Doctoral Thesis

Transformation of Industrial Cities and Sustainable Urban Development

(工業都市の変遷と持続可能な都市発展に関する研究)

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ABSTRACT

This research focused on the issues and challenges of industrial city transformation and transition towards the future in the context of Japan and Korea. The industrial city is a typical model of urban development throughout the history from 19C that cities are now facing its de-industrialization many cases prove in Europe or US cases. The trends of the decline of industrial cities – with manufacturing, industrial dominance – had continued from the 1970s in advanced industrialized countries and expecting further population out-migration and decline. Industrial cities became problematic and distressed places in the era of sustainable development. Many researchers focus on finding the commonalities of industrial cities, not only from growth period but also, after deindustrialization to discover its possible future development plans and model. The discussions mostly come from Western developed nations with a long account of industrial growth and experience capturing the dynamics of industrial city transformation and vision its future with planning and development strategies. Moreover, the cases of industrial city decline are found from the latest top-manufacturing producers such as Japan and the Republic of Korea. This globalized trend is bringing new challenges for the past and the current industrial cities to overcome the structural deficit and remain resurgent during de-industrialization. If the decline of manufacturing industries is an inevitable process of economic restructuring in the global and national level, the question lies in the likelihood of identifying common trajectories of growth, crisis, decline, and recovery of industrial cities to avoid collapse and prevent further decline in the upcoming future. This research is likewise an attempt to find common aspects in the transformation of industrial cities by identifying the patterns of industrial city development in Japan and Korea.

The study attempts to discover the commonalities in transformations of the industrial city using quantitative and qualitative measures supported by case studies to acknowledge the common processes of transformation of industrial cities and specific transition strategies based on issues and challenges for sustainable development. In short, the industrial city transformation is a successive transition from an industrial city to more diverse form and creating new features of the city. Therefore, the research aims to identify the common trend and issues of industrial city decline and transition.

Based on the specified objectives, the research is structured into three main parts. The theoretical review of the literature conceptualizes the industrial city specific urban transformation phases, including the process of decline and transition. Based on the transformation framework, the analysis provides empirical evidence to the theories. The first part of analysis illustrates the common trend of industrial city decline at the national level in global comparative perspective. Through this process, the study identifies the

relevant factor for industrial city decline and transition amongst different national and cultural context. Then, a specific city case is selected to examine the detailed process of transformation by examining historical development. The city-level analysis captures the complex process of city transformation by using a selected set of indicators and helps to determine the stages with a synthesis of each critical turning point. Lastly, case studies conducted to identify the current status of decline and evaluate the recent urban planning and strategies towards new transition. In this context, the thesis illustrates this research in a total of six chapters.

Chapter one explains the research background, clarifies questions and objectives, and show overall research flow and the structure of the thesis, along with clarifications of expected outcomes and significance. Lastly, it explains the terms and abbreviations.

Chapter two conceptualizes the transformation of industrial cities including the recent decline and transition phases in multiple sustainable development dimensions. The chapter provides a literature review of previous studies. It introduces two major areas of study as theoretical background, namely, industrial city discourse and urban transformation theories.

Industrial city discourses explain the factors of decline, process, and redevelopment strategies from a global comparative dimension. By giving the limited definition of the industrial city, the chapter explains factors, process, and problems of the industrial city decline. The common industrial city declines in the globalized economy and what problems that the industrial city at local level experiences as the decline is the main contents of industrial city discourse. The study describes the process of decline as successive dynamic of industrial decline, population decline, and urban decline. Common directions for transition strategies include the advanced industrial development, such as service and high-tech industries, some turns to educational or environmental business, and promote cultural tourism.

Then, from urban transformation theories, the concepts of transformation and transition were defined and reviewed the relevant urban transformation theories. Urban transformation theories recognize transformation as the stage of development and characterize each phase with relevant indicators. By adapting the transformation theories and each of the common phases of industrial city development, the transformation of industrial cities is summarized.

The outcome shows conceptualized transformation of industrial cities and determined phases of growth, peak, decline, and transition to post-industrial development. The study categorized the variables in sustainable development dimension, economic, social, environmental, and physical aspects. The

conceptual trajectory enables to capture the connection of past industrial development and its impact on a new stage of development and also to the new balance of economic, social, and environmental development condition of the city. The study applies the conceptual framework in the analysis of following chapters.

Chapter three identifies the common trend of industrial city decline in the US, Japan, and Korea. Transformation of industrial cities explains two main factors, industrial transition, and population change. First, identified de-industrialization timeframe for each country and compare at the city level and find a relation between industrial characteristics and population change patterns. Lastly compares demographic patterns of industrial cities in three countries. Finally, the study created a typology of industrial dominance, type, structure and population size, and change.

Based on the national industrial transition theory, the relation between de-industrialization to population change patterns of the cities and identifies the relevant factors for decline and transition. Statistical data are collected for two major variables, manufacturing employment and population, from the 1960s to 2010 at the city level in each country. The study created a typology of industrial dominance, type, structure and population size and change. The study categorizes cities into six types of industrial characteristic: Light Singular, Light Diverse, Heavy Singular, Heavy Diverse, Mixed, and High-tech. Also, seven types of population change are determined: Continued Growth, Peak, Recent Decline, Continuous Decline, Slow Down, Recovery, and Steady. Correlation and cross tabulation analysis are used to identify the relevance of industrial characteristics to population change. Trajectories of cities are shown in each country and described by comparison.

The findings show that there is a common decline of industrial cities in three countries within a different time frame, over 20 years of gap. The relevant factors of decline are the industrial type, population size, and location of the city. The decline in the US heavy industrial city is massive and also a few cases in Japan and Korea. Heavy industrial cities in Japan and Korea are at the Peak, or Recent decline stages that result implies the upcoming challenges for the future decline of local heavy industrial cities in Japan and Korea. The national population trends are also relevant for industrial city transition. The majority of cities in Japan, having Recent Decline patterns during 1990-2010 due to national population decline and aging. The location of cities is also relevant showing that the industrial city decline is broadly a regional and national problem. Moreover, in Japan and Korea, the trend of population concentration in the capital metropolitan region will give unfavorable conditions for local cities to maintain its growth in the future. The results from the three countries give empirical evidence for the common aspects of industrial city decline.

Chapter four identifies the process of industrial decline and transition with as a case of Kitakyushu, Japan. The objective is to capture the complex process transformation at the city level by adapting the concept of multi-dimensional transitions. The study selects a case of Kitakyushu city as a representative case of an industrial city in Japan. Overview the timeline of historical urban development and visualizes the trajectories of changes by using both quantitative and qualitative data. Statistical data are collected from 1963 to 2014 and utilized qualitative data, such as city reports and interviews. Data and indicators are categorized in sustainable development dimension (economic, social, environmental, and physical) and specifying each turning point and synthesize to determine the stages of transformation.

As a result, the phases of Kitakyushu city are in growth, peak, decline, and a transition by population and industrial development. The growth stage during 1960-1970 population peaks reaching in the 1980s. The Kitakyushu city follows the process of industrialization, population, and physical decline. Industrial decline after the oil crisis during 1973-1976, the population decline from 1990, and physical deterioration started in 2000. The result also shows the relevance of social and environmental factors in each stage. The impact of industrial pollution, social security issue and suburbanization are relevant at the Decline stage. The major issue of transition identified as aging, consumption, pollution, and unemployment. In the case of Kitakyushu city, the city planning and strategies are accordingly progressing with the critical urban issue. In the 1970s, the city government focused on improving environmental conditions from the pollution with the collaboration of private sectors and citizens. During from the 1980s and 1990s, physical redevelopment of the city center and Brownfields started with Kitakyushu City Renaissance plan also aiming to establish advanced industries such as research and technology, an increase of commercial areas, and promote tourism. The city moves towards the environmental model city from 2008, utilizing the accumulated technology and knowledge of the historical development. Conclusively, the case of Kitakyushu city illustrates how industrial city transformation is break down to a series of multi-dimensional transition and what issues and challenges remain for future development of industrial cities.

Chapter five analyzes the current status of industrial cities in Korea and transition strategies. The study first examines the current status of Korean industrial cities of the change of population, manufacturing, industrial employment and value, and total GRDP as the indicator of the status of the city economy. Selected two cases, cities in the phase of transition, Pohang City and Yeosu city, both cities are dominant local industrial centers having mono- structural industries and experiencing population peak to decline. The analysis includes synthesis of multi-dimensional transition variables from Chapter four and review of urban planning and development for recent ten years. The chapter summarizes by giving a comparison of two cities and identifies the commonality and differences in development paths and transition strategies.

As a result, both cities had the issue of industrial pollution, social integration, and suburbanization or out-migration during the Growth and Peak stages. Also facing the challenges of economic restructuring, aging, and city center development for decline and transition. Due to high dependency on manufacturing, industrial production, new industrial development for advanced high-tech research in Pohang city has been the key issue from the 1980s. Recent strategies, also include promoting tourism as Yeosu city enforcing cultural resources after Expo in 2012.

The role of local partnership increased for the private sector and universities in Pohang city, on the other hand, Yeosu city has resident groups as the main actor of transition. The city center decline is observed to be mainly due to suburbanization in the case of Pohang city, and Yeosu city shows the outmigration to neighborhood city. The key for transition for both cities is the role of local stakeholders, government support, and regional and global network. A key outcome of this study is its contribution to increasing the awareness of decline issue in Korea and changes to the growth-oriented mindset.

Finally, ***Chapter Six*** concludes with the whole summary of the research, the key findings of the analysis and case studies. The results put forward recommendations for possible future studies related to this topic for current industrial cities. The study gave direction for future development of industrial cities in Japan and Korea to bring awareness to prepare upcoming challenges and future industrial city development. Further, implications on sustainable urban development from the transformation of industrial cities are discussed.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

The industrial city is a typical model of urban development throughout the history of 19C European early industrialization to the recent high-tech Silicon Valley. The term industrial city covers a broad range of industrial type - from resource oriented industrial production such as mining and oil extraction, and small industrial clusters with various assembly units - and town scale – as large metropolitan areas with industrial zoning sites or company town with small worker's residential housings. An industrial city in general, the city has the dominance of industrial production – mostly manufacturing industry - and living environment of workers – concentrated area - defined as its distinctive characteristics.

An industrial city, described as a distinctive feature, on the one hand, it is also a temporal stage development at the local level when transformation in viewed in the long-term. As related to urban growth, a locating industrial production created employment and cause the in-migration of people and capitals in the region. This industrial urbanism theory covers the most of the initial stage of modern cities developed in 19C-20C. As the cities outgrown from its typical structure of the industrial city and diversified its industrial and population, industrial transition brought new urban status such as increase of commercial and service industries. In short, the industrial city transformation is a successive transition from an industrial city to more diverse form and creating new features of the city. Transformation also includes the declining side of the city that industrial cities often experienced a sudden system collapse after the economic downfall of pre-existing dominant industries. The study proved that type of sudden decline with specific cases such as the abandoned mining towns or Detroit, a motor city in the US bankrupted in 2013. Whether the city continues to grow or further decline from the industrial city stage, the city will reach the new equilibrium for its new system. As industrial city being a typical urban development model and a temporal stage of long-term transformation of the city, more recently the industrial city growth and decline are explained from interlinking the national and global context, the dynamics of industrial production change.

The trends of the decline of industrial cities – with manufacturing, industrial dominance - had continued from the 1970s in advanced industrialized countries such as in England, Germany, and the US. In the era of globalization, the rising international competition resulted in an exodus of manufacturing industries in

these developed countries, therefore, brought a national industrial shift and an emphasis on nurturing post-industrial business such as knowledge and information service industries (Glaeser, 1998; Hall, 1999). However, at the local level, once a great national economic city center, the industrial cities lost their pre-existing economy due to manufacturing industries closing operations or move overseas considering cheaper labor cost. The cities lost their competitiveness from the growing needs of the living quality of people, therefore, experienced further population out-migration and decline. With the economic recession and subsequent social and environmental problems such as unemployment and urban decay (Power, Plöger, & Winkler, 2008; Rieniets, 2009), industrial cities became problematic and distressed places in the era of sustainable development.

The recent Urban researchers focus on finding the commonalities of industrial cities, not only from growth period but also, after deindustrialization to discover its possible future development plans and model. The discussions mostly come from western developed countries with a long history of industrial development and experience decline in advance. The studies challenge to discover the commonalities in transformations of the industrial cities while elucidating the factors of decline, process, and redevelopment strategies from a comparative global dimension (Power, Ploger, & Winkler, 2010; Vey, 2007). However, the process of de-industrialization is also recognized in East Asian countries like Japan and Korea, where heavily industrialized from the national government development plan after the post-war period. Following European countries and the US, the growing concern on de-industrialization local areas has been often noticed from the researchers. The studies remain unanswered for its possible future of the city, although the further decline. The level of economic development and industrial transition fast and bringing the same challenges for industrial cities in later industrialized countries like China as well.

If the decline of manufacturing industries is an inevitable process of economic restructuring in the global and national level, the question lies in the likelihood of identifying common trajectories of growth, crisis, decline, and recovery of industrial cities (Plöger, 2013) to avoid misplanning and prevent further decline in the upcoming future. Do industrial cities decline in similar ways? Can common patterns of decline and recovery of industrial cities be identified? What are the various factors which affect the transformation of the industrial city? In this context, the research finds the relevant trend and patterns of decline and transition of industrial cities by adding the context of Japan and Korea cities.

Industrial City Decline and Globalization

The dynamics of the industrial movement explains the decline of industrial cities. Due to globalization, that relocation of industrial production from countries affect cities to grow in one hand, and the other side cities go through economic restructuring. International competition increased under the globalized economy, especially in the manufacturing sector, and industries move-out for cheaper labor cost and the absence of pre-existing industry are primary bringing unemployment and economic recession in the local area. This external economic situation is affecting the industrial cities at the local level. The impact of globalization and decline of industrial cities started in Europe, as earlier industrialized countries including UK, France, Germany and also the later coming industrial producers Italy and Spain. The US also experienced the major decline during the 1960s and 1970s. The studies were pointing the fact that the decline was due to industrial competitors from the main industrial actors in East Asia countries such as Japan and Korea. Now, the contributors are likewise facing growing competition from emerging industrial countries such as China. The countries are following the modern shift trend as economy advances and de-industrialization affecting the local areas of industrial cities.

The patterns for de-industrialization are also repeating from economic advancement, as the characteristic patterns of industrial city's growth shows similarity and typical process, More recently, the studies continue to find common aspects of city decline and revival in much broader global comparative perspective. Therefore, ask important questions about the possibilities of finding commonalities in the city industrial development from growth till declining, and even in its future.

> *"Can we identify a common trajectory of growth, crisis, decline, and – possibly – recovery for industrial cities? In the case of signs of recovery, what were the contributing factors? Is the resurgence strong enough notwithstanding further urban challenges such as the most recent recession?"*
>
> (Plöger, 2013)

The study responds to this question as many works of literature have been describing cases of decline and redevelopment measures. Many discover stories of decline and transition of industrial cities over the world. The growing number of case studies of declining industrial cities in Japan and Korea shows the acknowledgment of the issue and implies how the decline of industrial cities will be critical urban problems of the city and the nation in the future.

Industrial City Decline: Factors and Process

City decline emerges urban problems in general. However, industrial city decline stories are similar in its factors, process, and problems. Industrial city decline occurs from both external and internal factors that explained by macro and micro level economics. Globalization as external factors, internally industrial city decline is related to its economic diversity. It is a proven fact for the cities that singular economic structure is easier to decline from the economic crisis and especially from heavy industrial cities. Increasing the resilience of economic structure has been constantly argued however city remains to be dependent on industrial function and finding alternative seems difficult. Therefore, only after the decline of pre-existing manufacturing industry city requires a new transition for advanced industries in the region. In the case of industrial cities the decline is more often regarded as a result of economic consequences, however, more recently the phenomenon of the city and urban decline is also viewed from social and environmental factors. As people desire to live in the better quality of living, the industrial city became less popular lacking urban amenity and quality. In the case of the US, suburbanization was concurred with de-industrialization the decline accelerated population outmigration and resulted in deterioration of the city center. Industrial cities are challenging to improve environmental condition from the past and current production and recover its image from the polluted era by the redevelopment of city centers. This trend is evident from most industrialized countries where experienced early industrialization from 19C. ‘Old industrial city' now becomes a typical example of the failure of past ‘Fordism' urbanization and lack of competitiveness in 21C (Bartels, Buckley, & Mariano, 2009; N. Haraguchi & Rezonja, 2011; Nobuya Haraguchi & Rezonja, 2010).

Mostly theorized from advanced cases in western countries, the questions remain in its different national and cultural context. The overall impact of de-industrialization varies from a different stage of development and time of transition. How much social and environmental aspects will impact the decline and transition are unanswered. Therefore, defining decline and transition stages with commonalities in factors and process in different Japan and Korea cases will enable to back up a theory of industrial city decline.

Future Strategies of Industrial City

Industrial cities have been the important center of production, employment, and innovation. Due to deindustrialization, the cities are facing challenges to overcome the economic and population decline processes. Lacking industries imply less employment and private sectors in the region when tax reduction leads the poor management of the city. The problem of city decline is not only city government left with huge debt and physical urban decay, but also trouble for the national and regional government. In the case of European and the US, government dependency has been increased at all levels (EU, national, local) with the debt of local government and funding is only reliable sources for the city to redevelop.

On the other hand, the past industrial cities are finding its way to revive after 20-30 years of decline. A review of the literature shows that many discourses raised an issue for the future of industrial cities and found a possible transition from negative to positive scenarios. ‘Phoenix City' or ‘Resurgent City’ highlights the effort of local government and dramatic changes from declining past industrial city to newly formed town. Often the strategies are valued for changing the image of the city and redevelopment of city center area, identifying key factors in the leadership of city government, private sector's cooperation, and timely intervention for the decline. However, the condition of a successful transition is not a promised vision of all industrial cities.

In case Korea, the current status of de-industrialization started to affect the future of the cities. The decline of industrial centers of Korea will increase the financial burden of national and regional government and threats the livelihood of citizens. How cities will take different paths from industrial decline is a key for the future.

Research gap and need for study

The industrial city decline has been a universal phenomenon causing contemporary urban problems and redirecting future sustainability. However, the decline is relatively recent problems for countries due to its relations to the economic advancement. The study is ongoing to find common aspects and theories its downturn and management and change of the role of urban planning. In this sense, the study will cover the relevant issues in three aspects.

1) The previous studies haven't compared the major factors, process, and strategies of industrial city decline and theorized with Japan and Korea cases. Incorporate knowledge of the similar phenomenon and finding the common attributes in different national and cultural circumstance will empower the decline of industrial cities. This approach can also reprove theories in various contexts and stage of development by applying comparative global perspectives.

2) Interpretation of industrial city decline of the concept of sustainable development is a relatively new approach. The industrial city decline is not only due to economic factors but also related to social, environmental, physical issues that are critical for industrial cities to overcome the challenges of transition. This comprehension implies the paradigm shift in the era of sustainable development and how economic, social, and environmental changes should be balanced the opposite from the early development of economic interpretation.

3) Concerning the impact of deindustrialization on urban decline and the transition is an issue that later industrialized countries should acknowledge its significance. In this sense, reviewing the process of decline and examining current transition strategies of Korea industrial cities is relevant to prospect the future of cities. This learning will also enable to make suggestions and recommendation for cities to prepare for upcoming challenges.

