways of fostering societal transitions toward more sustainable development pathways in these settings. It is worth noting that the conventional technology transfer model is currently being promoted in various emerging economies such as India, China, Thailand and Latin America (Thorn and Soo, 2006; Yusuf and Nabeshima, 2007). Based on this observation, it would therefore seem likely that the co-creative model would also have implications for university research, education and outreach—as well as cross-sector efforts to drive urban sustainability—in emerging economies in Asia, Africa and South America.

With its focus on specifically urban and sub-urban settings, this study has not been able to explore the potential of the co-creative model to advance the sustainability of rural areas or sub-sectors such as agriculture, forestry and aquaculture. This therefore constitutes another important area of potential future research. The co-creation for regeneration model examined in this study through the Oberlin Project provides some insight into the potential of co-creative university partnerships to contribute to the development of semi-rural settings. However types of co-creation specifically suited to rural needs have not been explored by this study. Clearly an existing model of university stakeholder collaboration requiring consideration here would be the US land grant system and the co-operative extension, which some researchers argue has profoundly influenced the prosperity of rural America (McDowell, 2001).

Another area only partially explored is the potential of co-creative partnerships to enhance the educative function or first mission of the university. The macro-level empirical analysis from Chapter 4 has revealed that there is an unexploited potential for co-creative sustainability partnerships to also function as service learning platforms. With the exception of several pioneering partnerships mostly concentrated in North America[104], the majority of the 70 cases collected for this study should be understood as initiatives conducted chiefly from the research, function of the university, with others from outreach or campus development. Further work is

[104] To recall but two cases, these include City Studio Vancouver by Simon Fraser University, Emily Carr University and partners, and Sustainable City Year Program by the University of Oregon.

therefore required to investigate the factors preventing other partnerships around the world from functioning as educational platforms. Future empirical investigations would also be required on existing service learning platforms set up by North American institutions to address local and regional sustainability challenges. Specific areas to explore could be the exact ways by which pedagogy has been enhanced and the value of service learning partnerships for city governments. Lessons need to be also compiled on factors facilitating or impeding the success of such experiments. The necessity of work in this area has been expressed by a lead partner of the *Sustainability Cities Initiative* at the University of Oregon: “After four years, the university still has no idea how to help administer and support something that crosses across multiple disciplines and core institutional functions (research, teaching, and service). The program works despite (and sometimes due to) this institutional deficiency” (Marc Schlossberg, October 4, 2013, e-mail message to author).

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List of Appendices

Appendix 1: Summary of global sample database

Name	Lead academic institution(s)	Target area(s)	Description & Focus	Collaboration period
EUROPE				
Blue Green Dream (BGD)	Imperial College London	FRANCE: Paris, ENGLAND: London, NETHERLANDS: Rotterdam and GERMANY: Berlin	Four testing sites have been set up across EU to show benefits of combined B&G (water and greenery) management. Projects aim to improve the urban environment and boost resilience to climate change.	2012 – n/a Status: ongoing
Campus Sostenibile	University of Milan, Polytechnic Institute of Milan	ITALY, Milan	Project to transform entire campus neighbourhood of both institutions into an exemplary urban model of quality of life and environmental sustainability.	2011 – n/a* Status: ongoing
City Lab Coventry	Coventry University	ENGLAND, Coventry City	Initiative to establishing Coventry City as a test-bed, incubation hub and international showcase for low carbon innovation, with focus in transport, buildings, IT, green business and high-tech start-ups.	2011 – n/a Status: ongoing
Corridor Manchester	University of Manchester, Manchester Metropolitan University	UK: Central Manchester (Oxford Road)	Urban reform effort to transform built environment and infrastructure on 243 hectare strip of Oxford Road to a low-carbon hub of knowledge driven business activity, simultaneously generating economic growth and employment.	2007 – n/a Status: ongoing
District Future – Urban Lab	Karlsruhe Institute of Technology	GERMANY: Karlsruhe	An experimental living space is being set up in Karlsruhe to trial technological and societal innovation from KIT and transform a downtown quarter into an arena for sustainable living.	2011 - 2020 Status: ongoing
EcoCities	University of Manchester	UK: Manchester City	Seeks to provide Greater Manchester with a future scenario based blueprint for an integrated climate change adaptation strategy stretching to the year 2050.	2008 – 2012 Status: completed
Energy Atlas	Berlin Institute of Technology	GERMANY: Berlin	Development, application and transfer of decision making and planning tool for making comprehensive assessments of energy demand, energy balancing and planning, based on a digital 3D model of Berlin city.	2011 – 2013 Status: complete
GUGLE (Green Urban Gate towards Leadership in sustainable Energy)	University of Natural Resources and Life Sciences, Vienna	AUSTRIA: Vienna	Project aiming to contribute to citywide transition of Vienna to a sustainable and climate resilient city by testing a series of policies and technologies in districts of Penzing and Alsergrund.	2011 – n/a Status: ongoing
Hansa Energy Corridor Energy Gateway	University of Groningen	GERMANY: North-western Lower Saxony, Bremen NETHERLANDS: Northern provinces	Project aiming to accelerate the regional transition of Dutch-German border to sustainable energy in fields such as solar, wind and bio-fuels.	2011 - 2013 Status: complete
Innovative City Program	Aalto University	FINLAND: Helsinki	Programme directing R&D activities from Aalto University towards areas of need identified in the City of Helsinki to ensure their contribution to sustainable urban development in the capital region.	2001 – n/a Status: ongoing
Heat and the City	University of Edinburgh	SCOTLAND, Glasgow & Edinburgh	Action-learning research project to develop blueprint for catalysing transitions to sustainable district heating in 'cold climate' cities.	2011 – n/a Status: ongoing

MEU (Innovative Instruments for Energy Management in Urban Areas)	Ecole Polytechnique Fédérale de Lausanne	SWITZERLAND, La Chaux-de-Fonds, Lausanne, Martigny et Neuchâtel	Partnership creating IT visualisation tools to aid monitoring and planning of energy usage in small towns, for local government.	2009 – n/a Status: ongoing
Off4Firms	ETH Zurich	SWITZERLAND and EU	An incentive scheme for firms to reduce energy consumption and GHG emissions in employee households. Research platform has evolved to a spin-off firm.	2010 – n/a Status: ongoing
OPTIMISM Optimising Passenger Transport Systems	Coventry University (Coventry University Enterprises Ltd)	EU wide	Research project seeking to contribute to more sustainable and integrated transport system in Europe. Focus on passenger behaviour and developing a modelling technique to visualise new and improved service offerings.	2011 – 2013 Status: complete
Plan Vision	University of Natural Resources and Life Sciences, Vienna	AUSTRIA: Freistadt	A co-research effort with the Town of Freistadt to clarify and integrate the relationship between spatial planning, energy demand and district renewable energy supplies. Results integrated into urban development and district biomass heating.	2009 – 2011 Status: complete
Scottish Biofuel Programme	Edinburgh Napier University	SCOTLAND	Consulting platform to work directly with Scottish SMEs to develop opportunities for the conversion of low value biomass into bioenergy and sustainable fuels.	2012 – 2015 Status: ongoing
SMARchTrenk	Johannes Kepler University of Linz	AUSTRIA: Marchtrenk	Project to build a smart district in the town of Marchtrenk in view of becoming a showcase region for all of Austria regarding the handling of energy and resources.	2010 – 2011 Status: complete
Smart Urban Adapt	ETH Zurich	EU: (initial pilot in Zurich and London)	Project to assist European cities with computer aided decision making tools to design urban development pathways towards a low-carbon society.	2012 – 2013 Status: complete
SUN Sustainable Urban Neighbourhoods	University of Liege	BELGIUM NETHERLANDS GERMANY Meuse-Rhine Euregion	Participatory action research and multi-actor learning alliance to put seven urban neighbourhoods on pathway to sustainability and stimulate a stagnating socio-economic fabric.	2009 – 2012 Status: complete
SusLabNWE (Formerly Living Lab Project)	Delft University of Technology	NETHERLANDS: Rotterdam, ENGLAND: London, GERMANY: Goteborg and Nordrhein-Westfalen	A series of model homes have been built or appropriated and integrated into an R&D and demonstration network for generating and trialling sustainable products and services for European households.	2008 - 2015 Status: ongoing
Tecovoiturage	Université de Versailles Saint Quentin en Yvelines (Fondaterra)	FRANCE: 1. nationwide 2. Versailles, Saint-Quentin-en-Yveline	Free car sharing programme created to reduce transit related GHG emissions in national higher education sector and Saint-Quentin-en-Yvelines, outer Paris.	2008 – ongoing Status: ongoing
TURaS	University College Dublin	BELGIUM: Brussels, UK: Dublin, London, Nottingham, Seville, ITALY: Rome, Sofia, SLOVENIA: Ljubljana, NETHERLANDS: Rotterdam, GERMANY: Stuttgart, and Aalborg	Aims to contribute to EU wide transition to sustainability and resiliency by measuring and comparing transition demonstrations from various participating sites and producing a set of strategies and practical tools for other European cities.	2010 – 2016 Status: ongoing
2000 Watt Society Basel Pilot Region	Swiss Federal Institutes of Technology (ETH) domain	SWITZERLAND, Basel	Long-term effort to accelerate the transition to a '2000-watt society' and promote sustainable urban development through various projects in Basel, with wider ambition of accelerating national de-carbonisation in mobility, buildings and urban development.	2001 – 2017 Status: ongoing

Urban Laboratory for Sustainable Environment	Aalto University	FINLAND: Lahti	A test area and urban laboratory network set up in Lahti to study the functioning of urban ecosystems, impacts of building on the environment and associated knowledge infrastructure. Data built up during project will be integrated into models and planning tools for area.	2012 – 2014 Status: ongoing
Urban Living Lab: Versailles	Université de Versailles Saint Quentin en Yvelines (Fondaterra)	FRANCE, Versailles	Collaboration to 1) carry out experiments in areas such as energy efficiency, EV transport, low-carbon urban planning, green jobs and 2) diffuse already completed or ongoing sustainability initiatives into the community and accelerate the transition to sustainable development.	2011 – n/a Status: ongoing
Urban Transition Øresund	Lund University	SWEDEN & DENMARK, Øresund region	Alliance to promote sustainable growth in the Øresund Region by mobilising municipalities, universities and businesses for cross-border cooperation. Aims to develop cross-border methods and tools for sustainable urban transformation within 1) sustainable planning processes 2) sustainable construction and 3) financing.	2011 – 2014 Status: ongoing
URSULA (Urban River Corridors and Sustainable Living Agendas Research Project)	University of Sheffield	ENGLAND: Central Sheffield (Don River)	Interdisciplinary research platform to understand interaction between Don River and urban environment. Involved creation of blueprint for reform of built and natural landscape to improve flooding resistance, beautification and land-use.	2008 – 2012 Status: complete
Verdir	University of Liege	BELGIUM, Greater Liege	Socio-economic and research platform to transform industrial waste zones into centres of urban agriculture and aquaculture, stimulating the local economy and creating employment.	2012 – n/a Status: ongoing
ASIA				
CUHK Jockey Club Initiative Gaia	City University of Hong Kong	HONG KONG: Various communities	Initiative consisting of three components: 1) art exhibition showcasing CUHK's research in environment, energy and sustainability, 2) carbon scheme aimed at schools and NGOs to pursue energy efficiency and carbon reductions and 3) public education and awareness raising.	2012 – 2018 Status: ongoing
DHI-NTU Research Centre	Nanyang Technological University	SINGAPORE: Nationwide	R&D platform to generate new water knowledge and strengthen the water and environment industry in Singapore via the development of innovative technologies and training of water and environment professionals.	2007- 2016 Status: ongoing
(E2S2) Energy and Environmental Sustainability Solutions for Megacities	Shanghai Jiao Tong University National University of Singapore	CHINA: Shanghai SINGAPORE: Central Singapore	R&D platform to improve energy recovery from waste and develop system modelling and data management tools to track and mitigate emerging environmental contaminants. Dual test-beds are set up in several locations across Shanghai and Singapore.	2012- 2017 Status: ongoing
Hong Kong SME Business Sustainability Index	Hong Kong Polytechnic University	HONG KONG: Nationwide	Platform to promote the understanding and adoption of CSR as a business model to foster sustainability practices of business sector in Hong Kong and encourage reporting of sustainability practices.	2011- n/a Status: ongoing
Green Society ICT Life Infrastructure	Keio University	JAPAN: Okutama (Tokyo) and Kuribara City (Miyagi-ken)	R&D and testing platform to contribute to the resiliency and sustainability of two semi-rural communities. Involves development of ICT system to boost home energy efficiency and measure climate change impacts on health and agriculture.	2010 - 2015 Status: ongoing