1.2 Research Objectives

This study aims to identify common transformation phases and various factors for decline and transition of industrial cities and acknowledge the different dimension of the industrial city transformation process. Focusing on the decline phenomenon of a specific type of city development – based on the premise that common characteristics of the industrial city exists - by developing a framework to diagnose and analyze the factors and process. The study implies the limitation of industrial and population growth of urban development model and shows the complexity of decline and transition process.

The study first conceptualizes industrial city transformation in growth, crisis, decline, and transition phases to achieve the goal set. Population and industry as dominant indicators, the study gives empirical evidence of industrial city transformation at national and city level. The study also backs up theorizing deindustrialization and urban decline opposite to industrial urbanism, identifies factors for the decline in multi-dimension and finds its impact for decline and transition. Finally, the study enables other industrial cities to prepare for future challenges by visualizing the complex process of transformation and examining strategies for the transition.

In this context, and to achieve these aims, the dissertation has five sub-objectives;

1) **Associate** contemporary industrial city discourses and urban transformation theories. The process includes identifying issues and challenges for industrial cities in the context of the globalized economy and conceptualizes common trajectories of transformation phases in growth, crisis, decline, and transition.
2) **Verify** the impact of de-industrialization and city decline based on the relation between national level economic development and industrial transition. The global comparative measures will sustain the common trend of industrial city decline and enable comparison of the relative status of industrial city development at national level.
3) **Identify** multi-dimensional factors for decline and transition of industrial cities by collecting variables at the city level to determine phases and visualize the transformation in a long-term perspective.
4) **Examine** the process of transformation and transition strategies by conducting case studies of Japan and Korea. To compare and analyze the current status of case cities and evaluate their strategies based on previous industrial city transformation trajectory and factors

As a result, the study enables the comprehensive understanding of the industrial city transformation concept, the global trend of city decline and distinctive feature of industrial city decline, and multi-dimensional factors and its impact on decline and transition for the future development of cities.

1.3 Research Questions

According to each objective, the study will process to answer following research questions.

1) Transformation of industrial cities
   - What are transformation and transition?
   - How do we measure city decline?
   - What is the distinctive feature of the industrial city decline different to other types of decline?
2) Industrial city transformation: global and national comparative
   - Do industrial cities show common patterns of growth and decline about national economic advancement?
   - What is the relation between industrial decline and population change?
3) Industrial city transformation: factors, process, and strategies
   - What are the various factors to explain the industrial city transformation?
   - How much impact from social and environmental factors to decline or transition?
   - How do city government transition strategies affect the transformation?
4) Analysis of Korea industrial cities
   - What is the current status of Korea industrial cities?
   - What is the major factor for transformation in the case of Korea industrial cities?
   - What are the strategies of the Korea industrial cities and future challenges?
5) Implications for Sustainable Urban Development of Industrial Cities
   - What is the common aspect of industrial city transformation in different national context?
   - What planning and strategies should prepare during the critical turning point for industrial cities for the decline and transition?
   - How can industrial cities reduce the negative impacts of declining and achieve sustainable urban development?

1.4 Research Organization

The dissertation is structured in seven chapters. See **Figure 1-1**. The analysis of the study consists three main parts which are quantitative analysis at the national level (the US, Japan, and the Republic of Korea) and city level (Kitakyushu City, Japan) and two case studies in Korea (Pohang City and Yeosu City).

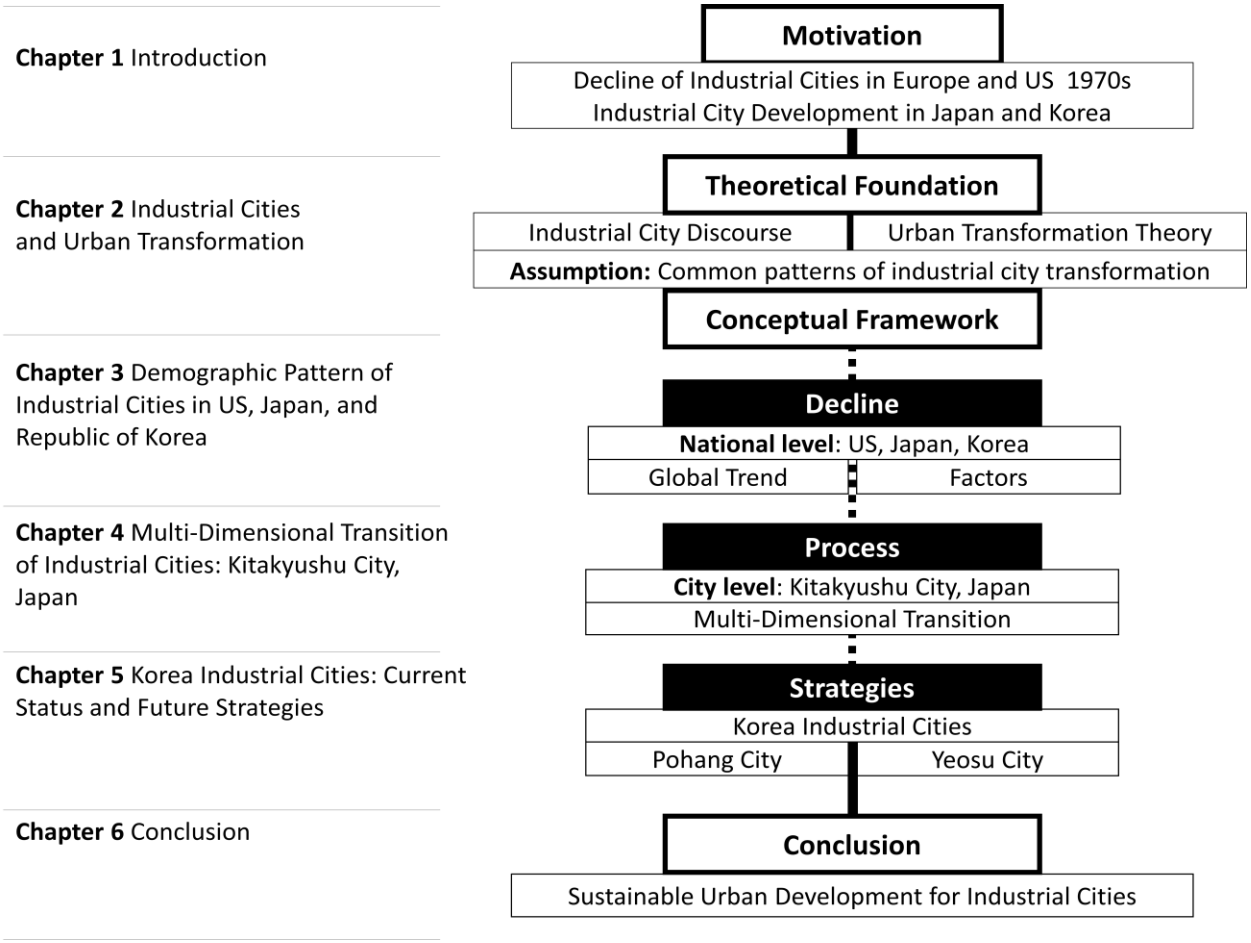

Figure 1-1 Outline of Research

Chapter One explains the background of research, research objectives and questions, and research organization, the significance of the study.

Chapter Two summarizes the theoretical background of the study by incorporating theories from industrial city discourses and urban transformation theory. Also include a definition of industrial cities, issues of globalization and industrial decline, and the story of transition and revival. As a result, the chapter conceptualized transformation phases of growth, crisis, decline, and transition of industrial cities.

Chapter Three analyzes the common trends of industrial city decline in global comparative. The study collects statistical data at the city level in the US, Japan, and the Republic of Korea. This chapter verifies the relation between the economic advancement of national level and industrial city decline, the impact of deindustrialization and population decline, and industrial characteristics relevant to decline.

Chapter Four explores the various factors for decline and transition and analyzes its impact and relations. The chapter explains transformation with a case of Kitakyushu City, Japan by visualizing the complex process in the historical timeline and defined stages using quantitative and qualitative data.

Chapter Five identifies the current status of Korea industrial cities and examines the transition strategies in selected two case cities, Pohang City, and Yeosu City.

Chapter Six concludes with the overall summary, industrial city and suggestions for sustainable urban transformation for industrial city model development.

1.5 Expected Outcome and Significance

Expected outcome and significance is from the amount of collecting data, new empirical evidence for existing theory and utilization of the analysis result to make a new argument on expected problems.

First, the research contributes to the theory of the deindustrialization and urban decline opposite to industrial urbanism. The common trend industrial city decline is with the empirical evidence in the case of the US, Japan, and Korea. The study also backs up the previous studies on transformation of industrial cities by confirming contributing factors for decline and transition. Also confirmation of repeating trend shows the lifecycle of the cities which engage long-term development of the cities. The data collected a broad range of national and city level will be academic resources for the future research on industrial cities.

Secondly, utilizing sustainable development aspects of industrial city decline and the transition is useful to demonstrate the complexity of the problem. The solution for the industrial city decline is not established yet due to its novelty and complexity. Therefore, to set up the indicators to capture the transitional phases and the critical turning point is meaningful to understand the city transformation. Specifically, for the industrial city, factors and the process of decline and transition is also claimed from the process and not only considered economic factors but included social and environmental aspects which different from existing studies. Therefore, the research brings attention to a perspective on sustainable development through long-term transformation on industrial city-specific models. To synthesize different aspects identified turning point with quantitative data and created a comprehensive timeline to visualize the transition phases which is a new approach.

Thirdly, the study raises the issue of the decline and transition of Korea industrial cities which is relatively recent issues. Previous studies discover the successful foreign cases regarding transition policy application. However, industrial cities have been still at the growth and peak stage of development. The study raises awareness of the decline from confirming the declining trend and change for the growth-oriented mindset to face the problem more realistic.

Lastly, the industrial city decline is the issue for future industrial development where to locate industries at national level and issues of city planning and management at the city level. Understanding the transformation in Japan and Korea industrial cities will strengthen the industrial city transformation theories. And each case will enhance the view and create a linkage between a distant time gap between the development of Western countries and developing countries, and also the features of fast changing society.

1.6 Clarification of Terms and Abbreviations

1.6.1 Key Concepts

Industrial City The past studies commonly define Industrial City as a conceptual image by industrial production dominant features. In this study, the term specifically refers to the cities with dominant manufacturing industry, but also separates its meaning with the type of industries, for example, heavy industrial cities. The definition excludes resource extraction business such as coal and mining. In Chapter Two, the study describes the concept and definition of industrial cities. However, the author used the technical definition for the quantitative analysis Chapter Three contains.

Decline Decline is a process combined the meaning of industrial decline, population decline, urban (physical). Industrial decline and population decline the term implies the decrease of quantity and physical decline deterioration of environment loss of the amenity living environment. Further explanation is in Chapter Two.

Transformation Transformation is long-term trajectories of changes. The industrial city transformation will be a long-term trajectory of industrialization-growth-peak-crisis-decline-post-industrial development over the period. In this study, time range often designated the decades since the post-war period.

Transition Transition is short-term changes from each phase. The key difference of industrial city transition will be before and after the industrial decline of manufacturing industries which transition varies from different dimensions.

1.6.2 Abbreviations

Korea The Republic of Korea (South Korea)

SOC Social Overhead Capital

E.G.W.S Electricity, Gas, Water, and Sewage

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Chapter 2 Industrial City and Urban Transformation

CHAPTER TWO
INDUSTRIAL CITY AND URBAN TRANSFORMATION

2.1 Introduction

This chapter introduces two major areas of study as theoretical background that is the industrial city discourse and urban transformation theories. The study first captures the issue of growth and decline of the industrial city in the context of urban transformation from globalization and national industrial transition.

2.1.1 Background

The recent urban decline and transition are a relatively new phenomenon compared to its growth phenomenon. Theories of industrial urbanism explained the growth dynamic of industries and urban areas but didn't capture the stage of decline and transition yet. Due to many evidential cases from the older industrialized countries that prove industrial city decline and also a few of successful transition stories that imply the uncertain future of industrial cities for post-industrial development. Also the industrial city nowadays, whether a decline or revived after the economic crisis, is viewed as a past legacy of the failed model of transitional Urbanism. The trend of increased emphasis on the importance of the sustainable dimension of city development considering its environmental enhancement and social diversity is also one of the reasons that industrial city as neglected place after its major decline of the economy.

Still, there are increasing attempts to understand the trends of industrial city transformation, finding commonalities in global comparative studies. The researchers view industrial city that can be better understood in much broader perspective of its growth, viewing how cities also can be the most potential place for transition also regarding its urgency. As recent shrinking city discourses suggest the industrial city decline as one of the types of typical decline story, more realistic approaches to planning the future of industrial cities also raised. These comparative ways are useful to define associated problems and to share the vision of industrial city development and strategies. However the connection between industrialized period and the deindustrialized process hasn't been viewed comprehensively, therefore, need for studies in not only successful post-crisis recovery examples which are very rare and few, but cities that struggled after the economic crisis and process to reach the with new equilibrium. The global comparative studies find the commonalities of decline and new measures for the redevelopment focusing on how industrial

city has its commonalities and differences of local dynamics in internal and external impacts of its historical and new development.

In this context, transformation theories are useful to explain the industrial decline and city decline and its dynamics in the long-term. Also, the concepts on the sustainability dimension of urban transformation allow the multiple aspects of visioning the industrial city which not simply as declining in economic and demographic perspective but also improving its unique balance of sustainability. Therefore, connecting the urban development process during the historical period of industrialization and its impact towards decline and transition will be a major lesson for present cities to prepare the upcoming transitions and also to revalue the new stage of development after the quantitative decline.

2.1.2 Objectives

The objective of this chapter is to conceptualize the transformation of industrial cities including the recent decline and transition phases and in multiple sustainable development dimensions. The conceptual trajectory, used as a framework for this study, will enable to capture the connection of past industrial development and its impact on a new stage of development and also the new balance of economic, social, and environmental development condition of the city.

To achieve the major objective, the chapter follows in order of sub-objectives; first clarify the definition of industrial cities and demonstrate the growth, decline, and transition of the industrial city from the industrial city discourses. Then, from urban transformation theories, define the concepts of transformation and transition and review the relevant urban transformation theories. By adapting the transformation theories and each of the common phases of industrial city development, the transformation of industrial cities is summarized as a result.

2.1.3 Data and Methodologies

This chapter will be a literature review of previous studies, including the broad range of literature on urban studies in various topics of the industrial city, shrinking city, urban redevelopment and theoretical studies on urban transformation. The study also includes additional data and references for reviewing the pre-existing cases of an industrial city as examples of cities in decline and transition. **Figure 2-1** shows the diagram of an overview of relevant fields of studies.

2.2 Industrial City Discourse

2.2.1 Definition of Industrial City

Conceptually, a city is a dense agglomeration of industrial production and people (Glaeser, 1998) but it also includes a dense concentration of capital that attract people to a certain locale (Walters, 2010). From resource oriented extracting business such as mining industry to petroleum and chemical manufacturing to advanced form of machinery and automobile assembly plants, locating industrial extraction and production created the employment and livelihood in the area with population inflow. A new town and village formed around the industrial production facilities and physical development of industrial center also developed roads and transportation route oriented.

The study combines the features of industrial cities with the image and characteristics which are rather descriptive. As industrial production cause environmental problems of pollution and the use of land, social problems occur with the dominance of employment of blue collar labor. However, the image of industrial changes from history. As Guun (2012) categorize industrial city into different types by the time of development, from early industrialization during the 19th century in Europe, during the modernization in 20C and 21C Globalization. **Table 2-1** shows how cities and relevant issues are changing 19C to 21C based on European context.

Previously researcher defined the industrial city by the industrial type naming such as 'Steel City' or 'Motor City'. Manufacturing industries also include different types of producing materials which vary the development patterns of cities.[1] The industrial city contains production, place, people (MIT, 2014). Therefore, not only distinguished by the dominance and the type of industrial activity but also shows a difference in land use and social structure.

In this study, the industrial city is defined as the city with dominant industrial activity in the region, limiting the type of industries into manufacturing. This definition excludes the resources oriented mining and extraction industries.

1 According to ICIS.rev4, C. Manufacturing (10-33)
10 - food 11 - beverages 12 - tobacco 13 - textiles 14 - wearing apparel 15 - leather and related product 16 - wood and related product, cork, except furniture; articles of straw and plaiting materials 17 - paper and paper 18 - Printing and reproduction of recorded media 19 - coke and refined petroleum 20 - chemicals and chemical 21 - basic pharmaceutical and pharmaceutical preparations 22 - rubber and plastics 23 - other non-metallic mineral 24 - basic metals 25 - fabricated metal , except machinery and equipment 26 - computer, electronic and optical 27 - electrical equipment 28 - machinery and equipment n.e.c. 29 - motor vehicles, trailers and semi-trailers 30 - other transport equipment 31 - furniture 32 - Other 33 - Repair and installation of machinery and equipment

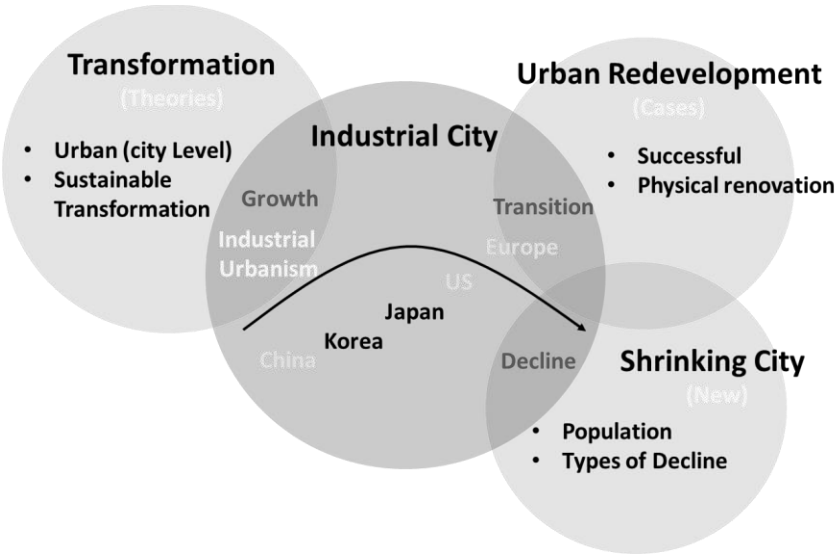


Figure 2-1 Relevant Field of Studies

Table 2-1 Image of Industrial Cities and Related Issues of Urban Studies

	19C	**20C**	**21C**
Characteristics	**Negative images**	**Modernity**	**Globalized economy**
Urban Issues	Industrial pollution Social insecurity	Rationalization with abundance Utopian optimism	Importance of tertiary sector Knowledge industry
Image and types	Heavy industry Coal extraction Dynamic, chaos, apocalyptic Dirty and dark living conditions Desperation of the individual: Insecurity Strong and intense protest	Disciplined workers at the furnace Heroic construction efforts Socialist industry cities, Company towns, Social and council estate in post-war era	Declining industrial cities Envisioning future of industrial cities

Source: Retrieved from the text of Industrial City (Gunn 2013)

2.2.2 Industrial Urbanism: The Growth of Industrial City

Industrial Urbanism explains how cities emerge from attracting employment, and the growth of cities differs due to industry type and activities. The difference in time, the relation to industrial development and urbanization and its pattern remains similar.[2] Gunn (2013) differentiated three categories from types of industrial urbanism: classic cities of the first and second industrial revolution in 19C, company towns from 20C, and cities where the industry was a substantial part but not defined as 'industrial'.