Infrastructure Supporting Project for Wind Power Generation Business in Jeju Region	Jeju National University	KOREA: Jeju Island	R&D effort to drive the development of the wind power industry on Jeju Island, creating jobs, boosting the local economy and building a sustainable energy base.	2004 – n/a Status: ongoing
Low Voltage Direct Current Grid Network	Nanyang Technological University	SINGAPORE: Jalan Bahar (CleanTech One)	Smart grid experiment to use JTC green cluster zone 'CleanTech Park' as a test-bed for lighting and smart grids. Direct Current (DC) is used to minimise energy losses from the renewable sources.	2010- n/a Status: ongoing
NUS-JTC Industrial Infrastructure Innovation (NUS-JTC I3) Centre	National University of Singapore	SINGAPORE: Nationwide	R&D and demonstration effort to drive innovation and sustainable development in various areas of industrial zone planning and construction. Focus on solutions to ensure efficient use of space, materials and energy in industrial real estate market.	2011-2016 Status: ongoing
Sustainable Supply Chain Centre Asia Pacific	Singapore National University	1. SINGAPORE 2. Asia-Pacific	Responding to predicted growth of trade and commerce in Asia, collaboration to develop the knowledge and business tools to diffuse green logistics and supply chain innovation.	2010 – 2013 Status: complete
Sustainable Urban Waste Management for 2020	Nanyang Technological University	SINGAPORE: Western Singapore	R&D and demonstration programme to develop sustainable urban waste management solutions for Singapore based on a decentralised 'waste to resources' concept.	2010 - 2015 Status: ongoing
Triple Water Supply (TWS) System	Hong Kong University of Science and Technology	HONG KONG: Tung Chung and Sha Tin	On-going R&D, demonstration and implementation platform to utilise Hong Kong's citywide seawater flushing system to develop energy-efficient and low-carbon sewage treatment technologies.	2004 - n/a Status: ongoing
TUM-Create	Technical University of Munich, Nanyang Technological University	SINGAPORE: Nationwide	Large-scale R&D and field testing project with focus on developing an electric taxi for Singapore, with potential for application in other tropical mega cities. Collaboration involves all levels of EV taxi transport: from batteries to the car design, extending to citywide infrastructure and traffic control systems.	2011 - n/a Status: ongoing
Underwater Infrastructure and Underwater City of the Future	Nanyang Technological University	SINGAPORE: Nationwide	R&D and demonstration project to utilise underwater sea space to construct infrastructures such as oil storage facilities or power stations whilst using the topside as reclaimed land.	2010 - 2015 Status: ongoing
Urban Design Centre Kashiwa	Tokyo University	JAPAN: Chiba-ken, City of Kashiwa	An information exchange, education and research platform addressing issues related to environmental, socio-political and urban planning issues in greater Kashiwa City. Brings together academics, citizens, local city authorities and real estate developers.	2006 - n/a Status: ongoing
Urban Reformation Program for the Realisation of a Bright Low Carbon Society	University of Tokyo	JAPAN: Chiba, Kashiwanoha	Large-scale applied research initiative to design blueprint for low-carbon, elderly citizen friendly community. Involves extensive demonstrations with technical and social innovation.	2010 – 2015 Status: ongoing

NORTH AMERICA				
Alley Regeneration Project (Formerly Alley Flat Initiative)	University of Texas at Austin	USA: Austin, Texas	Initiative proposes new 'alley flats' as sustainable and affordable housing alternatives for Austin. Involves development and installation of detached residential units utilising underused alleyways to increase availability of affordable housing.	2005 – n/a Status: ongoing
Carbon Solutions New England (Formerly Carbon Solutions New England)	University of New Hampshire	USA: New Hampshire, New England	Partnership to promote collective action in pursuit of a low carbon society for New England. Targeting areas such as GHG emissions and economic analyses, climate action plan, green economy and clean energy and sustainable forest yields. Research results are communicated to key decision-makers.	2008 – n/a Status: ongoing
Central New England's Green Business Zone	Clarke University (Institute for Energy & Sustainability)	USA: Massachusetts, Worcester	Strategic alliance to build a clean energy and renewable cluster zone to spur transition to low-carbon economy in Worcester and surrounding region. In addition to luring existing businesses, also provides training, consulting and start-up assistance.	2009 – n/a Status: ongoing
City Studio Vancouver	Simon Fraser University Emily Carr University	CANADA: British Columbia, Vancouver	Service learning platform to utilise educational resources from Vancouver higher education institutions to develop real-world projects for pursuing the City of Vancouver's ambitious sustainability goals.	2011 - n/a Status: ongoing
Compact for Sustainable Future	Massachusetts Institute of Technology Harvard University	USA: Massachusetts, Cambridge	An agreement between MIT, Harvard and Cambridge City to collaboratively work to tackle local climate change and sustainability challenges and combine resources to build a prosperous, sustainable community.	2013 – n/a Status: ongoing
Connective Corridor	Syracuse University	USA: New York, Syracuse	Urban-reform initiative to drive economic and socio-cultural regeneration by linking surrounding community with downtown through public works focused on art, technology, and sustainable design.	2005 – 2016 Status: ongoing
East Bay Green Corridor	University of California, Berkeley	USA: California, East San Francisco	Alliance to build high-tech green economy and renewable energy and business infrastructure in the East Bay area of San Francisco. Involves constructing new green cluster zone for spin-off firms from UCB and LBNL and attracting existing companies to area.	2007 – n/a Status: ongoing
Erie-GAINS	Gannon University	USA: Pennsylvania, Downtown Erie	Effort to coordinate strategic initiatives between the University, government agencies, community organizations and businesses to halt neighbourhood decline and improve the sustainability and prosperity of downtown Erie and campus neighbourhood	2010 – n/a Status: ongoing
Grand Rapids Community Sustainability Partnership	Grand Valley State University	USA: Michigan, Grand Rapids	Academic-city formed partnership, with over 200 businesses, institutions and organisations mobilised in coalition to revitalise rust-town of Grand Rapids and promote sustainability in diverse areas such as building, economy, energy, food and water, waste and alternative fuels.	2005 – n/a Status: ongoing
Green Corridor	University of Windsor	CANADA: Ontario, Windsor (Canada-USA border)	Project integrating public art, sustainable technologies, scientific monitoring and public information along two kilometres of roadway at Canada-USA border crossing. With grassroots engagement, members and students engaged in process transforming built and natural environment, infrastructures, energy production and socio-cultural fabric.	2003 – 2011 Status: complete