Industrialization and urbanization:

1) Industrialization occurring disconnection from previous urban development
2) Industrial cities linked to their locations (i.e. Natural resources) and transportation infrastructure adjacent urban growth
3) Proto-industrial activities[3] exist and evolve into a major industrial center with workers inflow and the emergence of large companies
4) New industries arise from technological advancement

An industrialization is a proven tool for national economic development, including poverty reduction (UNIDO, 2009). Industrial cities refer to how national economic development has been together with the development of certain cities. However, an industrial city is not a permanent condition, and the view has changed from the decline and changes in post-industrial society and negativity towards the city.

[2]There has been argument in relation between industrialization and urbanization recently that developing economies have exceptional cases showing urbanized form but neither manufacturing nor services economic contribution. High urbanization rates can occur from income effects and natural resource exportation: "consumption cities" rather than typical "production cities". (Gollin, Jedwab, & Vollrath, 2013)

[3] A phase before the industrialization of a country in which the necessary conditions are established

2.2.3 Decline of Industrial City

2.2.3.1 Globalization

According to OECD report, industrial structure changes in employment and value added in most of the developed countries which total share of manufacturing employment declines in G7 countries, however, the value added remains growing in countries such as Japan and US during 1980-1990s. Top manufacturing countries shown in 2002 in US, Japan, and other Asian countries includes Korea at seventh by production and exceed from emerging countries as China. Over 30 years of industrial relocation from economically developed countries to developing countries have been the major factors for urban growth and decline patterns (OECD, 2013). Development of manufacturing industries has been changed widely around the world.

2.2.3.2 Industrial to Post-industrial

Postindustrial society explains the future of industrial cities. The termination of the industrial urbanism brought the detachment from past industrial development and existing industrial cities to decline. Historical industrial city discourse has faced its end during 1990s post-industrial development. Growth and decline of industrial cities are more diversified with globalization and national industrial transition. A distinctive feature of industrial development at city level was outdated with the diversification of industrial type and development patterns that are making difficult to identify universal trends. However, the development patterns of industrial and urban development are still ongoing with the latest demand from the growing developing countries. Urban development is repeating the industrial cities under the economic regime, which simultaneously causing social and environmental problems. Also, it raises a critical issue for future sustainable development. The industrial shift from developing to developed countries with certain time gap a valuable question how cities in developed countries are now experiencing decline by remained consequences from emerged problems which is the legacy of industrialization period. Post-industrial City development have noticed the important key economy with i) Finance and Business Services ii) National and supranational organizations ("Power and Influence" or "Command and Control") iii) Creative and Cultural Industries and iv) Tourism (Hall, 1999). A new type of cities emerged with service industry with post-industrial development when 'the new world of the 1990s' begins (Glaeser, 1998). Therefore, industrial cities faced importance of reconstructing the image of industrial cities (Short, Benton, Luce, & Walton, 1993) along with increasing locality, regeneration, and diversities from post-industrial city view.

2.2.3.3 Shrinking City Discourses

More recently, urban decline and shrinking city discourses have been enlarged highlighting the decline in older industrial cities in Europe and US. Shrinking city, urban decline and regeneration have been a

continuous theme in urban studies from the early 2000s especially countries like England, Germany, and the US. Shrinking city in developed countries, the discourses varies from its factors and processes. The decline of the city is explained by overall population decline, rural decline, urban decline, and post-disaster region. Among them, the decline of old industrial cities with industrial decline is distinctive for urban decline, by size and its seriousness. With the unexpected crisis of industries, the process of economic restructuring is acknowledged in several countries, however, glory in the past.

> *"The factors of urban decline is notoriously difficult to explain, some combination of socioeconomic decisions. Recent causes are de-industrialization, the removal or reduction of industrial capacity in a region (manufacturing industry) is one of the main recent causes for urban decline in Europe and US".*
>
> (Plöger, 2013)

In Germany, older industrial cities are chronically under-financed and have amassed huge debts *(Holtkamp 2011, 16).* Suburbanization regard as the cause of the urban decline in the US, social issues between racial disparity as one factor and others find the reason because of decline' somewhere else, such as unionized labor institutions. (Walters, 2010).

The overall process of urban decline[4] in 'old industrial cities' (Lang, 2005), the US the industrial city as Shrinking City (case of Flint, MI) (Hannemann, 2013). Most of the discourses in a typical type of industries from textile to primary heavy industries like steel and shipbuilding and more recently 'motor towns' (Hebler, 2013). Radical strategies for reforming tax, public administration, assembling land and renewing infrastructure, employment and create a partnership between city, state, and federal government (Hill & Nowak, 2000). 'Older distressed cities' in the US, the increased role of federal government gives inputs for support for those cities in decline (Mallach, 2010). Shrinking Cities in the 20C changes the discourse from the demographic impact of industrialization to de-industrialization and urban shrinkage. (Hollander, Pallagst, Schwarz, & Popper, 2009; Rieniets, 2009)

[4] "Urban decline is the process whereby a previously functioning city or neighborhood falls into disrepair."

2.2.3.4 Industrial City Decline

Industrial city decline is a distinctive process from other decline or shifts.[5] **Figure 2-2** shows the process of decline in industrial, population, and urban decline. Factors caused from the external global and national changes to local impact, the city manage its process of developing new industries, create a job to attract an inflow of population, and manage city from physical decay.

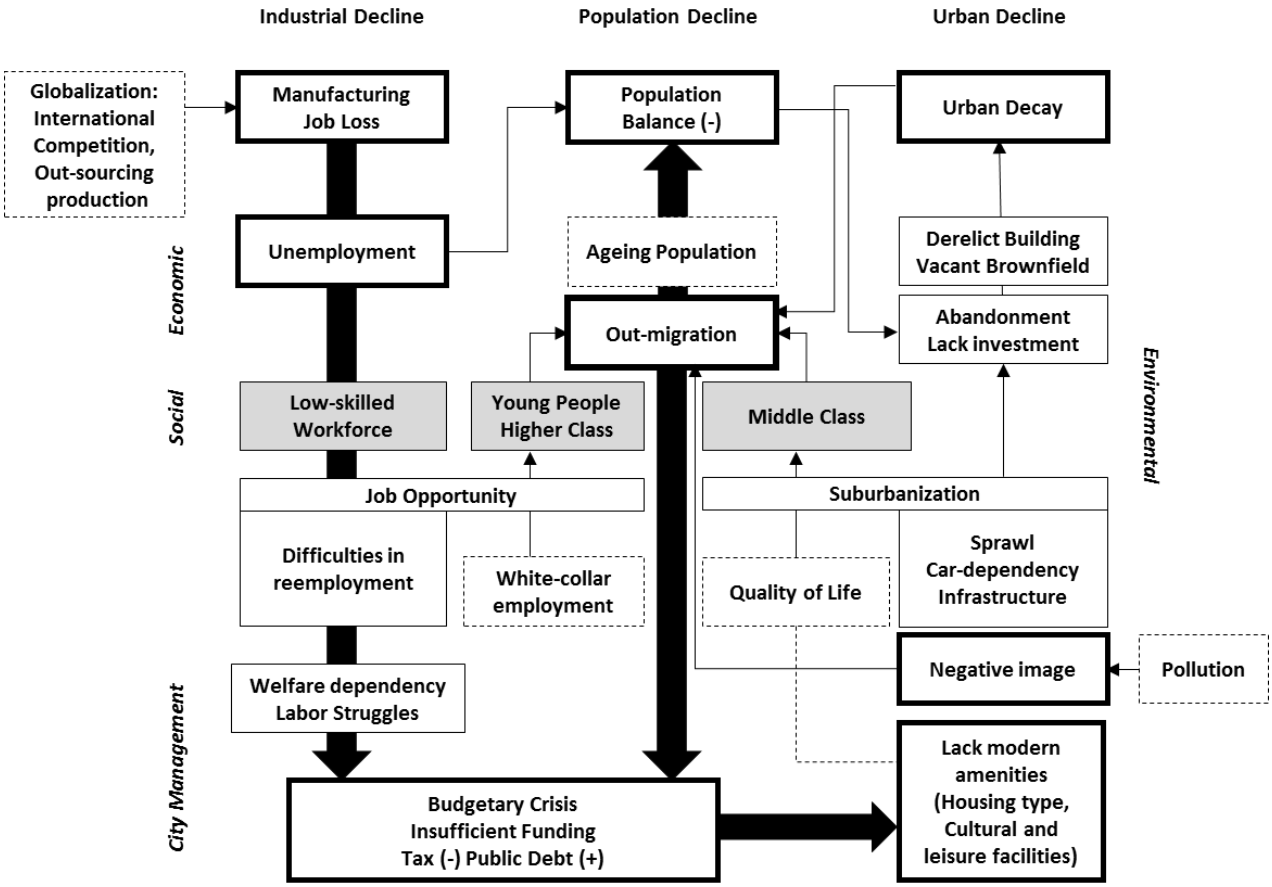


Figure 2-2 Factors and Process of 'Shrinking' Industrial Cities

Source: Retrieved from the text (Plöger, 2013)

[5] Resource exploit could be another factor of industrial decline in case of mining, extraction, and steel industries

De-industrialization is the first phase that effect from the global process of economic restructuring in industrialized countries (Europe 1970s, the economic recession from symbolic oil crisis) – collapse in certain industrial sectors and a dramatic workforce reduction in manufacturing in older industrial cities. Secondly, population decline emerges with rising white-collar employment post-war period, deindustrialization and suburbanization accelerated the industrial cities population decline. Negative natural population balance (aging populations and increasing out-migration) also cause population decline. Lastly, urban decline occurs with associating the problems of industrial and population decline, urban decline (old and vacant housing and abandonment) due to the capability of management with limited tax. Redevelopment associated with new industrial implementation bringing new population aligning endeavor the reuse of brownfield.

The decline is a result of economic decisions, circumstances, and processes of architecture and urban planning. The city is reactive to deal with factors from deindustrialization, demographic changes, and such as suburbanization. "The Myth of Planning" is tackled by other researchers (Oswalt, 2006) while decline clearly needs intervention with new models of development. Plöger (2013) explains how the urban development process is largely affected by external factors, however, despite the outside dynamics, the local impact exists as cities create initiatives and actions toward transition.

2.2.4 Resurgence: Recovery after Decline

Resurgent and revival also take parts to envision the bright future of some cities after the crisis.

2.2.4.1 Resurgent Cities

In the research, some cases are more likely to be introduced as successful cases in the literature as being never dying 'Phoenix cities' or view dramatic changes occurred after the decline 'Problem City to Promise City' in New Castel, Australia (Rofe, 2004). Plöger (2013) analyze seven cities in Europe regarding decline and recovery. The 'Weak Market Cities' which the city has transitory phase from older industrial cities, the on-going decline due to economic restructuring but overcoming structural weakness and the cities are showing symptoms of recovery such employment rates. These cities became the evidence of maintaining a certain level of 'resurgence.'

Based on population change, Turok & Mykhnenko identifies the patterns for European cities during the 1960s to 2005 and shows that how difficult for cities to involve resurgence, meaning a turnaround for growth after the period of decline, by urban regeneration and revitalization. It is only small (42 out of 310) compared to continuously growing (30%) and declining (40%) cities. The revival of cities seems to be the high-tech employment development boom of the 1990s and become as "superstar cities" while elsewhere wasn't lucky (Walters, 2010). Capitalist economy and urban development, however, neoliberal policies has not been reversing the decline of US cities. Industrial centers further decline without an upturn in the 1990s and brings critical consideration for whether creative industries, branding worked for continuous decline cities. The study indicates the example of Newark City, US (Kaminer, 2009).

Urban Matrix (2007) discovers the redevelopment projects in Europe, identifies success factors for transformed areas. Urban resurgence is apparently from urban preferences of individuals, and both concepts of resurgence or emergence are now due to "creative economy, urban amenities, diversity and tolerance, and urban beauty"(Storper & Manville, 2006). The most important points these types of the study raise under the redevelopment strategies are the social and environmental perspectives.

2.2.4.2 Future Scenarios of Industrial Cities

Industrial cities often have a make-over for the past, dramatic changes often related to the development of new industries.

1) Advanced industries in high-tech manufacturing
2) Tertiary sector service and commerce and finance center
3) University and knowledge industries continued with R&D
4) Tourism with resources with natural and cultural resource (included industrial heritage)
5) Environmental regime strategies cities

Other scenarios exist, new industries focused on agricultural, other industries such as a casino. Also, adopting multiple strategies is common in planning redevelopment stages.

2.2.4.3 Redevelopment Measures

Plöger (2013) explains 'endogenous and exogenous factors' for the recovery process. Internally, the recognition of city leadership on the issue of economic restructuring is urgent and also unavoidable from the economic crisis. New approaches supported by actors from negotiation, consensus building, and multi-sector collaboration. Convincing urban public for the need readjustment and the change of mindset from former industrial self-conception towards new post-industrial identity and proposing a new vision for the future. Externally, the factors are devolution of power to regional and local governments, funding programs from different tiers of governments, and designing own city program.

Past industrial cities 'shrinking', on the other hand, cities have survived through the crisis by its strategies and maintained its competitiveness. External factors such as globalization and an international market exist, however, internal reactions of the city management has been the key to its survival. Innovation stands from changing growth agendas to management of decline as "Smart Shrinkage" in Youngstown, Ohio (Rhodes & Russo, 2013; Rhodes, 2014; Schatz, 2008)

2.2.5 Summary

The following points are the key points from industrial city discourses.

a) The industrial city defined as a city as the local administrative boundary with dominance in manufacturing industries. The study uses the technical definition of using a percentage of employment in manufacturing industries.
b) Common characteristics exist among the typical type of city from the development, industrial urbanism.
c) Industrial city decline at the local level related to global dynamics of industrial relocation the common trend of developing countries and developing countries the growth
d) Among decline discourses, industrial city decline has been distinctively massive, which the deficit of structures of the economy.
e) After a decline, how cities emerge from post-decline has been also highlighted, only a few cases and not yet proved to be the solution. There are no common strategies to the redevelopment of the industrial city.
f) The study challenges to understand the complex process and management of transformation.

2.3 Urban Transformation Theory

2.3.1 Definition of Transformation and Transition

2.3.1.1 Transformation

Transformation is long-term trajectories of changes under the condition that total change of system. According to transformation studies in sustainability science:

> *"Transformability… is defined as the capacity to create untried beginnings from which to evolve a fundamentally new way of living when existing ecological, economic, and social conditions make the current system untenable."* *-(Olsson, Folke, & Hahn, 2004)*

According to the line, the transformation will be a long-term trajectory of determined stages in industrialization-growth-peak-crisis-decline-post-industrial development over the period. In this study, time range often designated the decades since the post-war period.

2.3.1.2 Transition

The transition is a short-term change from each phase. The key difference of industrial city transition will be before and after the industrial decline of manufacturing industries which transition varies from different dimensions. The transition is often explained by changing the previous stage to building another stage by preparing and navigating (Folke et al. 2010; Olsson 2004), the industrial city transformation also shows the critical turning point and change into a different stage. In this case, the level of transition dynamic is the highest during the de-industrialization period.

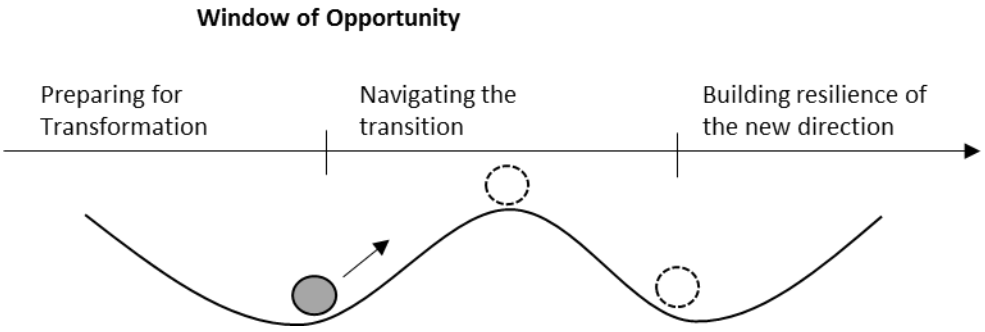


Figure 2-3 Transition and Window of Opportunity

Source: Retrieved from (Folke, Stevhen R. Walker, Scheffer, Chapin, & Rockstrom, 2010 ; Olsson et al., 2004)

2.3.2 Stage Theory

Stage theory explains the phases of industrial and population development over time and economic development stages. See **Figure 2-4**.

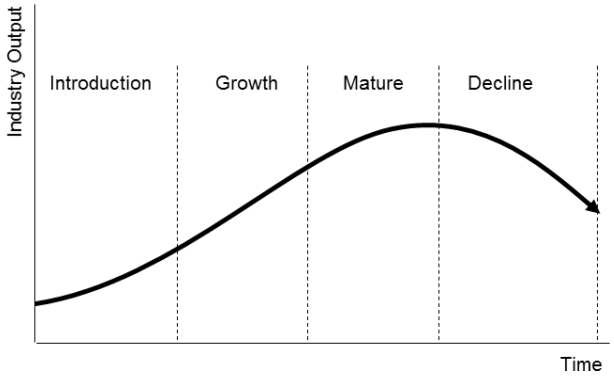
Industrial lifecycle explains the cycle of industrial product or decline of the industrial activity from city and region. From the introduction, growth, mature, and decline stage the limitation of industry output. The life cycle of regional industrial emergence is explained by (Phaal, O'Sullivan, Routley, Ford, & Probert, 2011) however, decline or renew left out as beyond the scope of the study. After the growth, the new emergence of innovation, the next growth stage from mature, disrupt or substitute emergence has not yet been clearly recognized.

The national level industrial transition is phases of industrial advancement. Economic development stages, however, explained at the city level. Urbanization, especially explains by industrial urbanism, industrial cities have secondary industry dominance and will remain longer in the phases while the increase of tertiary and quaternary industry in the region, but cannot replace for its volume and size of the economy.

Demographic transition theories also explain how the population will naturally decline from stage 5 after reaching post-industrial society. Researchers find Germany as its specific case and lower birth rate including USA and Japan. In this context, the countries with immigration will be able to make a turning point. However, the cities expect a continuous decline.

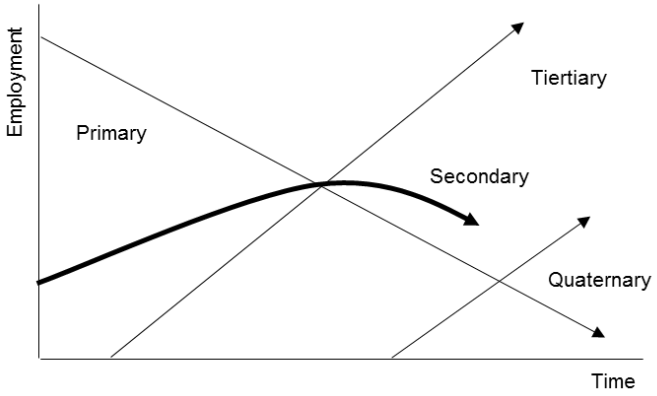
Regarding all theories of industrial population transition, the industrial city at city level will face decline. De-industrialization of national level and impact to the city level seems to be the natural process of the development cycle. However, the problem of industrial decline leading population decline, the city management focusing on the urban decline is not yet been considered to the national nor city level for new emerging issues.