Iowa Initiative for Sustainable Communities	University of Iowa	USA: Iowa (Numerous communities including: Anamosa, Burlington, Charles City, Columbus Junction, Decorah, Oskaloosa, Wellman and Dubuque)	Campus-wide service learning programme to enhance the capacity of Iowa's rural and urban communities to address various sustainability issues. Students and faculty are partnered with individual communities to identify, design and implement various projects.	2009 – n/a Status: ongoing
Nourishing Ontario	Wilfrid Laurier University	CANADA: Ontario	Research and knowledge exchange platform to accelerate transition to sustainable, local food systems across Ontario. Focus areas include: sustainable production, land access, community financing and supply management.	2007 – n/a Status: ongoing
NYC Solar American City Partnership	City University of New York	USA: Various areas across NYC	Through Solar American City Partnership, a collaboration to accelerate the diffusion of solar energy across NYC grid. Focused on creating solar mapping and zoning tool to determine most effective locations for solar installations. Also involves developing web-based platform to assist residents with permit and funding applications for solar installations.	2010 – n/a Status: ongoing
Oberlin Project	Oberlin Project	USA: Ohio, Oberlin	Ambitious project driven by Oberlin College to rejuvenate the town of Oberlin by transforming it into a prototype of a self-sufficient, prosperous and resilient post-fossil fuel community.	2008 – 2017 Status: ongoing
Pecan Street Demonstration	University of Texas	USA: Texas, Austin (Mueller community)	A smart grid and residential behavioural testing platform to collect and analyse data via smart meters and appliances from 1000 homes across Texas, the majority of which are concentrated in the Mueller community.	2008 – 2009 Status: complete
PSU/PGE Partnership	Portland State University		R&D and demonstration platform to drive green growth in the Portland metro region and trial emerging technologies from PSU and PGE in urban settings.	2010 – n/a Status: ongoing
Retrofit NYC Block by Block	Pratt Institute	USA: New York City: Brooklyn	Programme to help New York property owners in six boroughs exploit state and federal fiscal incentives to weatherise and take measures to increase energy efficiency. Continuation of Retrofit Bedford Stuyvesant project.	2010 – 2012 Status: complete
Rust to Green	Cornell University	USA: New York, Utica	Participatory action research effort to connect key stakeholders and generate strategies and projects to trigger Utica's transition from a 'rust town' to a green economy. Focus on built and natural environment, infrastructure and local agriculture.	2010 – n/a Status: ongoing
SEED Wayne	Wayne State University	USA: Michigan: Detroit	Effort to collaboratively build sustainable food system on campus and local community of Detroit. Involves student-run vegetable and herb gardens on campus, weekly farmers market and local produce selling initiatives.	2010 – n/a Status: ongoing
SoMA EcoDistrict	Portland State University	USA: Oregon, Portland, South of the Market District	Urban transformation effort targeted at the community surrounding campus. Project has adopted the Ecocities framework developed by local NPO Ecocities to fuse university development needs and a holistic vision of urban sustainability and community revival into a governance and action framework.	2011 – n/a Status: ongoing

Southeastern Massachusetts Council on Sustainability	University of Massachusetts at Dartmouth	USA: Southeastern Massachusetts	Council to provide education and assistance on sustainability in Southeastern Massachusetts. Acts as a leadership forum and network to connect, facilitate and coordinate sustainability efforts throughout region with focus on food and agriculture, transportation, energy and natural resources.	2009 – n/a Status: ongoing
Sustainable City Year Program	University of Oregon	USA: Oregon, Gresham, Salem, Springfield	To drive sustainable community change in various cities across the state of Oregon by applying the educational and research resources of the university to a city for one full academic year. In this service-learning programme, 20-30 courses across several disciplines work on designing and implementing projects.	2009 - n/a Status: ongoing
Sustainable Neighborhood Lab	Boston University	Massachusetts: Boston	R&D, demonstration and implementation effort to use the city of Boston as a living laboratory and test bed for sustainable urban development. Large focus on trialling and diffusing smart city technologies.	2011 - n/a Status: ongoing
University Clean Energy Alliance of Ohio	University of Toledo	USA: Ohio (statewide)	15 member consortium of Ohioan higher education institutions, government agencies and enterprises to foster sustainable development and deployment of advanced and renewable energy technologies in Ohio.	2007 - n/a Status: ongoing
UniverCity	Simon Fraser University	CANADA: British Columbia, Burnaby	New development of mountain top area on campus grounds into sustainable, compact and multi-use community for 10,000 residents. Includes residences, shops and services and school.	1995 – n/a Status: ongoing
Wisconsin Sustainability Business Council	University of Wisconsin-Madison	USA: Wisconsin (statewide)	Council serving state businesses interested in sustainability, CSR or corporate citizenship. Facilitates information exchange, support and education to integrate sustainable business practices. Seeks to build a collective mass for innovation, cleantech, alternative energy and sustainability leadership.	2008 - n/a Status: ongoing
Yale Community Carbon Fund	Yale University	USA: Connecticut: New Haven	Initiative targeting low-to-moderate income homes as part of university carbon offset initiative. Programme generates offset credits by installing programmable thermostats and conducting weatherisation fits.	2010 – n/a Status: ongoing
TOTAL:				**70**

* (n/a) Information not available

Appendix 2. List of interviewees for various partnerships*

Partnership Name	Interviewee	Type	Date	Interview location
Urban Reformation Program for Realization of Bright Low-Carbon Society	(Pr.) Asami Yasushi	Semi-structured (in person)	4.7.2011	University of Tokyo, Hongo, Tokyo, Japan.
	(Ass. Pr.) Hiekata Kazuo	Semi-structured (in person)	8.7.2011	University of Tokyo, Kashiwa, Chiba-ken, Japan.
	(Pr.) Koji Okamoto	Semi-structured (in person)	18.7.2011	University of Tokyo, Kashiwa, Chiba-ken, Japan.
	(Pr.) Makoto Yokohari	Semi-structured (in person)	22.2.2012	Arizona State University, Phoenix, AZ, USA
	(Pr.) Yoichi Hori	Semi-structured (in person)	28.7.2011	University of Tokyo, Kashiwa, Chiba-ken, Japan.
Low Voltage Direct Current (LVDC) Grid Network	(Dr.) Tan Yen Kheng	Semi-structured (in person)	19.6.2013	Nanyang Technological University (Energy Research Institute), Clean Tech One, Jalan Bahar, Singapore.
NYC Solar American City Partnership	Laura O’Reilly	Semi-structured (telephone)	27.1.2012	City University of New York, Office of Sustainability
Rust to Green	(Pr.) Paula Horrigan	Semi-structured (in person)	14.2.2012	Cornell University, Ithaca, NY, USA.
	(Pr.) Scott Peters	Semi-structured (in person)	15.2.2012	Cornell University, Ithaca, NY, USA.
Smart City San Diego	Byron Washom	Semi-structured (in person)	15.7.2012	University of California, San Diego, CA, USA.
Sustainable Urban Neighborhoods	Alex Ryder	Semi-structured (in person)	6.2.2013	University of Maastricht, Maastricht, Netherlands.
	Carijn Beumer	Semi-structured (in person)	6.2.2013	University of Maastricht, Maastricht, Netherlands.
	Christine Ruelle	Semi-structured (in person)	7.2.2013	University of Liege, Liege, Belgium
	(Pr.) Jacques Teller	Semi-structured (in person)	8.2.2013	University of Liege, Liege, Belgium
	(Pr.) Pieter Valkering	Semi-structured (in person)	6.2.2013	University of Maastricht, Maastricht, Netherlands.
TUM-Create	Kimitsu Yogachi	Semi-structured (in person)	19.6.2013	National University of Singapore (CREATE) University Town, Singapore