Industrial Production Lifecycle



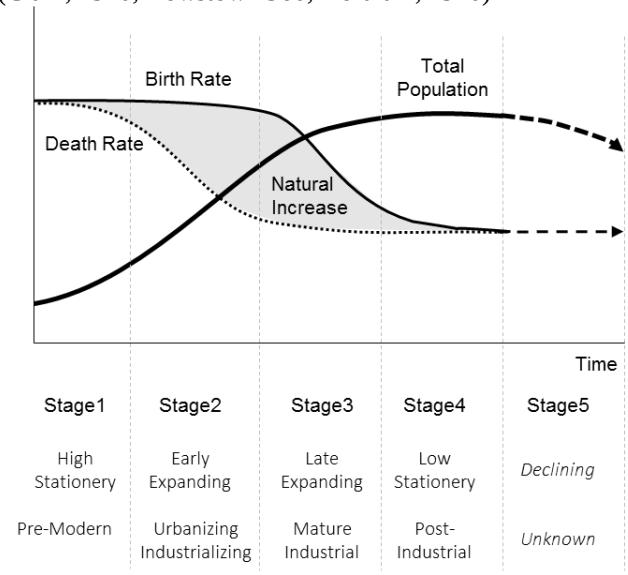
The evolution of Marshall's (1890) agglomeration economies and the industry life cycle (Phaal et al., 2011; Potter & Watts, 2010)

Industrial Transition (National Level)



Theories of industrial transition stages by economic development level of countries (Clark, 1940; Rowstow 1960; Northam, 1970)

Population Decline (National Level)



Thompson's Demographic Transition Model (DTM) with the fifth stage of population decline (Bloom & Williamson, 1998; Borgerhoff Mulder, 1998)

Figure 2-4 Industry Lifecycle, Industrial Transition, and Population Change at National Level

2.3.3 Urban Transformation towards Sustainable Development

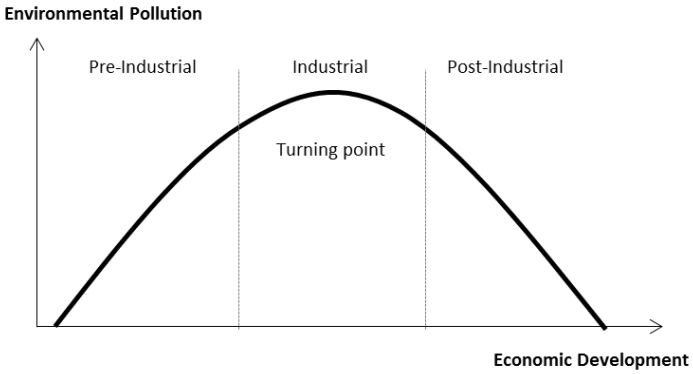
The urban transformation theory describes the city level transformation and stage model. However, not only industrial population dynamics, but also city level socio-environmental aspects are relevant to city level transformation. See **Figure 2-5.**

Kuznet's curve explains the relation between economic development and environmental conditions. Industrial stage the turning point will be an improvement of environmental pollution. In this sense, the industrial city decline is also a better quality of living regarding cleaner air and amenity of the area. Bai & Imura (2000) describe the improved stage theory of environmental impact at the city level. The issues are changing from one to another, but problems remain. They compare cities in East Asia (Japan, Korea, and China) with three cities cases matching the stages of the environmental problem of cities. Consumption related issues will arise at the de-industrialization phases.

Yang (2010) developed sustainability indicators with environmental degradation (built & natural environment) and Human well being. The natural environment is energy and water consumption and pollution level, housing, public space and public transportation for building environment. Human wellbeing includes individual wealth, public health, and education. The stage of a sustainable city is where the population will manage to decline with certain environmental degradation but the increase in wellbeing.

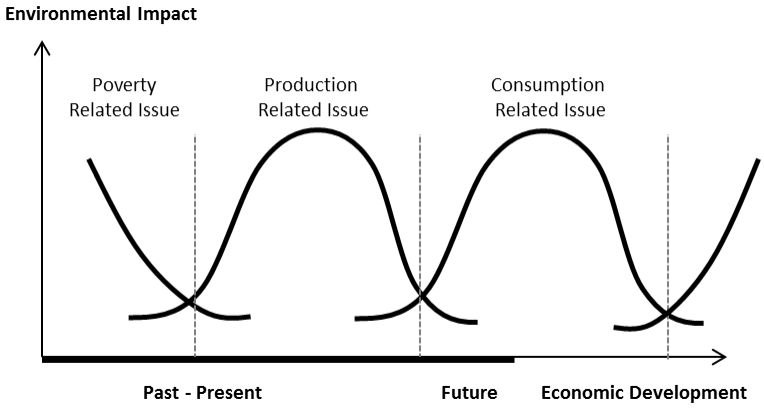
The industrial cities have specific issues regarding de-industrialization and the question arise how social and environmental changes will occur beyond the existing urban transformation theories.

Environmental Stage Theory 1



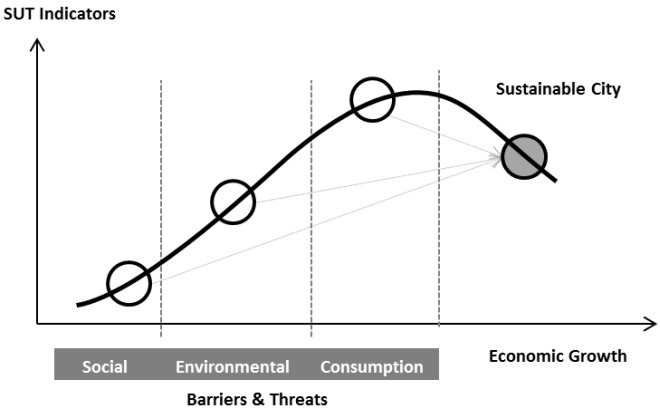
Environmental Kuznet's curve on relation between economic development and environmental changes

Environmental Stage Theory - Urban



Revised model of environmental stage theory at urban level (Bai & Imura, 2000)

Sustainable Urban Transformation Stages



Sustainable Urban Transformation (SUT) – Y axis
= Environmental Degradation (built & natural environment)
+ Human Well Being

Sustainable urban transformation by environmental degradation and human wellbeing index (Yang, 2010)

Figure 2-5 Environmental and Sustainable Development Stages at City Level

2.3.4 Summary

Urban transformation theories require an understanding of transformation and transition.

a) Transformation is an ultimate long-term change from one system to another which involves many different transitions from one phase to another.
b) Adapting industrial city decline and future transformation will require different sets of multiple transitions in various aspects.
c) Stage theories of national level and urban transformation towards sustainable dimension can be a useful setting for understanding the industrial city transformation.

2.4 Conceptual Framework: Transformation of Industrial Cities

The conceptual framework for industrial city transformation described in **Figure 2-6**. The transformation divided into each phase diagnosed from primary indicators such as industrial and population change. The multi variables for explaining different dimension in each phase is from the features of the industrial city. The conceptual framework completed by identifying the relevant variables from the analysis at city level with empirical evidence.

2.4.1 Transformation Phases

2.4.1.1 Variables

Population and industrial changes mainly define the phase of development.

1) **Population:** Population in long-term trajectories the maximum population is identified as peak level and transition point. The value of population growth and decline rate will define the phases.
2) **Industry:** Industrial variables initially divided from primary, secondary, and tertiary industries. Subdivisions of manufacturing industry are taken account to identify the relevance of industrial characteristics of the city. The new industrial growth indicated from the detailed classification of services industries such as some employees in education, technology, healthcare, and other services.

2.4.1.2 Phases

Transformation phases are divided into four stages of development, growth, peak, decline, and post-industrial.

1) **Growth:** In Growth stage, the secondary industrial employment is dominant, and the city grows with the industrial development. Primary industries are declining due to its transition.
2) **Peak:** Industrial city on the Peak stage of development shows the exceeding rate of employment in tertiary industrial development. The population reaches its peak level at a certain point.
3) **Decline:** The city encounters a sudden economic crisis of secondary industries which will bring the city the Decline phase. The deindustrialization starts in Decline phase and impact of de-industrialization will lead population changes at the city level. Tertiary employment also affected by the economic recession and outmigration starts from unemployment due to termination of production in the local area.

4) **Postindustrial – New Phase:** After the decline stage, post-industrial development can follow different paths. The population can re-grow with the new industrial development or stabilize after a certain decline. The further decline is from the de-industrialization causing a severe impact on the local region.

Transformation as long-term trajectories commonly explains the industrial city status of its growth and decline with two major indicators. However, the detailed condition of each phase of development explained with multi-dimensional transition variables.

2.4.2 Multidimensional Transition

A transition shows in the period of change from decline to a new phase of development. The major transition is from industrial to post-industrial development. Urban planning and strategies in transition period could impact the future of the cities whether to notice a population increase or economic upturn from the transitional phase. Management of economic crisis and other related issues from the historical urban development will be a key factor at this stage.

The variables are from the previous description of industrial city characteristics which has the distinctive features from past development.

2.4.2.1 Economic Dimension

Economic variables explain industrial economy and city economy.

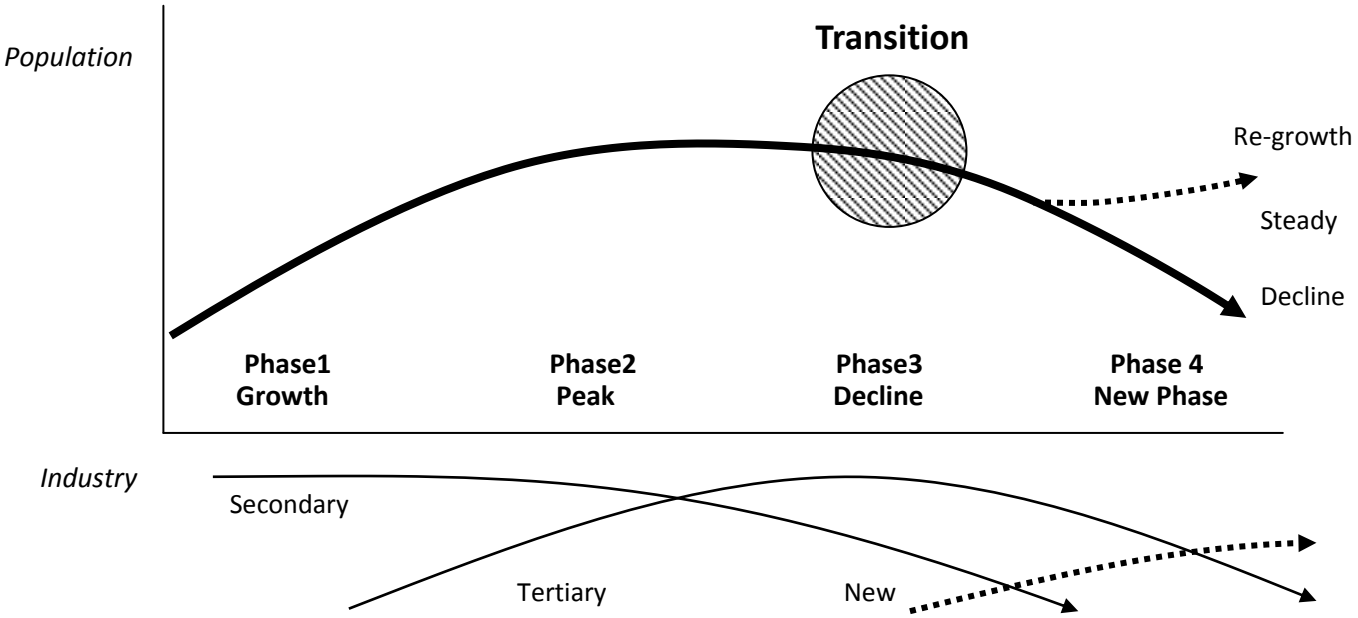
- **Industrial Economy:** Manufacturing production value, shipment, and status of the major private company recognized as industrial variables. As the employment structure mainly used for transformation variables, the status, economic trend is considered as additional variables.
- **City Economy:** GRDP, city tax, debtors, and various city financial indexes are used to identify the condition of the city economy and relations between the industrial economy and city economy. The industrial city often shows a keen relation with industrial and city economic, where de-industrialization of the certain economy shows the impact to the whole city economy.

2.4.2.2 Social Dimension

The main social indicators include basic social structure (quantitative: population variable) and social integration issues (qualitative: historical events and other descriptive sources).

- **Social Structure:** Population characteristics in gender, age, foreigner relates to the industrial city regarding laborer characteristics. Also, education and income level will define the social status of

Transformation



Multi-dimensional

Economic	• Dominance in secondary industry • Primary industrial decline	• Tertiary employment exceeds secondary • Economic crisis from external	• Impact of economic crisis in tertiary and other industries • Increase of new industrial approach	• The increase of new industries – ex. Technology, tourism, educational, medical services
Social	• Male/Female dominance • Migration of outside workers	• Population peak	• Outmigration • Unemployment • Increase of labor strikes and crime	• Scenarios of population decline, regrowth, steady • Population Aging
Environmental	• Increase of environmental pollution	• Industrial pollution peak • Decrease of pollution with counteract	• Consumption related pollution	• Physical deterioration
Physical	• Industrial complex • Old city center	• Increase of new housing development • Suburbanization	• City Center decline	• Brownfield redevelopment

Figure 2-6 Conceptual Framework for Transformation and Transition of Industrial Cities

workers and citizens compared to other cities. Often the manufacturing, industrial dominant cities have male-dominance (female in case of light assembly manufacturing business), age bracket of 30-40of blue-collar workers with less income compared to white collar workers, in the case of Western countries.

- **Social Integration:** The social integration issue is from the local stakeholder relation with a private company (including workers), local government (and non-worker citizens), and also other local institutions and national and regional government. Industrialization often brings new workers from another region and within the influx of a new group of residents and old residents as non-workers or conflicts at the institution level. The social problems such as massive layouts during the de-industrialization process also considered as major conflicts from industrialization between the working group and a private company.

2.4.2.3 Environmental Dimension

- **Industrial Pollution:** The local issues of increasing industrial pollution of migrated workers will be the characteristics of this stage. Industrial pollution also shows the peak level, however possible decreases over time due to counteracting measures. Consumption related pollution, increased at this level while the increase of car use, waste, and energy issues.
- **Consumption Related Pollution:** Variables related to consumption issues, such as water, electricity, and waste, are used for identifying the environmental condition of city development.

2.4.2.4 Physical Dimension

- **Land Use and Urban Infrastructures:** The basic physical variables considered with urban development in land use, housings, and transportation. If the population decline process further, decline patterns are similar to stories of decline with vacant housings and deterioration of the city center.
- **Suburbanization and City Center Redevelopment:** The suburbanization has a certain effect on the industrial city decline is European countries and the US, thus, included as a common phenomenon of cities after growth. This trend detected with the population by district and inflow and outflow of population. The city center redevelopment considered with the significant local government projects with the co-existing issue of suburbanization.
- **Brownfield Renovation:** Physical development of large Brownfield and old infrastructures remains as the unique problem of the industrial city after the de-industrialization.

2.5 Conclusion

2.5.1 Summary

This chapter reviewed two major areas of study as theoretical background that is the industrial city discourse and urban transformation theories.

Industrial city discourses also demonstrated the growth, decline, and transition of the industrial city. As the growing city, in general, has been studied from 19C industrial urbanization, decline and transition are the relatively new theme from urban studies. The recent effort in finding commonalities on factors, process, and problems of the decline of industrial cities combined with shrinking discourses that similarities exist among declining cities regarding population. Despite the negative vision and scenarios increased in industrial cities, there are a group of researchers focus on planning the future of these cities and acknowledging the potential of transition. A successful transition story is often introduced in the urban redevelopment field, although very few, with a positive future. Transition strategies might vary, but includes advancement in industries and also confronting new issues and challenges such as aging and consumption related environmental issues. The overview of research trends in urban studies of Japan and Korea showed how industrial sites related to the diverse topic of sustainability and how it changes over time. The sustainable development dimension, not only economic and industrial characteristics but also social and environmental impact can be affecting the city in new development stages.

Later urban transformation theory defined transformation and transition as in the difference between long-term and short-term changes. Various transformation concepts separately indicated the limitation of its growth in industries and urban growth regarding population. However, recent sustainable urban transformation describes the environmental and social aspects how cities are experiencing multiple stages of transition and reaching its sustainable adaptive level despite its quantitative decline.

Overview the two major fields of studies, developed a conceptual framework for setting the relevant indicators. The industrial city-specific characteristics come from industrial city discourse describing in each stage characteristics. Division of stages in the quantification of multiple data adapted from transformation theories. As a result, the conceptual trajectory of industrial city specific transformation is comprehensively showing the series of transition ad in a different dimension. The development stages are divided into five stages of industrialized, growth, peak, decline, and transition. The multidimensional transition level is explaining the different aspects of economic, social, and environmental, and physical dimension. The new framework enables to revalue the industrial city despite quantitative decline the growth of different dimension will follow and reach its new system equilibrium.

2.5.2 Application of Framework

The study views the transformation process in various dimensions, and this will integrate the sustainable development at the city level in each chapter. Therefore, the conceptual framework is applied in steps by adding the variables found from the analysis. From Chapter Three, the decline is defined as the population and secondary industrial change to identify the relation between industrial decline and population change at the city level to use the common variables to detect the declining trend of the industrial city and with the available collection data.

The multi-dimensional variables defined at the city level analysis in Chapter Four, which requires the multi-variables to explain the detailed process of industrial city transformation. The collected data from the case city (Kitakyushu City, Japan) which describes the urban economic, social, and environmental condition will enable to understand the change over time. Identifying the critical turning point in each dimension the city transformation process will be captured not only by population and industries, but also the impact of social and environmental factors in urban development. The process will imply the balance of sustainable development dimension.

After identifying the multiple related variables in previous chapters, the overall framework applied in Chapter Five. First, with transformation variables the study analyzes the current status of Korea cities and select the cities in similar phases. Then, in-depth analysis with multi-dimensional variables found in Chapter Four in the case cities (Pohang City and Yeosu City) to find the commonality and difference in its transformation phase, factors, and process. The comparison of two cities and Japan case cities as advanced case city will show the modified version of industrial city transformation paths as a result.

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Chapter 3 Demographic Patterns of Industrial Cities in the US, Japan, and the Republic of Korea

CHAPTER THREE
DEMOGRAPHIC PATTERNS OF INDUSTRIAL CITIES IN THE US, JAPAN, AND THE REPUBLIC OF KOREA

3.1 Introduction

Chapter three identifies the common trend of industrial city decline in the US, Japan, and Korea. In this chapter, Transformation of industrial cities is described with two main factors, industrial transition, and population change. Based on the national industrial transition theory, the chapter confirms the impact of de-industrialization and population change patterns at the city level and analyzes the relevant factors for decline and transition. Analysis consisted three parts: first to identify de-industrialization timeframe for each country and compare at the city level, secondly find a relation between industrial characteristics and population change patterns, and compare demographic patterns of industrial cities in three countries. Statistical data are collected the 1960s to 2010 at the city level in each country for two major variables, manufacturing employment and population. The result created a typology from industrial dominance, type, structure and population size, and change.

3.1.1 Background

Industrial city decline is a re-known problem of in the most of the advanced industrial countries. The main factors for the decline of industrial cities are due to a globalized economy that industrial production is moving to oversea or close down after losing industrial competitiveness from labor cost. Therefore, the decline of industrial cities in developed countries has tightly related to the period of massive growth of industrial cities in later industrialized countries. In this context, current industrial cities will expect the upcoming challenges for the decline and transition in the future. Accordingly, the theory of national industrial transition explains the dynamic of industrial transition and population growth from economic advancement.

Based on the transformation of the industrial city, the hypothesis of the industrial transition and population change at the urban level. **Figure 3-1** explains the theories of industrial transition and population growth at the national level. The growth of secondary industries brought the fast growth of the city population. The population reaches the peak level of development during the increase in tertiary and quaternary employment. National de-industrialization period is the point of secondary industry decline when the industrial cities are no longer the place of production and economic driving force. How de-

industrialization will affect the population change of the cities hasn't been yet theorized from the transformation theories. **Figure 3-2** shows Hypothesis on demographic changes of industrial cities at the point of de-industrialization. Industrial cities in which highly concentrated secondary industries will show different paths of population change at the point of deindustrialization. Due to its lacking industrial advancement cities would experienced decline along with pre-existing industries. The time national de-industrialization will be a critical turning point for the cities whether to remain competitive in growth with advance industrial development or further decline with population outflow. Therefore, measuring the impact of de-industrialization at the city level by looking into the patterns of population changes will enable to identify the trend of industrial city decline and transition.

3.1.2 Objectives

The main objective of this chapter is to find the common trend of population changes of an industrial city in the comparative global perspectives. Based on the hypothesis of a correlation between industrial transition and population development, the study aims to theorize industrial city transformation with empirical evidence. The study includes following sub-objectives: First, create a typology of industrial cities from industrial characteristic and population change to standardize comparison among different 'city' context. Then, identify the relation between characteristics of the cities and population changes to find the factors related to its decline and transition. Lastly, compare the commonalities and differences among the trend of different countries.

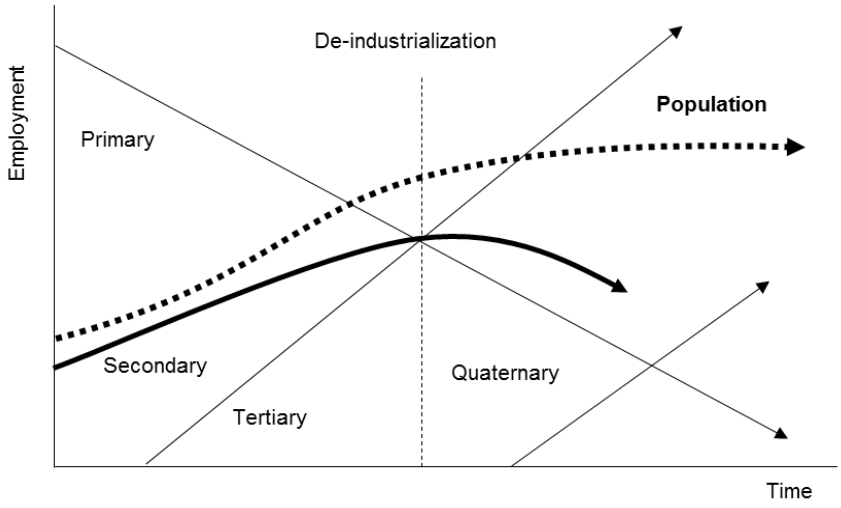


Figure 3-1 National Level Industrial Transition and Population Development

Source: Retrieved from Clark, 1940; Rostow, 1960; Northam 1970

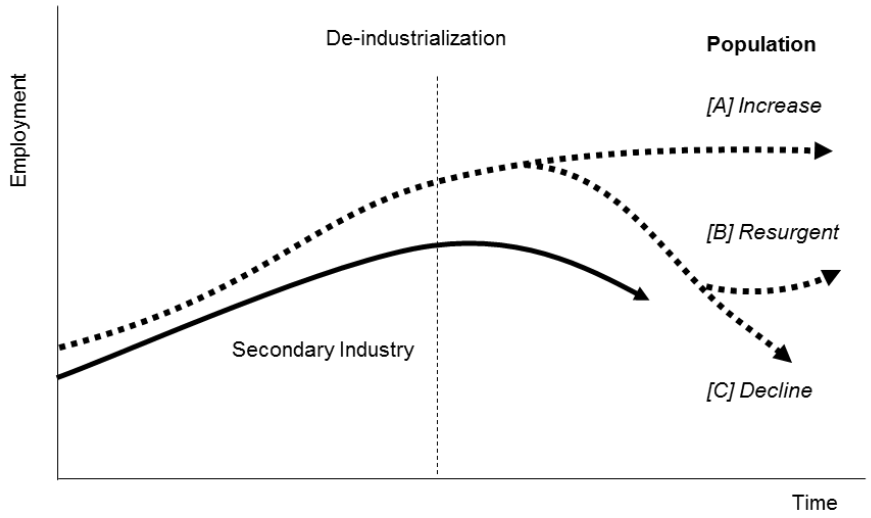


Figure 3-2 Hypothesis on the Demographic Changes Scenarios at City Level

3.1.3 Data and Methodology

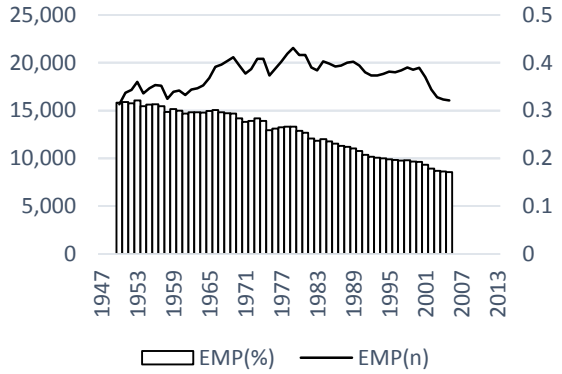
The study compares the US, and Japan, and Korea from 1960-2010. Statistical data collected from 1960-2010. Created typology with the classification of cities.

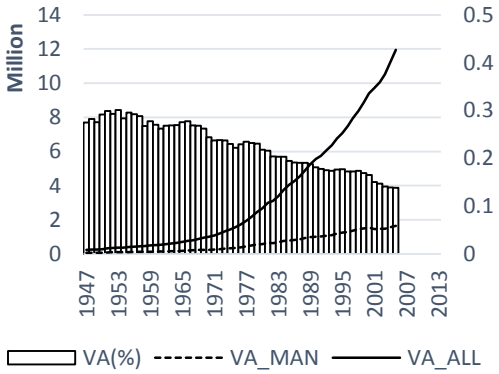
3.1.3.1 Selection of Countries

Three countries-the US, Japan, and Korea-are selected to identify transformation of industries in the different level of de-industrialization referring to national economic advancement. US and Japan have been dominant manufacturing producers since post-war era. Among OECD countries (Pilat et al. 2006). As the US and Japan classified as high-income countries, Korea is in 'Fast-growing, middle-income countries) according to UNIDO classification of countries by industrial development phases from 1975-2000 (UNIDO 2009). Korea, industrial development started in the 1970s and recognizable after post-war period among the East Asia countries (UNIDO 2009; Haraguchi & Rezonja 2010).

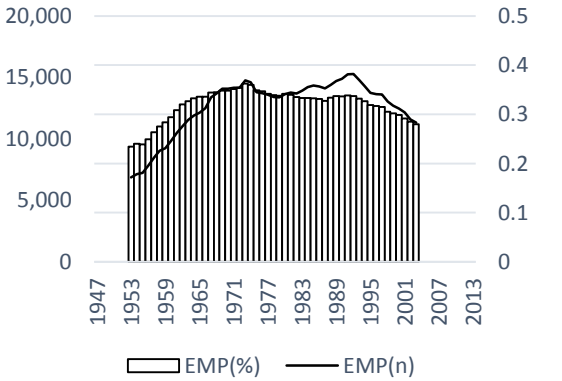
According to manufacturing employment and value added data shown in **Figure 3-3**, the US, Japan, and Korea have a close relation between each 20 years gap between the peaks of industrial development. See Figure 3-3. The manufacturing employment percentage shows the peak level in the US before the 1950s, Japan from 1960 to the 1980s, and Korea in the 1990s. The percentage of manufacturing value added shows similar peak level as the US in 1950, Japan in the 1970s, and Korea reaching till 2010. Japan shows a steady relative decline in employment compared to two other countries while the peak value of Korea which not yet confirmed from the data.

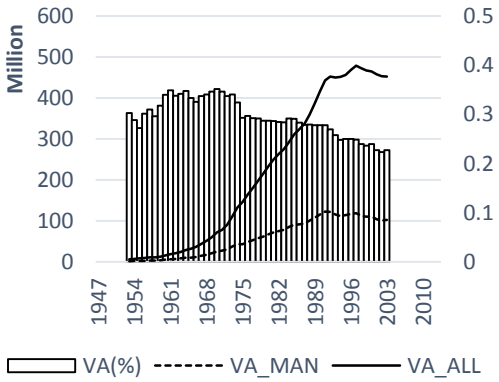
US



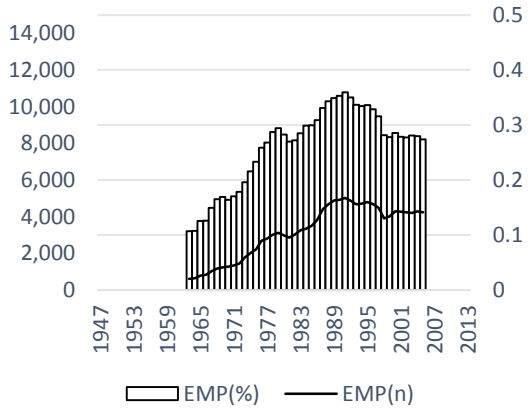


Japan





Korea



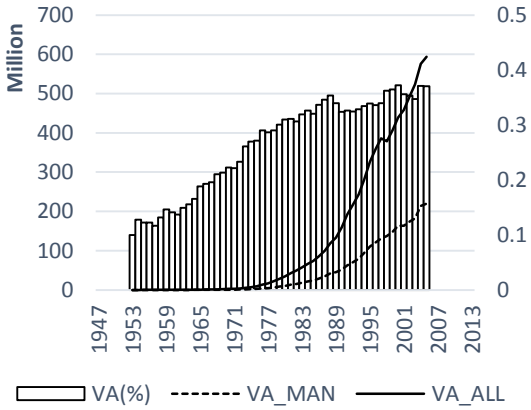


Figure 3-3 Manufacturing employment and value added in US, Japan, Korea (1947-2007)

Source: STAN Indicator(OECD, 2011)

3.1.3.2 Range of Data

Statistical data of industrial variables and population are collected at the city level in each country from 1950 to 2010 from available data.

As 'City' is defined by the statistical scope of each country. The US, the term 'city' refers to the incorporated place with a population of 100,000 or more in the statistical years. Japan 'Shi' or Korea 'Si', in general, designated town with a population over 50,000 and over, 60% population living at city center, over 60% employment in secondary and tertiary industries.

Cities are selected based on two criteria: 1) maximum industrial level that the percentage of manufacturing employment over 30% [1]and 2) maximum population over 100,000 during the selected period. Total 297 case cities are selected (US 95, Japan 148, and Korea 54).

Table 3-1 shows the selected number of cities – ***See Appendix 3-1 and 3-2***

Table 3-1 Selection of Cities

	US	**Japan**	**Korea**
Total	963	787	84
Excluded	795	598	13
Included	168	188	71
Selected	95	148	54
Percentage (%)	56.54	78.72	76.05

[1] Clark (1940) defines the industrialization level of 20% employment in secondary industries at the national level. Engle & Longworth (2012) define the industrial cities: population at least 50,000; manufacturing accounting at least 25% of the total; in 1960s US. The level of 30% of manufacturing employment is set regarding higher average in Japan and Korea at city level.

3.1.3.3 Variables

Table 3-2 shows all data source by country and year with two variables of population and manufacturing employment.

1) Population

The population is an indicator of urban change. In the case of an industrial city, transition population decline is mainly caused by economic restructuring in the region where turning points for industrial decline and increase or relatively stable stages are resurgent cities. If analysis confirms the population at the declining level, the significant urban problems occur. Therefore, population changes is an important consequence of industrial transition in the local area as much as it can influence on urban economic condition (Turok & Mykhnenko 2008).

Using population data is also due to data availability at city level which is difficult obtain economic data and urban indicators across different countries. Demographic data, however, changed with city boundary changes are considered.

2) Manufacturing Employment

The study uses the manufacturing labors for de-industrialization of at the city level. Employment often declines with the productivity increase but at the urban growth, the percentage represents the relative portion between service industries.[2]

[2] Manufacturing employment decline can be also explained by rapid growth in manufacturing productivity. However, the more important reasons seem to be losing the competitiveness in global and rising imports.

Table 3-2 Data Source

		Years							Source	Description
		1950	1960	1970	1980	1990	2000	2010		
US	Population	●	●	●					County and City Data Book 1944-1977	: Cities 25,000 or more through 1944
					●				County and City Data Book 1983, 1986	: 957 incorporated cities 25,000 inhabitants or more in 1980
							●		County and City Data Book 2007	: 1,265 incorporated places of 25,000 or more population as of April 1, 2000
								●	County and City Extra 2013	
	Manufacturing	●	●	●					County and City Data Book 1944-1977	: *Percentage* of (%) extractive industries, construction, manufacturing
					●				County and City Data Book 1983	: 1980 Employed in Manufacturing (%)
						●			County and City Data Book 1994	: Civilian Labor Force, percent employed in [3] manufacturing (%) 1990, manufacturing employees 1987
									County and City Data Book 2007	
							●	●	County and City Extra 2013:	Annual Metro, City, and County Data Book Extra 2013
Japan	Population		●	●	●				Census	Cities with 100,000 or more as of the 1980 Census date
					●	●	●	●	Statistics Bureau (Online)	All Cities: [A] Total population (person)
	Manufacturing	●	●	●					Establishment and Enterprises	Showa 26 year (1951): Showa 35 year (1960): Showa 44 year (1969): [2] No. of Workers All Industries A-L [F] Manufacturing (18-39) Intermediate Classification >> 2nd Industry (D+E+F)
					●	●	●	●	Statistics Bureau (Online)	All Cities: No. of Employees (N/A) [C] Persons at work in manufacturing establishments (person) [F]
Korea	Population			●	●	●	●	●	Census	All Cities: Population
	Manufacturing			●	●	●	●	●	Korean City Statistics: Establishment and Employment	No. of establishment and employees, by industry, by size (annual) -KSIC 8th, (1971-2000), KSIC 9th (2004-2006, 2007-2011)

3.1.3.4 Typology

Dividing Industrial characteristics into two different categories: type of manufacturing industry (light, heavy, high-tech, or mixed), and composition (singular or diversified). Cluster analysis is used to interpret the trajectory of the percentage change in population over time. Types of pollution changes are divided into three categories: 1) increase (continued increase and peak), 2) decline (continued decline, recent decline, and slow down), and 3) other patterns (fluctuate or steady).

1) **Industry Dominance**

   Used the percentage of manufacturing employment for dominance of industries. Each of average value differs from the countries which might be due to the data.

2) **Industry Type**

   According to ISIC rev4. C. Manufacturing. Light industries include food, beverage, tobacco, textile, apparel, leather, wood, furniture, paper, and printing (C10-18). Heavy industries include coke and petroleum, chemical, pharmaceutical, rubber, plastic, non-metal, basic and fabricated metal, machinery, equipment, motor vehicles, trailers, transport equipment (C19-30) except computer, electronics, and optical (C26) as Hightech Industries. The dominance of industries is defined over 60% of total industries.

   Power et al. (2008), Kaminer (2009), and Zimmerman (2013) highlighted the severe decline of industrial cities with heavy industries in Europe and the US.

3) **Industry Composition**

   The study uses both Huff index and DS index for measuring the diversity of industries. Huff index is for the weight of employment concentration and on the DS is capturing the variety and number of industries. With a total number of industries (j), if the Huff index value ($1/j<d<1$) is close to one it means more diverse, on the other hand, the DS ($1<d<J$) close to one means more concentrated in singular industry.

Herfindahl index [3]

$$D^h{}_{i,t} = \sum_{j=1}^{J} \left(\frac{\sum_{j,i,t}}{\sum_{i,t}} \right)^2 , \frac{1}{J} \leq D^h{}_{i,t} \leq 1$$

i :Region
t: Time
j: Industry

$\left(\frac{\sum_{j,i,t}}{\sum_{i,t}} \right)$ = j (%)

Close to 1 = Singular
Close to $\frac{1}{J}$ = Diversified

Employment Weight

Dixit-Stiglitz (DS) index

$$D^s{}_{i,t} = \left(\sum_{j=1}^{J} \left(\frac{\sum_{j,i,t}}{\sum_{i,t}} \right)^{\frac{1}{2}} \right)^2 , 1 \leq D^s{}_{i,t} \leq J$$

i :Region
t: Time
j: Industry

$\left(\frac{\sum_{j,i,t}}{\sum_{i,t}} \right)$ = j (%)

Close to 1 = Singular
Close to J = Diversified

Numbers of Industry

4) Population Size

The population is divided into four groups based on the size. Large cities are classified with over 1 million and cities over 500,000 to 1,000,000; medium sized cities from 200,000 to 500,000; and small cities from 100,000 to 200,000.

5) Population Change

The study divides the population change rate into decrease (-) and increase (+) by ten year period. The study measured a rapid as the population change rate over 10% in 10 years or over 5% change in 20 years, either decrease or increase and captured the change rate has from any of the criteria the category belongs to 'fluctuate' and 'steady (low rapidness)'.

[3] Ades and Glaeser, 1999: Retrieved from Sangheon Lee (2011), *Industrial Diversity and Frictional Unemployment*, The Bank of Korea, Economic Analysis 17.2. 2011 [Vol.17 No.2]

Table 3-3 Typology of Industry and Population Characteristics

Category		Variables	Contents
Industrial Characteristics	Dominance	Manufacturing Employment (%)	Number workers in manufacturing industries / Total employment
	Type	Light Heavy High-tech Mixed	Man. Emp. over 60% in type, if not Mixed
	Comp.	Singular Diverse	Huff Index DS Index
Population	Size	Metropolitan Large Medium Small	10 (1million or more) 5 (500,000 - 1mil) 2 (200,000 - 500,000) 1 (100,000 - 200,000)
	Change	Decline Increase Fluctuate	Percentage change (+/-) of population in10 year period

3.2 Analysis

3.2.1 Basic Statistics

The analysis first showed basic statistics with industry and population category from the previously created typology. First, give the overall description of the data set and then compared the industrial characteristics and population characteristics from the US, Japan, and Korea.

3.2.1.1 Industrial Characteristics

Table 3-4 shows the number of cities by industry type and composition.

The overall data set shows the majority number of cities are in Diverse (215 cities) and Mixed (117) group. Among the individual category, the majority group is Mixed (117), and Heavy Diverse (59) follows. Heavy industrial city group (101) is larger than the light industrial city group (71). There are a similar number of cities in the Light-singular group (36) and Light diverse (35). The number of cities in Heavy-Diverse (59) is larger than Heavy-Singular (42).

Findings by comparing of each country are:

a) All three countries show dominance in Diverse type

The US (61cities, 64.2%), Japan (115 cities, 76.5%) and Korea (39, 70.9%).

b) The US shows dominance in Heavy and Light Industries while Japan and Korea cities dominate in Mixed and Heavy Industries

The US has the largest group in Heavy (38, 40.0%) and Light (32, 33.7%) second, Japan has Mixed (68, 45.3%) and Heavy (43, 28.7%) and Korea also Mixed (26, 47.3%) Heavy (20, 36.4%) in order.

c) The US, Light industries show more diverse types, Heavy industries in the singular, opposite to the case of Japan and Korea, light-singular type shows dominance while heavy diverse is in dominance

The US have 19 cities in diverse while 13 in the singular in light industries, on the other hand, 20 cities in singular and 18 diverse in heavy industries. Light industries are often older industrial cities in textile industries in case of US. Light industries often include Agra-food manufacturing and traditional craft manufacturing in Japan. Korea also shows food-manufacturing in Agra-food and fishery town. In the case of heavy industries, Japan and Korea cities include diverse type possibly related to the development of the mixed industrial complexes.