* Interviewees for the two case studies are listed in Chapter 3.

Appendix 3: Questionnaire for Analytical Framework [A]

(Appears on next page)

東京大学
THE UNIVERSITY OF TOKYO

Background Information

Thank you so much for taking time to participate in this survey on cross-sector partnerships for urban sustainability transformations. I really appreciate your time and kindness.

Purposes of survey

This survey is designed to 'connect the dots' between various university sustainability partnerships around the world (Europe, Asia and North America) and gather data regarding:

- Project timelines and total budgets
- The various sustainability areas targeted (e.g. buildings, transport etc.)
- The various actors involved
- The reason why the partnership was formed
- The 'channels' used to pursue the objectives of the partnership

All data obtained will be used for the purposes of my doctoral research only and will be kept completely confidential.

Survey structure

The survey consists of some background questions and 6 main questions.
It should take about 10 minutes to answer completely.

About me:

I am a PhD candidate in the Graduate Program in Sustainability Science at the University of Tokyo. My supervisor is Professor Masaru Yarime. This survey is part of my doctoral research which attempts to assess the significance of cross-sector university partnerships in advancing the transition to a sustainable future.

To return the survey:

Please complete directly in Microsoft Word and return via email to:

Gregory Trencher (PhD candidate)
E-mail: trencher@sustainability.k.u-tokyo.ac.jp
Graduate School of Frontier Sciences, The University of Tokyo
Graduate Program in Sustainability Science
Chiba Prefecture, Japan

Background Questions

Kindly fill in the below questions in the column on the right:

Question	Answer
1. Formation date When was the year that your collaboration was <u>officially</u> formed?	
2. Completion date What year do you expect your partnership to finish? (If not sure, please leave blank)	
3. Funding information A <u>IN TOTAL,</u> how much funding has been secured until present? (No need to list individual sources)	
4. Funding information B What is the name of the agency or programme that is the MAIN source of external funds you have received (e.g. National Science Foundation etc.)	
5. Main co-ordinator of project Of all project partners, which institution is currently the main co-ordinator of project?	

Instructions for Rest of Survey

How to answer

From here on you will find 6 more questions with multiple answers listed in a table. **Please show the relevance of EACH listed response to the collaboration you are involved in.** Do this by typing a score of 0, 1 or 2 in each box in the right-hand column using the following weighting:

- 2 = applies *strongly* to our partnership
- 1 = applies *mildly* to our partnership
- 0 = *does not* apply to our partnership

Please note that for most questions you will find an explanation for each response in the table. Please decide the appropriate score after reading these explanations.

Question 1

In which of the following urban sub-systems is your collaboration trying to drive sustainable development?

Various sub-systems	Relevance score (0, 1 or 2)
A. Buildings and the built environment This refers to all types of buildings, houses and built infrastructures. For example, partnerships targeting this sub-system may involve projects in: • urban development (both buildings and roads) • new buildings and construction • retrofitting and weatherisation and so on.	
B. Transportation This refers to the technologies, infrastructures and vehicles used for public and individual transport and the circulation of goods. For example, partnerships targeting this sub-system may involve: • EV automobile technology & charging stations • car-sharing • logistic networks and so on.	
C. Energy and heating/cooling This includes the infrastructures and systems used for the generation, supply, storage and management of electricity or energy for residents and industry. It also includes heating and cooling infrastructures. Partnerships targeting this sub-system may involve in: • renewable energy • smart grids and devices • energy efficiency measures • heating or cooling systems and so on.	
D. Economy, employment and industrial production This includes the various economic, financial, manufacturing and business activities conducted by both companies and individuals. Partnerships targeting this sub-system may involve projects in: • green technology parks and business development • sustainable manufacturing or business practices • green jobs creation and training or consulting and so on.	
E. Natural environment or green spaces This includes both natural biological resources and manmade natural spaces and may include: • parks and waterways • building greenery • tree planting or urban eco-systems regeneration and so on.	

F. Food, agriculture and forestry
This includes systems for the production, processing, distribution and selling of food, agricultural or forestry products. Partnerships targeting this sub-system may involve:

- local food networks
- urban agriculture and forestry
- biomass fuel production and so on.

G. Water
This refers to the technology and infrastructures for the supply, treatment and collection of water. Partnerships targeting this sub-system may involve:

- sewerage and storm-water systems
- water supply and recycling
- water consumption reduction and so on.

H. Solid waste
This includes the technologies and facilities for collecting treating, disposing or recycling all forms of solid waste. Partnerships targeting this sub-system may involve:

- household or industrial recycling
- waste reduction programmes and so on.

I. Governance and planning
This refers to the institutional and political structures and processes that govern and plan the target area. Partnerships targeting this sub-system may involve:

- decision making tools, support and training
- knowledge transfer to government and so on.

J. Human and social systems
The citizen, cultural and social systems that make up an area such as working, living and consumption patterns, social and information networks. Partnerships targeting this sub-system may involve:

- sustainable lifestyle workshops and training
- citizen involvement and public communication
- social media and social network creation and so on.

Question 2.

Which of the following best describes the geographical scale of the area where MOST of the activities and projects for your collaboration are unfolding?