Table 3-4 Number of Cities by Industry Composition and Type[4]

	Composition		Industry Type			
	S/D	**Count**	**Light**	**Heavy**	**High-tech**	**Mixed**
Total	Singular	85	36	42	7	0
	Diverse	215	35	59	4	117
	Total	297	71	101	11	117
US	Singular	34	13	20	1	
	Diverse	61	19	18	1	23
	Total	95	32	38	2	23
Japan	Singular	35	18	14	3	
	Diverse	115	16	29	2	68
	Total	148	34	43	5	68
Korea	Singular	16	5	8	3	
	Diverse	39	0	12	1	26
	Total	54	5	20	4	26

[4] Due to data availability of historical years, the number of cities is missing in the data. See Appendix.

3.2.1.2 Population Characteristics

Table 3-5 shows the number of cities by population size and change.

In the case of population size, the majority of cities (total 136 cities, 78.3%) is included in small and medium sized groups (population 0.1-0.2 million). The major group for population change pattern is increase group (150 cities, 50%), followed by Decline group (113cities, 37.7%), and Fluctuate group (37cities, 12.3%).

Findings by comparing of each country are:

a) **All three countries, Metropolitan areas are in increase**

   Countries have a similar number of cities in Metropolitan group: US (8 cities), Japan (8cities), and Korea (9cities). Population group of 1million shows an increase in the US (4, 50%), Japan (5, 62.5%), and Korea (6, 66.7%). In the case of metropolitan areas, often the temporal decline is caused by suburbanization trend.

b) **US cities have the majority of cities in Decline which especially noticeable from 0.5million group**

   Cities in decline (41, 43.2%) is larger than other groups. Decline is especially dominant from US 0.5million group (9, 64.3%) opposite from Japan and Korea shows dominance in increase for the same population group: Japan (10, 66.7%) and Korea (9, 90.0%).

c) **More than half of Japan and Korea cities are still experiencing growth**

   The majority of cities included in increase group Japan (92, 61.3%) and Korea (33, 60.0%), while US has a smaller group in an increase (25, 26.3%). Small cities in 0.2-0.1 million groups in Japan and Korea also shows dominance in increase which also differs from the US.

d) **Fluctuating and steady types are mostly evident in US cities**

   The US shows the major group in Fluctuate (29, 30.5%) compared to Japan (3, 2.0%) and Korea (2, 15.4%). Mostly the analysis result detected a fluctuation in a smaller size of cities, as 0.2-0.1 million group.

Table 3-5 Number of Cities by Population Group and Change

	Population Group		Population Change		
	N*100,000	**Count**	**Decline**	**Increase**	**Fluctuate/Steady**
Total	10	25	9	15	1
	5	39	15	21	3
	2	115	41	62	12
	1	121	48	52	21
	Total	297	113	150	37
US	10	8	3	4	1
	5	14	9	2	3
	2	24	9	7	8
	1	49	20	12	17
	Total	95	41	25	29
Japan	10	8	3	5	-
	5	15	5	10	-
	2	68	24	43	1
	1	59	23	34	2
	Total	148	55	92	3
Korea	10	9	3	6	-
	5	10	1	9	-
	2	23	8	12	3
	1	13	5	6	2
	Total	54	17	33	5

3.2.2 Statistical Analysis

3.2.2.1 Correlation

Table 3-6 shows the result of correlation analysis. The percentage of manufacturing level is different among countries (0.597). Industry type and country (0.225), and also with manufacturing percentage (0.199) have small relevance. Heavy industry, in general, has higher levels of industrial concentration. The result is also relevant to the relationship with the highest manufacturing percent and singular industrial composition (0.354). Selected variables have shown a Pearson correlation significant at 0.01level. Population change and industry type have relevance significant at 0.05 levels.

For the full list of correlation results, ***See Appendix 3-3.***

Table 3-6 Correlation (Selected Results Only)

Variable 1	Variable2	Correlation	Significance Level
Country	Industry Type	.255**	0.000
Country	Industry Dominance	.597**	0.000
Industry Type	Industry Dominance	.199**	0.001
Industry Type	Population Change	-.144*	0.049
Heavy/Light	Singular/Diverse	.354**	0.000

1. Pearson Correlation is significant at the 0.01 level (**) and 0.05 levels (*)
2. Correlation analysis result of all variables sees Appendix

3.2.2.2 Cross Tabulation Analysis

Table 3-7 shows the number of classified cities by six types of industrial characteristics and seven patterns of population change.

1) Industrial type of population change

a) Light-Single and Light-Diverse group increase in the US while the decline in Japan and Korea

Light-diverse group, an increase in the US and the recent decline in Japan, no Korean cities in this type of group. The US 26 cities out of 53 (48.6%) in increasing, 14 cities (26.6%) in steady, 13 cities (24.8%) in decline. Japan 28 cities (39.9%) in increase, 22 cities (31.5%) continuous decline, 20 cities (28.7%) recent decline. Korea 4 cities (47.4%) decline, three cities (36.8%) recent decline, and one city (15.8%) growing.

b) Heavy-Single or Heavy-Diverse group decline in the US while increases in Japan and Korea

Compare population growth and decline for three countries time order. The heavy-diverse group, no fluctuate. US 18 cities out of 34 (52.1%) are declining. Japan 32 cities out of 50 (63.1%) are on the increase. Korea 17 cities out of 27 (61.4%) are recent declining.

c) Mixed group increase and Fluctuate found in the US

The US 10 cities out of 24 (41.2%) are steady but varies with increase and decline for both 7 (29.4%). Japan 28 cities out of 48 (57.6%) are on the increase. Korea 17 cities out of 27 (61.4%) are in recent decline.

d) High-tech mostly increasing: Japan decline and recent decline, possibly due to national population decrease

Population change patterns relevance to industrial type. US (US 1940 data don't include the relevant classification type). Japan 6 cities out of 12 (48.1%) decline, five cities out of 12 (40.7%) increase. Korea all three cities are increasing.

Table 3-7 Number of Cities by Industrial and Population Typology

US	Population/Industry type	LS	LD	HS	HD	MX	HT	Sum	%
1	Continued Growth	3	7	4	2	4	2	22	23.2
2	Peak	1						1	1.1
3	Recent Decline							0	0.0
4	Continued Decline	4	4	9	13	7		37	38.9
5	Slowdown		1	1		4		6	6.3
6	Recovery	2	5	5	3	7		22	23.2
7	Steady	3	2	1		1		7	7.4
	Total	13	19	20	18	23	2	95	
	%	13.7	20.0	21.1	18.9	24.2	2.1		
Japan	**Population/Industry type**	**LS**	**LD**	**HS**	**HD**	**MX**	**HT**	**Sum**	**%**
1	Continued Growth	5	11	6	20	27	1	70	47.3
2	Peak	3	2	1	2	8	2	18	12.2
3	Recent Decline	5	2	2	3	18	1	31	20.9
4	Continued Decline	4	1	5	4	10	1	25	16.9
5	Slowdown					1		1	0.7
6	Recovery	1		1				2	1.4
7	Steady					1		1	0.7
	Total	18	16	15	29	65	5	148	
	%	12.2	10.8	10.1	19.6	43.9	3.4		
Korea	**Population/Industry type**	**LS**	**LD**	**HS**	**HD**	**MX**	**HT**	**Sum**	**%**
1	Continued Growth	2		4	8	14	4	32	59.3
2	Peak	1			1			2	3.7
3	Recent Decline			3		4		7	13.0
4	Continued Decline	1			3	6		10	18.5
5	Slowdown							0	0.0
6	Recovery	1		1				2	3.7
7	Steady					1		1	1.9
	Total	5	0	8	12	25	4	54	
	%	9.3	0.0	14.8	22.2	46.3	7.4		

2) Population change of industry type

a) Continued growth in the US (Light-Diverse) and Japan and Korea (Mixed and Heavy)

A large number of cities are included in continued increase and continued decline. In the increase group, mixed industry type is the highest both in Japan and in Korea; however, light-diverse type in the case of the US. Among continued growth, the US cities, light industries (singular 3, divers 7). Japan also shows light industries (singular 5, diverse 11) in growth, but most are in mixed industries (27 cities) and similar amount of heavy industries are in continued growth (singular 6, diverse 20). Korea shows mixed (14 cities) and heavy industrial cities (singular 4, diverse 8) in growth.

b) Continued Decline in Heavy industry type in the US while Japan and Korea in Mixed

The decline group in the US has the largest number of heavy industrial cities (singular 9, diverse 13); on the contrary heavy industry type cities are dominant in the increase groups in Japan and Korea. Declining heavy industrial type exists in Japan (singular 5, diverse 4) and in Korea (singular none, diverse 3).

c) Recent decline and Peak for all type of cities in Japan (all types) and Korea for Mixed and Heavy

Two variations of increase group, peak and recent decline, are largely evident in Japan. Mixed industries are dominant in peak (8 cities) and in recent decline (18 cities). Light industries and heavy industrial cities also peak (singular 1, diverse 2) and recent decline (singular 2, diverse 3) and are in Japan. In case of Korea, heavy singular (4 cities) and mixed (4 cities) at recent decline while heavy diverse (1city) in peak.

d) Slowdown, Recovery, and Steady shown in US with Mixed, Heavy, and Light industries

US cities show the pattern of slowdown, recovery, and steady fluctuation; light-diverse and mixed type is dominant among them. Slowdown have mixed (4 cities) and light diverse (1cities) and heavy singular (1 cities) Recovery shows from mixed (7cities) light diverse (5cities) and heavy singular (5cities) as well. Steady shows light industries (singular 3, diverse 2).

3.3 Demographic Patterns of Industrial Cities in US, Japan, Korea

3.3.1 Trajectories

Conceptual diagrams of population change patterns (line) and the change of manufacturing industries (bar); and the example of case cities and aggregated graphs of individual cities. See **Figure 3-4**.

The population scale is 0 to 1, the highest level as 1 at the peak year10. The typology indicates diverse paths of demographic change.

3.3.2 Scatter

The scatter graph visualizes the shift and pattern over the years to understand the trend of decline of industrial cities. **Figure 3-5** shows the distribution of cities in the dimension of industrial change (x) and population change (y) for 20 years. Due to the data available, the Japan and Korea only show from the 1970s.

From the graphs, the cities are distributed in four different dimensions

Industrial Urbanization	Population (+) Manufacturing (+)	Right, Upper Dimension
Transition	Population (+) Manufacturing (-)	Left, Upper Dimension
Decline	Population (-) Manufacturing (-)	Left, Below Dimension
Reversed	Population (-) Manufacturing (+)	Right, Below Dimension

The first of Industrial Urbanization (right upper dimension), manufacturing employment percentage is higher at the beginning of city development in the case of industrial urbanization, while industrialization, the start of industrial production will create employment in the local area. The second Transition (left upper dimension) implies de-industrialization, as the city grows the percentage will decrease due to its tertiary industrial growth. The impact of the manufacturing, industrial decline can lead to population decline, in the case of third Decline (left below dimension) capturing the decline of industrial cities. Finally, in other case Reversed (Right below dimension), the population is declining, but manufacturing, industrial percentage might grow, which relatively indicates the decline without de-industrialization, factors such as suburbanization or population decline.

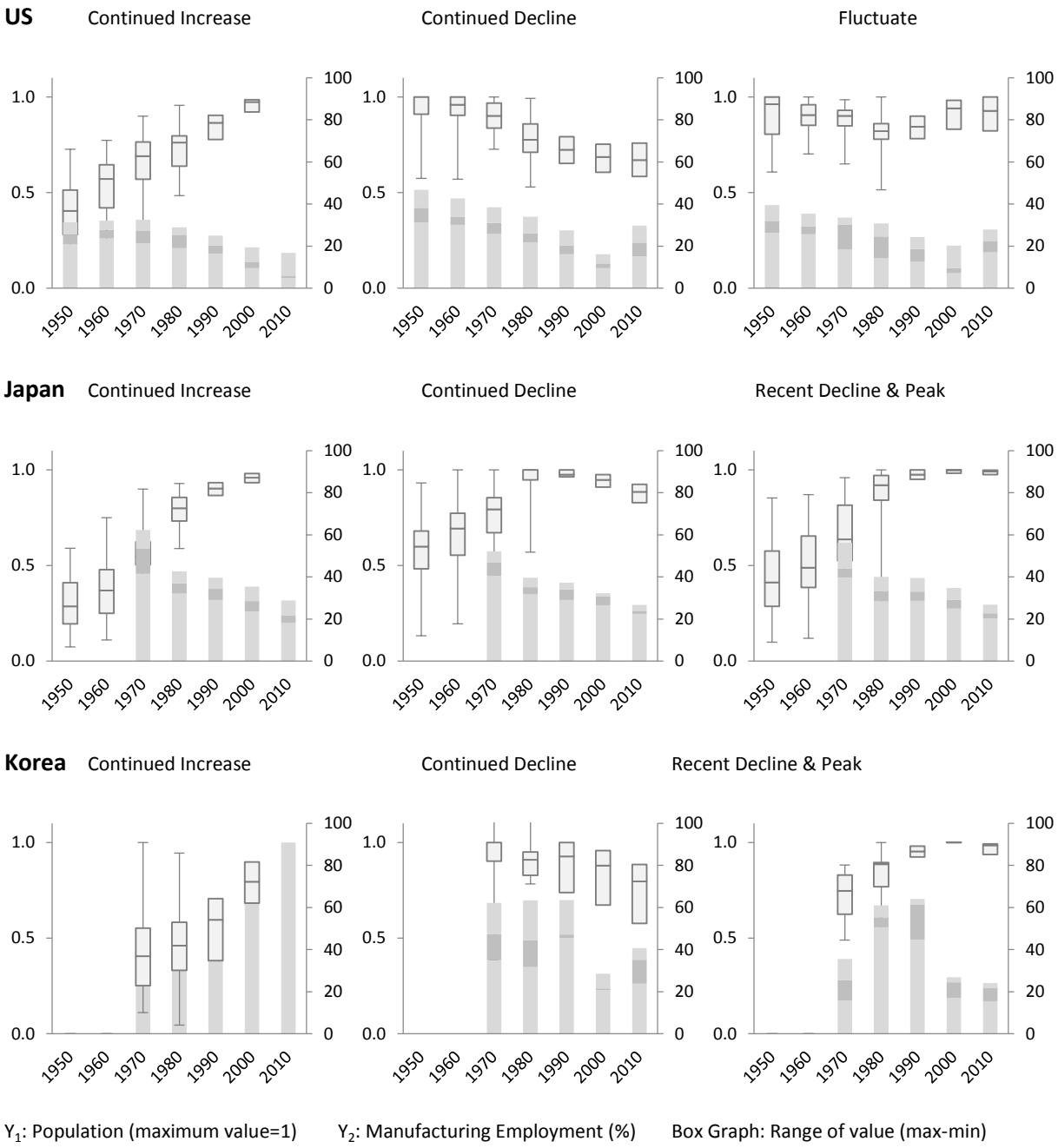


Figure 3-4 Trajectories of Population and Industries of US, Japan, Korea (1960-2010)[5]

[5] For each graphs of cities in group A-B-C-D by each country, see Appendix

As a result, US shows more diverse scatter patterns over the years. The result shows the difference by the different context of city development in larger territories compared to the size of Japan and Korea. However, majority shifted in manufacturing decline from the 1970s and also shows the range of population decline shown as the increased number of cities below zero on the Y axis. Japan shows a steady decline with the smaller size of scattering in 1990-2010. Compare with the pattern of US scatter, cities show a unified trend of decline in both manufacturing and population. Korea has its manufacturing, industrial growth and population growth from between 1970-1990 and shifted pattern of the decline of manufacturing from 1990-2010 shown by the majority of cities located in minus on the X axis.

The scatter graph also shows how Korea has a fast transition between the 1970s to the year 2010. From growth to decline, this reflects the fast economic growth and development.

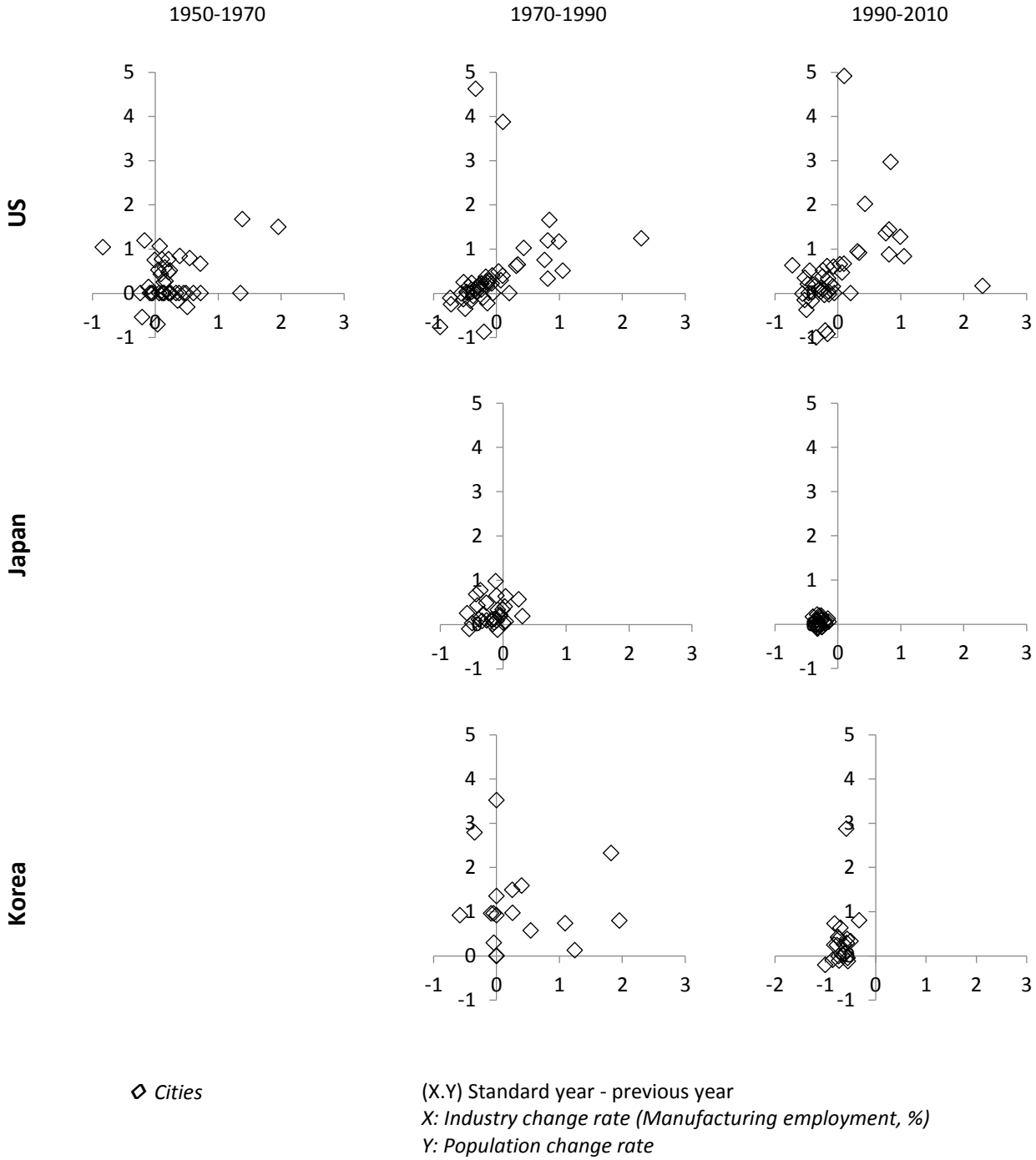


Figure 3-5 Trends by Industry-Population Dynamic in National Level, 20 Years Span

3.3.3 Groups and Example Cities

3.3.3.1 Continued Increase

Cities in the continued increase group follow a typical growth model that manufacturing industries decline with the relative growth of the service sector, and increase in population. Large cities over 1 million in the population are mostly in continued increase group in all three countries. In the US, cities newly developed in the 1960s with mixed or high-tech industries were increasing, while Japan, the number of heavy or mixed industries types is relatively high because the location of the national industrial complex. 'Company cities' in Heavy-Singular type are also increasing in Japan. Korea cities show a similarity with Japanese cities while large cities over 1 million are sustainable growing, and smaller cities with heavy and high-tech industrial cities are also on the increase. A few cities with a high concentration of light or heavy manufacturing industries maintain their business over time in the US, and also in Japan with food and traditional craft manufacturing.

a) **Light Singular:** the US Cities industrial decline and population growth has minus correlation in Japanese cities (Miyazaki and Shizuoka) rapid growth during 1970-1980. Korean cities (Jeonju and Eujoengbu) radical drop in 1990-2000 after continuous exponential population growth since 1970s.
b) **Light Diverse:** Large cities (Pheonix, Los Angles, and Dallas in the US; Sapporo, Sendai, and Fukuoka in Japan) increase. Nashville-Davidson decline from the 1950s, the rapid increase in 1960s and increase, an industrial decline from 1970s. Tampa shows slight decline from 1970-1980. Lexington, Waco, recent industrial increase from 1990
c) **Heavy Singular:** Large cities (Chiba, Japan; Gwangju, Ulsan, Changwon, Korea) growing since the 1970s. *Detroit exceptional decline from the 1950s. *Kitakyushu at its peak level decline from the 1980s. Toyota, Hirataka exponential growth in 1960-1980s. Changwon's unusual growth 2010 due to integration Siheung growth in the 1990s raised to the status of a city. Gwangju, Geoje recent increase in industry
d) **Heavy Diverse:** Longbeach, Japanese cities 1960-1970s, fast growth, Korean cities 1980 newly developed cities as bed town near Seoul metropolitan area, Kyung-gi province such as Asan and Pyungtak recent increase in industry.
e) **Mixed:** Large cities increase while San Diego, Houston lower 30% manufacturing percent, Hiroshima, Incheon, Daejun over 50% at some point, Wichita industrial fluctuate, 1980s population growth with other sector business, Joliet increase from 1990s, University city growth from 1980s, industrial increase during 1980-2000.

Table 3-8 List of Cities in Continued Increase

US			Japan						Korea		
PG	IT	City	PG	IT	City	PG	IT	City	PG	IT	City
10	M	Los Angeles	10	HD	Yokohama, Kanagawa	2	HD	Yamato,	10	M	Incheon
10	HD	Houston	10	HD	Nagoya, Aichi	2	M	Atsugi	10	M	Daejun
10	HT	San Diego	10	LS	Sapporo, Hokkaido	2	HS	Kanagawa Ageo Saitama	10	HD	Gwangju
10	LD	Dallas	10	HD	Kobe, Hyogo	2	HS	Ota, Gunma	10	HD	Ulsan
5	HT	San Jose	10	M	Hiroshima, Hiroshima	2	M	Gunma Gunma	5	M	Seongnam
5	LD	Columbus, OH	5	HD	Chiba, Chiba	2	HT	Chofu, Tokyo	5	M	Cheongju
2	HD	Long Beach	5	LD	Hamamatsu, Shizuoka	1	MX	Suzuka, Mie	5	LS	Jeonju
2	HS	Wichita	5	LD	Okayama, Okayama	1	HD	Itami Hyogo	5	MX	Cheonan
2	LD	Santa Ana	5	MX	Funabashi, Chiba	1	HD	Yachiyo Chiba	2	HD	Pyungtak
2	LD	Lexington	5	M	Hachioji, Tokyo	1	LD	Uji, Kyoto	2	HT	Gumi
2	HS	Baton Roudge	5	HD	Kawaguchi, Saitama	1	M	Kodaira Tokyo	2	M	Wonju
2	LS	Greensboro	5	HD	Himeji, Hyogo	1	LS	Izumi Osaka	2	M	Chuncheon
2	LD	Durham	5	M	Matsuyama, Ehime	1	HD	Toyokawa Aichi	2	M	Yangsan
2	M	Glendale	5	M	Utsunomiya, Tochigi	1	M	Hino, Tokyo	2	HS	Geoje
1	LD	Winston-Salem	2	M	Matsudo, Chiba	1	M	Anjo, Aichi	1	HT	Icheon
1	HS	Newport News	2	M	Nishinomiya, Hyogo	1	LS	Tomakomai	1	HD	Jinhae
1	M	Aurora	2	LD	Kurashiki, Okayama	1	HD	Sakura, Chiba			
1	M	Joliet	2	HD	Oita, Oita	1	LD	Matsuska, Mie			
1	LS	Cedar Rapid	2	M	Ichikawa, Chiba	1	M	Narashino Chiba			
1	HS	Inglewood	2	HD	Toyama, Toyama	1	LD	Nagareyama			
1	LS	Manchester	2	HS	Toyota, Aichi	1	HD	Kawanishi			
1	LD	Green Bay	2	HD	Fujisawa, Kanagawa	1	MX	Hyogo Oyama Tochigi	**Recent Increase**		
			2	MX	Hirakata, Osaka	1	M	Higashimurayama	10	HD	Changwon
			2	M	Kashiwa, Chiba	1	M	Iruma Saitama	10	HT	Suwon
			2	LS	Ichinomiya Aichi	1	HD	Komaki Aichi	5	HT	Yongin
			2	LD	Toyohashi, Aichi	1	HS	Kariya Aichi	5	HD	Bucheon
			2	HD	Okazaki, Aichi	1	LD	Fujieda Shizuoka	5	HD	Ansan
			2	M	Takasaki, Gunma	1	HS	Seto Aichi	2	HD	Gimhae
			2	HD	Kawagoe, Saitama	1	LD	Fujinomiya	2	HD	Shiheung
			2	M	Tokorozawa Saitama	1	LD	Kisarazu Chiba	2	LS	Eujeongbu
			2	M	Koriyama, Fukushima	1	LD	Kashihara Nara	2	M	Paju
			2	M	Otsu, Shiga	2	HD	Yamato	2	MX	Gunpo
			2	MX	Koshigaya Saitama	2	M	Atsugi	2	MX	Asan
			2	HD	Yokkaichi, Mie	2	HS	Kanagawa Ageo Saitama	1	M	Guri
			2	M	Kasugai, Aichi	2	HS	Ota, Gunma	1	HD	Osan
			2	HS	Ichihara Chiba	2	M	Gunma Gunma	1	M	Euwang
			2	HD	Hiratsuka, Kanagawa	2	HT	Chofu, Tokyo	1	M	Hanam
			2	LS	Fuji Shizuoka	1	MX	Suzuka, Mie			
			2	M	Soka Saitama	1	HD	Itami Hyogo			
			2	HD	Chigasaki, Kanagawa	1	HD	Yachiyo Chiba			
						1	LD	Uji, Kyoto			

PG: Population Group, IT: Industrial Type – based on typology

a) **Hightech:** All industrial decline and minus correlation. San Jose shows industrial increase peak in the 1980s with population growth. Gumi shows a recent increase in industrial growth with the high-tech transition from light industries.

3.3.3.2 Peak or Recent Decline

The cities reaching population peak or recently declining are evident in Japan. These cities are mostly a small population group (0.1-0.2 million) in growth, but reduce the growth rate over time. The result reflects Japan's trend of national population decline.

a) **Light Singular:** Japanese cities including Hachinohe, Morioka, Obihiro, Yamaguchi, and Aomori.
b) **Light Diverse:** Japanese cities, population growth from 1950-1980, rapid 1970-1980, RD due to national population decline. BD: Increase-Steady or Peak—LD Kyoto, Shizuoka, Mito, Kakogawa, Takamatsu, Miyakonojo increase in the 1970s and steady, an industrial decline from 2000, possible future decline. BD: Increase- Steady or Peak. Quincy industry peak in the 1960s, the population increase from 1970, slight decline or steady, irrelevant industrial development Yao increase, slight decline or steady
c) **Heavy Singular:** Only Japanese and Korean cities in Recent Decline. Japanese cities (Kurume, Sayama) have (-) correlation with and.decline and population growth. Yeosu, Pohang industrial decline in 1990-2010 recent population decline detected. Gunsan declined first in the 1990s and recent industrial development places through 2000-2010
d) **Hightech:** Japanese cities at peak, Daegu recent decline

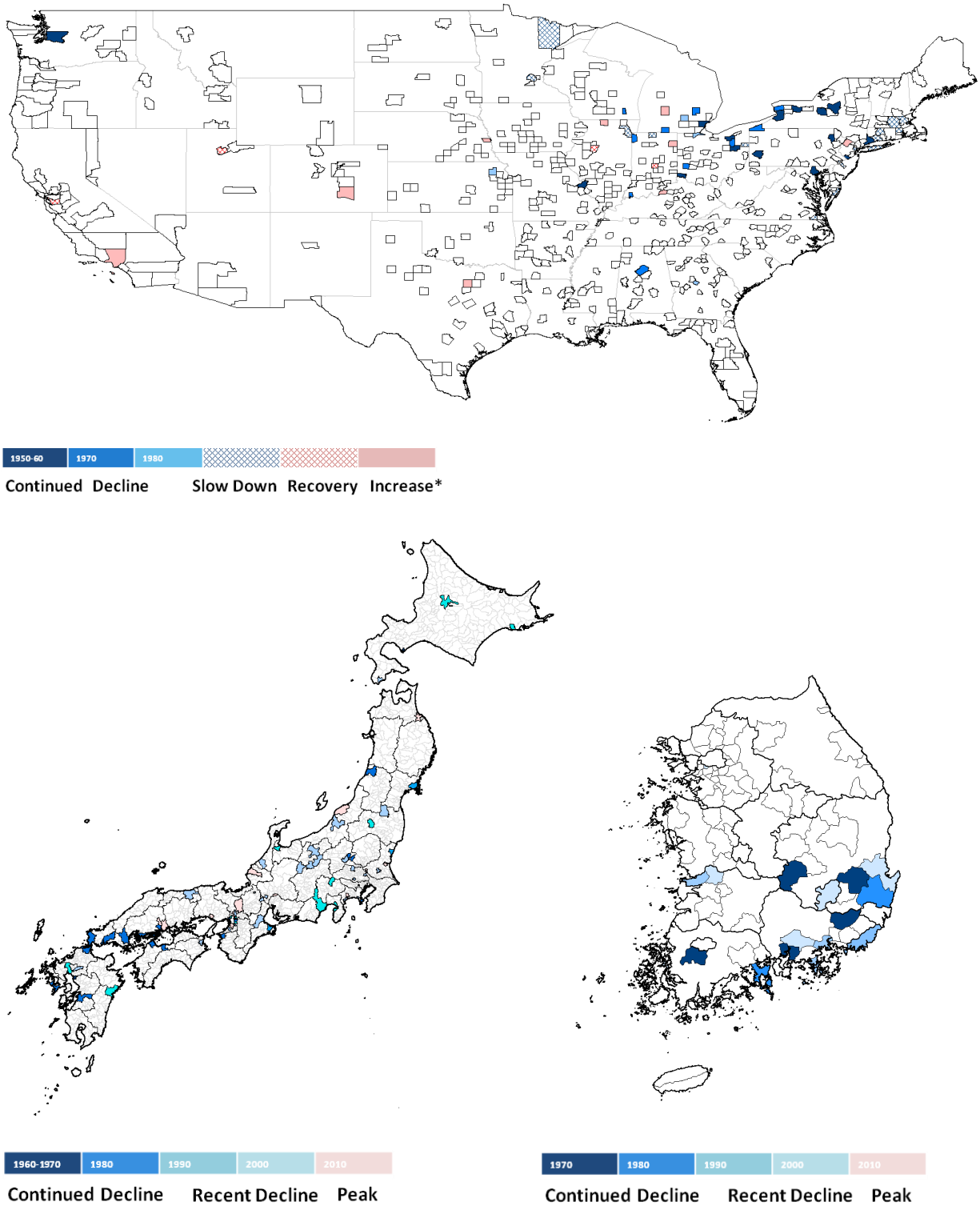


Figure 3-6 Location of Cities in the US, Japan, and Korea

3.3.3.3 Continued Decline

Most dominant declining cities in the US are in heavy-singular type cities declined earlier from the 1950-1960s. Japan's heavy industrial cities have also been in decline since the 1960s also found in mixed and high-tech industries. Korea, heavy industrial cities in decline, while detecting the recent decline. In Korea, recent industrial development is seen in the cities that already had a population decline in the past and often developed new manufacturing industries as a strategy to bring new economic benefits in the region. Cities with light-singular type industry is the fishery or agro-industry with dominant food manufacturing and population decline detected due to decline in primary industries. Cities often have port and shipbuilding industries together in the region. **Table 3-8** shows the cities in decline group.

a) **Light-Singular:** Japanese cities (Hakodate, Kushiro, Hirosaki, Ishinomaki, Nobeoka) have been declining since1980s, Otaru, Hokkaido have been declining since the 1960s, Korean cities (Nissan, Gongju, Namwon) has been declining since the 1970s, Seoul Metropolitan Area decrease in population from the 1990s due to suburbanization.
b) **Light-Diverse:** US cities (Philadelphia, St.Louis, Rochester, Trenton, Scranton) declining from 1950s, (Akron 1960s, Richmond 1970s) Richmond also shows decline-growth-decline in 1970s, industries decline from 1970s, Rochester recent and. Increase, Japanese cities (Kiryu, Onomichi, Imabari, Yasuhiro) decline from the 1980s.
c) **Heavy-Singular:** US cities rapidly decline from the 1950s (Birmingham, Dayton, Gary, Flint, Youngstown, Canton). More gradual decline Portsmouth from the 1960s, Lansing from 1970s. Japanese cities (Nagasaki, Yokosuka) peaks in 1980-1990s and decline till now Muroran continuously declines from the 1970s. Korea, only Samchuck is declining from the 1970s.
d) **Heavy-Diverse:** Cleveland, Buffalo, Pittsburgh, Syracuse, Toledo (1970) decline from the 1950s Small cities (P1) Hammond, Erie in rapid decline; Bridgeport (1950), Evansville relatively gradual, peak in the 1960s. Amagasaki (1970), Kure (1980), Fukuoka (1960) continuous decline, Numazu gradual decline. Jeongup decline from the 1970s, Masan industrial development during 1970s and decline from 1990s.
e) **Mixed:** US cities (Baltimore, Cincinnati, Milwaukee, Niagara Falls) decline from 1950s, Japanese cities, gradual decline from 1980s, possibly due to national pop.dec., Korean cities, continuous decline from 1970, Busn (1980s) with industrial decline Sacheon, Gimcheon (1980s) and.development.
f) **Hightech:** Japanese city, Moriguchi 1970s, Hitachi from 1980-1990s declining.

Table 3-9 List of Cities in Continued Decline

US			Japan			Korea		
PG	IT	City	PG	IT	City	PG	IT	City
10	HS	Detroit	10	HD	Kitakyushu, Fukuoka	10	M	Busn
5	HD	Baltimore	5	HD	Amagasaki, Hyogo	2	HD	Masan
5	HD	Cleveland	5	HS	Nagasaki, Nagasaki	2	HD	Gyungju
5	MX	Saint Louis, MO	2	HD	Yokosuka, Kanagawa	2	HD	Gunsan
5	HD	Milwaukee	2	M	Wakayama, Wakayama	2	M	Naju
5	HS	Pittsburgh	2	M	Shimonoseki, Yamaguchi	1	M	Gimcheon
5	HD	Buffalo	2	HD	Kure, Hiroshima	1	M	Milyang
5	HD	Cincinnati	2	M	Neyagawa, Osaka	1	M	Youngcheon
2	HD	Toledo	2	LS	Kushiro, Hokkaido	1	M	Sacheon
2	HS	Birmingham	2	HT	Hitachi, Ibaraki	1	LS	Tongyeong
2	LS	Rochester	2	HD	Omuta, Fukuoka			
2	LS	Akron	1	LS	Imabari, Ehime			
2	HS	Dayton	1	M	Takaoka, Toyama			
2	LD	Richmond	1	LS	Ishinomaki, Miyagi			
2	HD	Syracuse	1	MX	Moriguchi, Osaka			
1	HS	Flint	1	M	Onomichi, Hiroshima			
1	HS	Gary	1	M	Iwakuni, Yamaguchi			
1	HD	Bridgeport	1	HS	Muroran, Hokkaido			
1	HD	Evansville	1	HS	Nobeoka, Miyazaki			
1	HS	Erie	1	LD	Yatsushiro, Kumamoto			
1	HS	Lansing	1	LS	Kiryu, Gunma			
1	M	Trenton	1	M	Ise, Mie			
1	LD	Scranton	1	M	Matsubara Osaka			
1	HS	Canton	1	HD	Niihama, Ehime			
1	HD	Hammond	1	M	Sakata, Yamagata			
1	M	Niagara Falls						
1	LS	Utica						

PG: Population Group, IT: Industrial Type – based on typology

3.3.3.4 Resurgent or Recovery

a) Light-Single: Example cities are Boston, Minneapolis, Des Moines, St.Paul, Providence, Grand Rapids, Chattanooga, and Salt Lake City. Salt Lake City (1980s) and Grand Rapids (1990s), Chattanooga, Springfield shows industrial fluctuation.

b) Mixed: Chicago (1950-1990) decline steadily and Osaka (1960-1980) shows a decline to recent increase. Peoria decline from the 1970s while slight increase during 1970-1980. Jersey City, Newark, New Heaven, and Duluth decline steadily while Camden shows steady and decline. Other hand, Seattle experience industrial and population decline during 1960-1980 and transformed in the 1980s. Oakland and Worchester showed gradual decline and gradual increase in the 1980s. In Japan, Iwaki, decline in the 1960s and recovers from 1970

c) Hightech: New York, Fort Worth, Omaha, and Memphis,show decline in the 1970s possible due to deindustrialization (except New York). The population increase more than previous level, which Louisville (1960s) and Springfield (1980s) also decline and increase. Industrial decline in Louisville (1970s) is the example of economic restructuring