NOTE: ***This DOES NOT refer to the wider area (e.g. entire country) that you are possibly trying to influence via your collaboration.***

Geographical scale of target area	Relevance score (0, 1 or 2)
A. Local/neighbourhood level For example, a street, block, neighbourhood or community.	
B. City/town level Several areas or neighbourhoods within a town or city, or alternatively, the entire town or city.	
C. Regional level An area that includes several towns and cities that are mainly concentrated in a single region.	
D. National level An area that includes several towns and cities etc. within a single country.	
E. Trans-border level An area reaching across one or more international borders.	

Question 3.

Which of the following best describes the main <u>UNIVERSITY</u> actors who are/were involved in the formation, co-ordination and implementation of the partnership?

Main university actors	Relevance score (0, 1 or 2)
A. Faculty/Researchers	
B. Administration	
C. Students	
D. Bridging organisations This includes community outreach offices, technology transfer offices and sustainability offices etc. that have been set up especially to forge links and build partnerships with the community.	

Question 4.

Which of the following best describes the main EXTERNAL partners and stakeholders who are/were actively involved in the partnership?

Main external partners	Relevance score (0, 1 or 2)
A. Local or regional government/public service sector Includes local or regional government offices or representatives as well as government financed public service agencies.	
B. State or national government	
C. Civic society groups This includes think tanks, NGOs, NPOs and community groups etc.	
D. Other academic institutions	
E. Large or multi-national corporation An enterprise with more than 50 employees, typically with several premises across the state, country or globe.	
F. Small-medium enterprises An enterprise with less than 50 employees, typically with premises concentrated in one area or town.	

Question 5

Which of the following 'motivating factors' best explain why your partnership was formed?

Motivating factors	Relevance score (0, 1 or 2)
A. Missional motivation When the partnership was formed by a sustainability office, community outreach office or research foundation etc. where one of the main missions is to form partnerships with external stakeholders and social or sustainability problems.	
B. Funding motivation When the presence of research funds especially for collaborative sustainability projects have enticed or encouraged the formation of the partnership.	
C. Scientific/scholarly motivation When a partnership is formed mainly for scientific or scholarly interests such as the desire to: • trial and diffuse academic knowledge in real world settings • learn from external stakeholders or situations • translate research into useful or commercialisable results	
D. Social contribution/community relations motivation When the partnership is formed to: • to contribute to society or the community • to improve community relations or the image of the university.	
E. Developmental/strategic motivation When a partnership is formed to: • respond to climate change, energy challenges and sustainability issues to help ensure the physical survival of the university and surrounding community/town/city or region. • improve the strategic situation of the university by reforming the neighbouring community and economy in a manner that would also benefit the university itself.	
F. Entrepreneurial Partnership formed as a means of generating revenue for any of the partners or institutions involved.	
F. Other If you feel that the above options don't describe very well why your partnership was formed, please quickly describe here the main triggers or motivations for your partnership. Please only do this <u>AFTER</u> indicating the appropriate score for each answer above.	

Question 6

Which of the following mechanisms does your collaboration use to try and materialise sustainable development in the target area?

NOTE: ***Please do not confuse the mechanisms that you actually use below with the sub-sector(s) that you target in Question 1.***

Engagement modes	Relevance score (0, 1 or 2)
A. Knowledge management Here the aim is to create, process and diffuse knowledge to private and public decision makers and stakeholders. Typical examples of initiatives using this channel include: • reports and publications • policy tools and decision making instruments • consultation and training • conferences • awareness raising to general public • formal and informal discussion spaces and workshops	
B. Governance and planning When partnership members play an active role in governance and planning for the target area. The aim of this is to influence political structures, decision making and development trajectories. Activities falling into this channel may include: • Formation of new governance or decision making bodies in the community • Political lobbying or participation in existing political processes for policy making and planning • Efforts to improve the sustainability of governance and decision-making in the community/city.	
C. Technical experiments and demonstrations When initiatives aim to demonstrate, test and evaluate unproven technological innovation. Typical examples of initiatives using this channel include: • trials of new technologies such as electrical vehicles and so on. • showcasing and testing of renewable energy or smart grid facilities	
D. Socio-technical experiments In contrast to above, this channel includes a social dimension and social innovation (that may also accompany a technical experiment). Activities in this channel will often involve experiments with new configurations of technology, people, businesses, policies, financial and legal tools and so on. Activities in this channel might also be non-scientific and may include: • sustainable food or consumption networks • experimental policy tools or behaviour change programmes • new social networks such as car sharing or carbon-offset programmes for example.	

E. Technology transfer or economic development The aim of this channel is to spur low-carbon economic growth and diffusion of green technologies in a specific locality or region. This may involve: • fostering new businesses to spur economic development and green jobs • creation of green cluster zones • transfer of intellectual property to industry or government (with or without patenting and licensing) • commercialisation of research results via spin-off firms	
F. Reform of built or natural environment In this channel the focus is on transforming the built or natural environment. In the built environment, this may involve: • real estate or urban development through new construction or retrofitting • improvement of infrastructures such as energy, transport, road and communication networks • For the natural environment, this may include: • restoration of natural eco-systems • creation of man-made natural spaces.	
F. Other If you feel that the above options don't describe very well the 'channels' used by your partnership, please quickly describe here the main way your partnership seeks to achieve its goals. Please only do this AFTER indicating the appropriate score for each answer above.	

Thank-you for your time

Your time and energy is sincerely appreciated. Please kindly email the completed survey to this address:

Gregory Trencher (PhD candidate)
E-mail: trencher@sustainability.k.u-tokyo.ac.jp
Graduate School of Frontier Sciences, The University of Tokyo
Graduate Program in Sustainability Science
Chiba Prefecture, Japan

Appendix 4: Questionnaire for Analytical Framework [B]

(Appears on next page)

Background Information

Firstly, thank you so much for taking time to participate in our survey on cross-sector partnerships for urban sustainability transformations.

About us

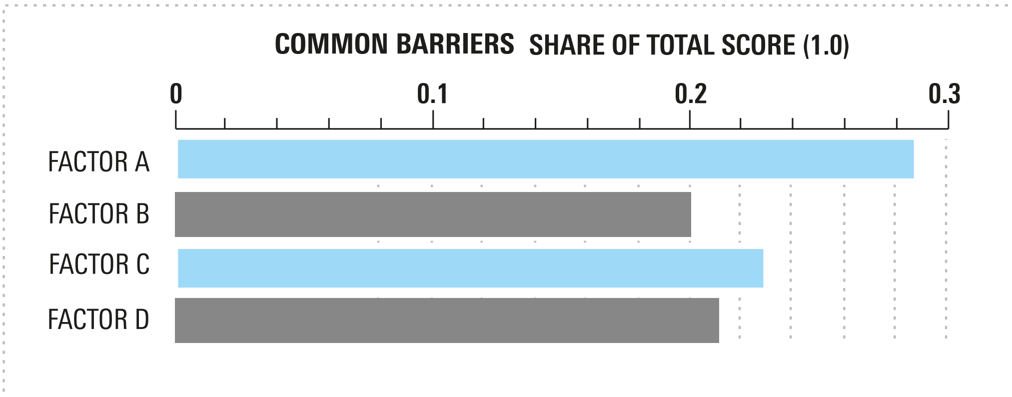
We are a team of three. Firstly there is me, a PhD candidate in Sustainability Science at the University of Tokyo. Secondly there is my supervisor Professor Masaru Yarime from the same university, with a third collaborator Professor Xuemei Bai from Australian National University. This survey is part of an upcoming journal article, and also my doctoral research, which attempts to assess the importance of cross-sector university partnerships for urban sustainability transformations.

Purposes of survey

This survey is designed to 'connect the dots' between various sustainability partnerships around the world (Europe, Asia and North America). It seeks to identify:

- Obstacles that prevent successful partnerships
- Drivers or positive factors that aid success
- How successful, efficient and relevant the partnership is perceived to be

All data obtained will be kept completely confidential. The individual responses for a single partnership will not be revealed in our study, which will display results like below:



Survey structure

The survey consists of two sections: 1) Drivers and barriers 2) Evaluating success and impacts.

How to return this survey:

Please complete directly in Microsoft Word and return via email to:

Gregory Trencher (PhD candidate)
E-mail: trencher@sustainability.k.u-tokyo.ac.jp
Graduate School of Frontier Sciences, The University of Tokyo
Graduate Program in Sustainability Science
Chiba Prefecture, Japan

Background Questions

Please indicate insert an 'X' to show which of the following sectors you mainly belong to:

Academia	Government	Industry or business	Civil society[105]

[105] This includes people from the community, NPO's, NGO's as well as think tanks and other organisations not falling into the first three sectors.

Section 1:

Drivers and barriers

1a: DRIVERS & POSTIVE FACTORS

Which of the following factors have been <u>the most helpful</u> when either forming the partnership and securing stakeholder support, or implementing various activities and projects?

INSTRUCTIONS: Please read through the following drivers and positive factors and then give a score from 0 to 3 to show how relevant each is for YOUR partnership. Please give a score to EACH AND EVERY description.

- 3 = this is an ***EXTREMELY*** significant driver for our partnership
- 2 = this is a ***MILDLY*** significant driver for our partnership
- 1 = this is a ***NOT VERY*** significant driver for our partnership
- 0 = this is ***NOT AT ALL*** a significant driver for our partnership

Description	Score (0, 1, 2 or 3)
A. External funding The availability or obtaining of an <u>*external*</u> research fund set up to promote, for example, sustainable development or multi-stakeholder collaboration was helpful.	
B. Partnership synergy When the impact and effectiveness of the partnership is increased because of the participation, knowledge and expertise of members from different societal sectors (e.g. government, industry, community members and think thanks etc.)	
C. Government policy When the policy or existing commitments of a local, state or national governments (e.g. renewable energy or sustainability) has been a positive, driving force.	
D. University policy When the policy or existing commitments of a university (e.g. for sustainability, community outreach, technology transfer etc.) has been a positive, driving force.	
E. Strong leadership When there is a strong leader or 'sustainability champion' in the partnership that has helped to, for example: • Clearly define goals, expectations and roles • Provide feedback, support and guidance • Secure the support of key regional players	
F. Co-ordination support When the co-ordination and management of the partnership runs smoothly because it is handled by an office or department with dedicated or specialised staff and resources.	

G. Societal 'need' When leaders and stakeholders in the community or societal sub-sector have voiced a strong need and demand for solutions to address various sustainability issues such as, for example: • Climate change, food and energy security • Economic development and regional competitiveness • Aged infrastructures and building stocks • And so on…	
H. Positive external forces When there are external factors aiding the partnership such as: • a culture or history of collaboration, experimentation and innovation for sustainable development in the region • a society that is progressive, environmentally aware or receptive to new forms of social experiments	

1b: (OPTIONAL)

After completing the above question, I would really appreciate it if you quickly described the main POSTIVE and DRIVING factors that have helped the success of your partnership during its formation and implementation.

Please write freely here:

2a: BARRIERS & NEGATIVE FACTORS

Which of the following factors do you feel are/were the <u>greatest barriers</u> to the development of your partnership or the successful implementation of its activities and projects?

INSTRUCTIONS: Please respond in the same way as the first question, giving a score from 0 to 3 for each description.

- 3 = this is an ***EXTREMELY*** significant barrier for our partnership
- 2 = this is a ***MILDLY*** significant barrier for our partnership
- 1 = this is a ***NOT VERY*** significant barrier for our partnership
- 0 = this is ***NOT AT ALL*** a significant barrier for our partnership

Description	Score (0, 1, 2 or 3)
A. Time restraints When partners and stakeholders have trouble finding the time from normal duties to devote to partnership activities.	
B1. Funding (availability) When it is difficult to secure suitable funding (internal and external) or when funding grants prioritise other types of research or collaboration.	
B2. Funding (length) When funding grants are too short to allow long-term sustainably projects.	
B3. Funding (amount) When there is not enough funding to pursue partnership goals or planned projects.	
C. Communication difficulties When large numbers of partners and stakeholders or geographical distance makes it difficult to, for example: • Share key information, measure progress and provide feedback and guidance between partners and stakeholders • Meet regularly with other partners and stakeholders	
D. Poor management and leadership When poor leadership or management results in, for example: • Poor co-ordination and linking of projects and activities • Poor understanding of project goals or roles and responsibilities of each partner and sector • Poor organising of partnership schedule	

E. Lack of unity/harmony
When there is, for example:

- Different visions, values and approaches amoungst the partners and stakeholders that may conflict with each other
- Difficulties in linking the different stakeholders and projects together
- Different understandings of the goals of the partnership

F. Lack of INTERNAL incentives or support
When there is, for example:

- A lack of departmental or top-level support or incentive for sustainability partnerships with external stakeholders
- Pressure to pursue traditional activities such as teaching, research, publishing and conference presentations
  A lack of support or interest from colleagues for co-operation across different academic departments or partnerships with external stakeholders to tackle local sustainability issues

G. Lack of EXTERNAL support and interest
When there are difficulties in securing the participation or support of key external stakeholders or sectors (such as government, industry or the civic sector) for reasons that may include:

- Lack of appreciation or interest in local sustainable development initiatives
- Lack of interest in innovating or collaborating with others
- Lack of interest in long-term sustainability research and experiments which are unpredictable and may not bring guaranteed or predictable results

H. Social, cultural or institutional barriers
This refers to a situation where the presence of bigger, external forces such as those below are negatively impacting partnership activities:

- Locked-in local cultures and lifestyles in the area
- Low environmental or sustainability awareness
- Poor socio-economic conditions in the target area
- Conflicting government policies or institutional frameworks

I. Technical barriers
This refers to a situation where technological limitations or difficulties are preventing or affecting the realisation of partnership objectives.

2b: (OPTIONAL)

After completing the above question, I would really appreciate it if you quickly described the main barriers you have encountered during the formation of the partnership and implementation of partnership activities and projects.

Please write freely here:

Section 2:

Evaluating success and impacts

0. INSTRUCTIONS

Please respond to each of the following questions by marking an 'x' in ONE of the following boxes.

For example:

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree
	X			

1a. SYNERGY

Overall, the participation of different actors and sectors (e.g. universities, government, industry and citizens) has had a positive effect on the partnership and their presence is necessary (or was necessary) to achieve the goals of the partnership.

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree

1b. FUNCTION

Overall, the various partners, stakeholders and sectors involved in the partnership are successfully carrying out (or have successfully carried out) their expected roles and contribution.

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree

1c. SYNERGY & FUNCTION (OPTIONAL)

If you selected 'not sure', 'disagree' or 'strongly disagree' for any of the above, please quickly explain the main reason you feel this way.

Please write freely here:

2. TIMESPAN

Please indicate how you feel about the length (of time) of the collaboration.
For achieving its objectives, the timespan set out by the partnership is/was:

Much too short	Too short	Just right	Too long	Much too long

3. EFFICIENCY

Resources and inputs such as money, time, people and materials etc. are (or have been) converted efficiently to results.

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree

4a. EFFECTIVENESS

<u>Overall</u>, the partnership is on track to achieving its initial objectives, or for a finished partnership, has successfully achieved its initial objectives.

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree

4b. EFFECTIVENESS (OPTIONAL)

Regarding question 4a above, I would really appreciate it if you briefly explained the main reason why your partnership has been, or has not been successful in reaching its objectives. In other words, what have you learnt from your involvement in the partnership and what lessons could you give to other sustainability partnerships around the world?

Please write freely here:

5. ECONOMIC impacts

In terms of ECONOMIC impacts, do you think that the partnership has made (or will make) a positive impact on the target area/city/region? For example, such impacts might include:

- Stimulation of economic activities
- Creation of employment or a new product/business/service
- Increase of industrial or business performance and efficiency
- Increase of regional competitiveness and vitality

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree

6. ENVIRONMENTAL impacts

In terms of ENVIROMENTAL impacts, do you think that the partnership has made (or will make) a positive impact on the target area/city/region? For example, such impacts might include:

- Improvement of sustainability, environmental impact or resiliency of target area/city/region or business and industry activity in that area
- Improvement of infrastructure and/or built or natural environment
- Improved management of infrastructure and/or the built or natural environment

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree

7. SOCIETAL impacts

In terms of SOCIETAL impacts, do you think that the partnership has made (or will make) a positive impact on the target area/city/region? For example, such impacts may include:

- Improvement of social, political or cultural conditions
- Improved liveability and quality of life
- Improved public awareness or engagement in sustainability or environmental issues

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree

8. OVERALL impacts

Now please consider the OVERALL impacts of your partnership in all three of the above areas (economic, environmental and societal). Do you think that OVERALL, your partnership has made (or will make) a positive impact on the sustainability of the target area/city/region?

Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree

Thank-you so much for your time

Your time and energy is really, really appreciated.
Please kindly email the completed survey to this address:

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Chiba Prefecture, Japan

Appendix 5: Databases used for identification of cases

Website and organisation	Description
WORLDWIDE	
International Sustainable Campus Network http://www.international-sustainable-campus-network.org	Sustainability initiatives of member institutions are summarised in a systematic database that also contains information on outreach activities in the context of sustainability.
United Nations University Institute of Advanced Studies (UNU-IAS) Regional Centres of Expertise database URL https://www.ias.unu.edu/sub_page.aspx?catID=108&ddlID=2452	Contains institutional profiles for member universities functioning as regional hubs of exchange related to education for sustainable development.
ASIA	
Japan Science and Technology Agency *Social System Reformation Program for Adaptation to Climate Change* *http://www.jst.go.jp/shincho/en/program/kikou.html*	Contains five R&D programmes selected by funding programme for climate change mitigation and adaptation.
National Research Foundation Singapore Competitive Research Programme (CRP) https://rita.nrf.gov.sg/default.aspx	Contains several national funding schemes set up by the NRF in Singapore for urban sustainably.
Council for Sustainable Development Hong Kong Sustainable Development Fund http://www.susdev.gov.hk/html/en/sd/index.htm	Contains projects selected by funding programme for sustainable development in Hong Kong
EUROPE	
Smart Cities Initiative from Climate Energy Funds http://www.smartcities.at/	Austrian government funding portal for smart-city projects in Austria (Information available in English)
European Network of Living Labs http://www.openlivinglabs.eu	European database of partnerships registered as ‘living labs’, with targeted keyword searches possible.
Seventh Framework Programme http://www.cordis.europa.eu/fp7/home_en.html	Database of successfully funded partnerships from European Commission programme CORDIS
Sustainable Urban Environments Programme http://www.rcuk.ac.uk/documents/innovation/larci/sustainableurbanenvironmentsprogramme.pdf	Contains list of successfully funded projects in the field of urban sustainability in the UK.
NORTH AMERICA	
Association for the Advancement of Sustainability in Higher Education http://www.aashe.org	Sustainability initiatives of member institutions are summarised in a systematic database that also contains information on outreach activities in the context of sustainability.
National Science Foundation Award Grants http://www.nsf.gov/funding/	Database of all successfully funded research projects. Allows for targeted keyword searches.
Sierra Club Cool Schools Ranking http://www.sierraclub.org/sierra/201209/coolschools/complete-rankings-cool-schools.aspx	Sustainability initiatives of participating institutions are summarised in a systematic database also containing information on outreach activities in the context of sustainability.