Table 3-10 List of Cities in Peak, Recent Decline, Fluctuate, Steady

US			Japan			Korea		
PG	IT	City	PG	IT	City	PG	IT	City
1	LS	Columbus, GA	10	LD	Kyoto, Kyoto	10	LS	Seoul
			5	HD	Sakai, Osaka	10	M	Daegu
Fluctuate		**US**	5	M	Niigata, Niigata	5	HD	Anyang
10	LD	New York City	5	MX	Shizuoka, Shizuoka	5	HS	Pohang
5	M	Indianapolis	5	HD	Higashiosaka Osaka	2	M	Jinju
5	LD	Fort Worth	2	HS	Fukuyama, Hiroshima	2	HS	Gwangmyung
5	M	Seattle	2	MX	Toyonaka, Osaka	2	HS	Yeosu
2	LS	Omaha	2	MX	Nagano, Nagano	2	M	Iksan
2	M	Oakland	2	MX	Takatsuki, Osaka	2	M	Mokpo
2	LD	Louisville	2	MX	Maebashi, Gunma			
2	LD	Providence	2	HS	Kurume, Fukuoka			
2	HS	Fort Wayne	2	M	Fukushima Fukushima			
2	LS	Yonkers	2	HD	Akashi, Hyogo			
2	M	Worcester	2	M	Nagaoka, Niigata			
1	MX	Grand Rapids	2	MX	Tsu, Mie			
1	MX	Salt Lake City	2	M	Yao Osaka			
1	LD	Chattanooga	2	LS	Fukui, Fukui			
1	HD	Rockford	2	LS	Tokushima, Tokushima			
1	HD	Elizabeth	2	LD	Kakogawa Hyogo			
1	HS	Dearborn	2	MX	Ibaraki, Osaka			
1	HS	Burbank	2	LS	Hachinohe, Aomori			
1	HS	Pueblo	2	LS	Saga Saga			
1	HD	Davenport	2	MX	Matsumoto, Nagano			
1	LD	Kansas City	2	LD	Kasukabe Saitama			
1	LS	Macon	2	HT	Fuchu, Tokyo			
			2	HD	Numazu, Shizuoka			
			2	M	Kumagaya Saitama			
Steady		**US**	2	LD	Yamanashi Kofu			
2	LD	Des Moines	2	M	Tottori Tottori			
1	M	Springfield	2	M	Odawara, Kanagawa			
1	LS	Paterson	2	LS	Kishiwada Osaka			
1	LS	New Bedford	1	MX	Kamakura, Kanagawa			
1	LD	Allentown, PA	1	MX	Mitaka, Tokyo			
1	HS	Waterbury	1	M	Hadano Kanagawa			
1	LS	Lowell	1	LS	Ashikaga Tochigi			
			1	M	Ueda Nagano			
			1	LS	Ogaki Gifu			
			1	MX	Sayama Saitama			
			1	M	Kakamigahara Gifu			
			1	M	Tsuchiura Ibaraki			
			1	HT	Kadoma Osaka			
			1	LS	Yaizu Shizuoka			
			1	HT	Aizuwakamatsu Fukushima			
			1	MX	Daito Osaka			
			1	MX	Osaka Habikino			
			1	M	Yamaguchi Hofu			
			1	M	Komatsu Ishikawa			
			1	HS	Ikeda Osaka			

PG: Population Group, IT: Industrial Type – based on typology

3.3.3.5 Fluctuate or Steady

Old industrial cities in the US with dominant textile industries declined in the 1950s are included in this group. Most cities have a population in 0.1-0.2 million. However, some cities are growing by making the industrial transition from light industries to heavy, and heavy to high-tech industries also the case in Japan and Korea. Fluctuating of the population in small-sized cities in the US showing a temporal decrease and recovery. Some cities developed critical redevelopment strategies after the economic crisis, creating a different focus on culture, education, and tourism.

a) **Light-Singular**: Augusta experienced decline during 1950 to 1980 then rapid growth during 1980-1990 which might be developed with other business. Knoxville experienced a decline during the 1950s and changed to growth in the 1960s. Tongyeong has developed industry during the 1990s, but with population decline in 1990-2000. Gyungsan experience population decline during the 1980s and regrowth in 1990s. New Bedford is declining from the 1950s, massive industrial decline, relatively gradual decline. Yonkers, Paterson, Lowell dropped manufacturing industries in the 1950s relatively steady
b) **Light Diverse:** Macon, Kansas City decline from 1950s, the rapid increase in the 1960s and decline, probably irrelevant with and.dev. Savannah growth from 1950, decreases 1960, regrowth from the 1970s, decline 1980s; recent and.increase; irrelevant to industrial growth-decline. Cambridge steady
c) **Heavy Singular:** Waterbury (IN DE 1950s), Fort Wayne (1960), Burbank (1970s), rapid grow 1960s rapid decline from 1970s, regrowth from 1980s. Sasebo, Ube declines during 1960-1970s, but regrowth in the 1980s. Seosan declines from the 1970s, but the recent increase in industrial development and regrowth from 2000s. Gwangyang grows from the 1980s due to industrial development and steadily Gimhae declines from 1970-1980 and regrowth from the 1990s, recent industrial development. Pueblo experienced a decline from the 1980s, but steady Ikeda grows in 1960-1970 but steady. South Bend, Dearborn declines from the 1960s, but steady, regrowth in 1990s
d) **Heavy Diverse:** Stamford, Rockford, Davenport (1990), Elizabeth slight decline and regrowth during 1980s Choongju and.dev. And pop. change opposite fluctuates. Higashi-Osaka, Sakai, Toyonaka, Akashi rapid growth in the 1960s and steady. Beaumont, Niihama steady
e) **Mixed:** Indianapolis Inc-Dec-Inc, irrelevant to industries Springfield Dec-Inc-Dec-Steady, but overall pop.ind.decline. Iksan, Donghae increase (1970-1980) -Dec-Inc-Dec, overall decline., and. Opposite fluctuation Paju Dec-Inc-Dec-Inc, Increase in 2000-2010 due to in.dev.
f) **High-tech:** Japanese cities are rapid growth from the 1960s to 1980s, Takatsuki exponential growth, and steady

3.4 Conclusion

3.4.1 Summary

The chapter identified the common trend of industrial city decline in the US, Japan, and Korea. National industrial transition theory, de-industrialization, and population change patterns at the city level and finding relevant factors for decline and transition. Statistical data are collected for two major variables, manufacturing employment and population, from the 1960s to 2010 at the city level in each country. The result created a typology from industrial dominance, type, structure and population size, and change. Cross tabulation analysis was to find the relevance of industrial characteristics to population change. The trajectories of cities are shown in each country and by comparison.

3.4.2 Key Findings

The outcomes indicate common and different aspect of demographic patterns of the industrial city among the US, Japan, and Korea.

1) Typology

a) The study categorized cities into six types of industrial characteristic are Light Singular, Light Diverse, Heavy Singular, Heavy Diverse, Mixed, and High-tech; and seven types of population change Continued Growth, Peak, Recent Decline, Continuous Decline, Slow Down, Recovery, and Steady.
b) Industrial characteristics show dominance in heavy industries in the US, mixed in the case of Japan and Korea. The industrial structure also shows singular in the US and diverse in Japan and Korea, including mixed type which is due to national industrial complex development.
c) Population change shows that the majority of cities are in Continued Growth or Continued Decline. Only a few cases included in Slowdown, Recovery, and Steady is in the US. Recent peak is dominant in Japan. Smaller cities tend to decline on the contrary, large cities over 1million is a continued increase. The result reflects the trend of growth in the mega city as metropolitan region and decline of local and small-sized cities.
d) b) Heavy industrial cities show a major decline in the case of the US, however, a few cases in decline, recent decline, and peak in the case of Japan and Korea.

2) Comparison of the US, Japan, Korea

e) National trends of manufacturing industry peaked in the US from the 1950s, Japan in the 1970s, and Korea in the 1990s. Population growth is also distinctive in these periods. The findings also

show that there is a common decline of industrial cities in three countries. The similarities found in the patterns of industrial urbanization with a certain time gap.

3) Factors for Decline

f) The relevant factors of decline are industrial type, from the massive heavy industrial city decline in the US, and a few advanced cases of decline in Japan and Korea. The historical decline of industrial cities similarly rooted in the flexibility of reformation that the number of cases of decline in heavy industrial cities in the US is enormous.

g) National population trends are also a relevant component for industrial city decline, such shrinking and aging society issues in Japan and population concentration in capital metropolitan areas in Korea. The trend of population decline gives an unfavorable condition for local industrial cities to maintain compatibility.

h) The location of cities shows the population concentration in capital metropolitan in Japan and Korea implying the unfavorable conditions for local cities to maintain its growth in the future.

3.4.3 Factors for Industrial City Decline and Transition

That industrial city decline is relevant to the following factors: industry type, population size, and location of the city.

1) **Industry type** from the heavy industrial city in case of the US, the majority of the city declined regardless of structure singular or diverse. Detroit has been a representative case for industrial city declining, the city having singular structure reaching over 1 million populations. The Kitakyushu City and Busn are the only cities in the same population group as this exceptional case however in the diverse structure of industries.
2) **The singular structure** has been a dominant factor in the case of Japan showing cases of decline in singular structure. The light industries and singular structure show decline of rural cities in related to primary industries such as food manufacturing and heavy singular structure such as shipbuilding.
3) **Population size**, smaller cities tend to decline, in general, the US city's population above 5million cities also shown a continued decline.
4) **The location of the cities** is relevant to decline since the US mostly located in Rust belt area, the Kyushu area in case of Japan, and southern, eastern part of the continent. The result implies how decline is a regional problem as well as national level. In the case of Japan and Korea, national industrial city development during industrialization is now resulting in decline.

3.4.4 Limitations and Connection to Chapter Four

As an attempt to find the common trend of industrial city decline, the study redirects the issue of the severe heavy industrial city decline in the US. Also discovers the similar case of a decline in Japan and Korea expecting the transition in the near future. Assessing the current status of industrial cities would be needed in the future.

Some cases show that population changes are not always the consequences of de-industrialization. The cities are recently in peak or recent decline implies. Therefore, the common industrial decline factors should also consider the population trend in national context

Also, the transformation of industrial cities regarding population changes is short to verify the direct impact of the industrial transition to population changes. Therefore, more detailed analysis at an individual city level will be needed to identify factors for decline and transition.

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Chapter 4 Multidimensional Transition of Industrial City

Kitakyushu City, Japan

CHAPTER FOUR
MULTIDIMENSIONAL TRANSITION OF INDUSTRIAL CITY: KITAKYUSHU CITY, JAPAN

4.1. Introduction

The Chapter Four analyzes transformation of an industrial city at city level with a case of Kitakyushu City, Japan. In the previous Chapter Three, the study identified common trends of population changes of an industrial city in the US, Japan, and Korea. This chapter focuses on a city transformation process in detail with multiple variables to overview the trajectories the series of transitions in sustainable dimension.

The study overviews the timeline of historical urban development and synthesizes the trajectories of changes by applying the conceptual framework explained in Chapter Two. First, determined the stages using both quantitative and qualitative data and determine the stages of transformation. The transition variables classified in each category as economic, social, environment, and physical dimensions and specified, each critical turning point by identifying key events. At the final stage, all dimensions are synthesized to show the transformation trajectories of Kitakyushu City. The study explains the key factors for the decline and transition by connecting relevant interactions among dimensions. This part of the study has its significance in capturing the complex process transformation at the city level by adapting the concept of multi-dimensional transitions.

4.1.1. Background

Sustainable urban transformation theories explained the process and change of urban issues in each development phase and described the stages with relevant economic, social, environmental aspects. However, the previous studies discuss the cities in general that industrial city as a specific type of city in growth is often unidentified with its distinctive feature. Also, the recent decline and transition stages have not been captured from the general development stages. Therefore, by including decline and transition phase of city industrial development and combining multiple dimensions by using various indicators to enhance the holistic view of the transformation of industrial cities. How industrial city transformation connected to sustainable development will be the key question.

Kitakyushu City is a representative case of an industrial city in Japan. Industrialization started early from 19C with mining and steel industry booming the city development during the 1960s. The city became a

major ‘Steel City’ during the 1970s, and industrial production reached its peak until having a hard impact on global oil crisis and faced an economic recession in the 1980s. However, Kitakyushu City became the largest industrial city experiencing decline issue from the 1980s[1]. Many studies on Kitakyushu City find the decline factors, mostly due to economic reason, such as de-industrialization and economic crisis, and the process of decline follows in order as industrial decline, population decline, and urban physical decline. On the other hand, the Kitakyushu City is most often introduced with its successful urban redevelopment measures and becoming “Environmental Model City” in a recent city plan. The story of the city’s transformation process introduced from many aspects. However, the comprehensive understanding of different dimension and identifying the connection between past development and current status of the city have been left out. Therefore, finding the bridge between the historical city developed as an advanced industrial city and development of new city model as an environmental city in a long-term transformation process will be important to imply the potential of the industrial city for its future development.

4.1.2. Objectives

The objective of this chapter is to examine the transformation process at the city level and determine relevant factors for decline and transition by applying multi-dimensional transition framework. Kitakyushu City, Japan, as a case, the analysis follows sub-objectives:

First, find relevant variables to explain the transformation of the industrial city. Second, examine the process of transformation in different sustainable dimensions by applying the conceptual framework. Thirdly, identify factors related to decline and transition by synthesizing multiple transitions.

4.1.3. Data and Methodology

Statistical data of Kitakyushu City is collected from 1960 to 2010. Variables are from applied conceptual framework and used which describe the common characteristics of each stage of industrial city transformation. Some of the specific variables added or used instead due to the data availability.

Timeline of each dimension - economic, social, environmental and physical - is created to determine the key events and critical turning point by using both quantitative data and qualitative data. The quantitative variables identified for its patterns in principal component analysis. The analysis is used to select relevant

[1] Based on the typology from the Chapter, Kitakyushu City is the only city categorized in population group of one million which the largest among 16 cities in Japan in pattern of continue decline of population.

indicators for transformation and identify the trends and changes of statistical data by grouping the similar patterns of changes[2]. As a result, a list of variables is selected for quantitative data is shown in **Table 4-1**. Each phase of development and the critical turning point defined by the quantitative data. However, due to the limitation of quantification trajectories are further explained by using the qualitative data. Quantitative data are referred from city reports, news, previous research, and interviews[3].

Indicators and related issues are classified based on industrial city characteristics and transitional measurement and categorized in economic, social, environmental, physical dimension. Conclusively a synthesis of all dimensions and visualizing the relation between different dimensions enable to identify the key factors for the decline and a new transition.

[2] Table of Rotated Component Matrix and figure of Component Plot in Rotated Spaces are enlisted for detail process of analysis. ***See Appendix 4-1.***

[3] Interview is conducted as a data collection process. Verbal data includes opinions from different local stakeholders group including local government officials, university professors, news paper journalists, and local-global organizations.

Table 4-1 List of Variables of Kitakyushu City

Category		Variables	Unit	Years
Population		Population	Person	1932-2014 (1)
		Population change	(+)(-)	2000-2010 (1)
		Migration	Person	2010, 2011
		Household	Houses	1970-2014 (1)
Economic	Industry	Employment by Sectors	Person, %	1960-2010 (5)
	Manufacturing Industry	Establishment, employment, shipment, value Added	No., Person, Million yen	1963-2013 (5)
	City Economy	Financial Strength Index (FSI)		1980-2011 (1)
		GRDP	Million yen	2000-2010 (1)
		Tax (Income, Expenditure), Tax Debtors		2000-2011 (1)
Social	Social Structure	Age, Gender, Education, Foreign Population	Person, %	1960-2010 (5)
	Social Environment	Unemployment Crime Rate	%	1963-2013 (1)
Environment	Pollution	Air (Dust fall, NOx, SOx, Ox, CO), Water	ppm, tons	1963-2013 (1)
	Environmental Sustainability	Energy use (gas, electricity) Waste management (incineration, landfill, recycle)	m^3, kw/h, tons	1963-2013 (1)
Physical	Land Use	City planning (Industrial, Residential, Commercial)	ha	1960-2010 (5)
		Green area (park area)	ha, %	1960-2013 (1)
	Housing	Type of housing (public, private)	Houses, %	1960-2010 (5)
	Transportation	Mode (air, railroad, ship, monorail)	Passengers, m^2	1963-2012 (1)
		Road pavement	m, m^2	1963-2013 (1)
		Car ownership	Per capita	1963-2013 (1)

4.2. Kitakyushu City

4.2.1. Location and Administrative Boundary

Kitakyushu City located at the North end of Kyushu Island and a pathway to the mainland across the Ganmon strait. The closest city is Shimonoseki by distance, Fukuoka city is nearby. Kitakyushu City administrative seven districts (since 1975) total area 487.89 km^2. The population is 960,000 (in 2015) while the peak of population was 1,060,000 in 1975 and declining since. **Figure 4-1** shows the location and administration boundary of Kitakyushu City.

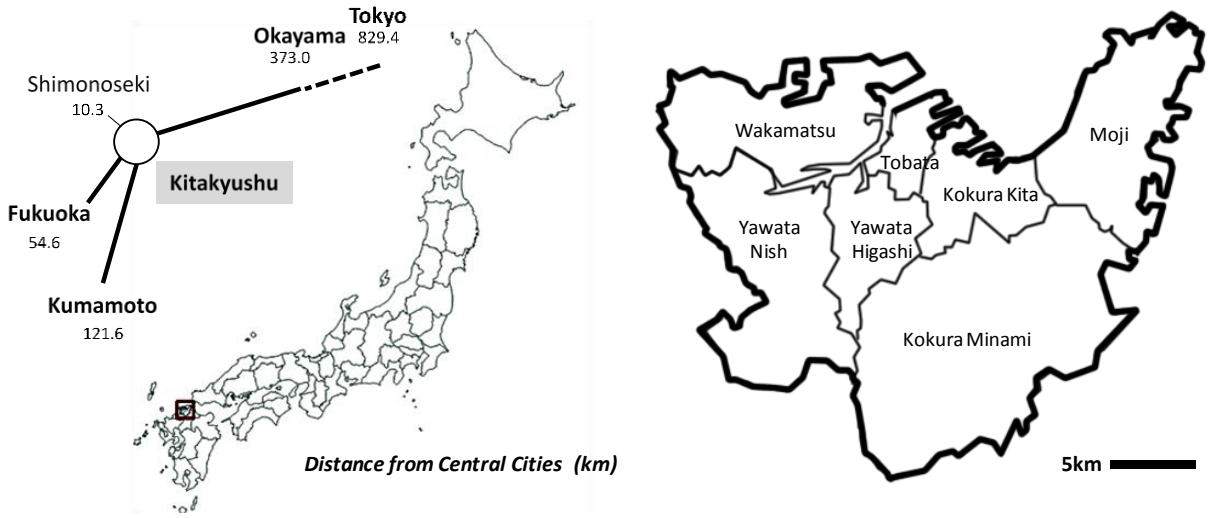


Figure 4-1 Location and Administrative Boundary of Kitakyushu City

4.2.2. Key Administrative Events and Political Background

Kitakyushu City developed early 20C during the national industrialization of Japan. In 1905, the Yawata steel industries started its business in the area, for it became famous for the home ground of steel industries and called as ‘Steel City.' Kitakyushu City became the Designated City in 1963 with the merger of five cities in the region, which now became the individual districts; Kokura, Tobata, Wakamatsu, Moji, and Yawata. The city administration changed in 1974 with the growth of Kokura and Yawata region divided into Kokura Kita (north), and Kokura Minami (south), Yawata Higashi (east) and Yawata Nish (West) remain in seven administrative divisions.

The political background of Kitakyushu City has started from 1963 after integration. The city has two of four-time elected mayor Tani Gohei (enrolled 1967-1986) and Sueyoshi Kouichi (1987-2006) for 20 years each. Mayor Tani Gohei**,** during the development of Kitakyushu City as Industrial City, development of infrastructure and the industrial pollution recovery action was a key issue for planning. The transition stage began with Mayor Sueyoshi Kouichi period when Kitakyushu Renaissance was planned to redevelop a city with agenda of “Environmental city.” In 2007, Mayor Kitahashi Kenji started with Environmental Model City plan for future development of the city.

See Appendix 4-2 for Kitakyushu City Timeline in detail.

4.2.3. Population Trajectories

Figure 4-2 shows the historical development of population and household of Kitakyushu City.

Population development of Kitakyushu City follows four stages of development:

Phase 1 Growth (-1961): Fast growing population post-war period Kitakyushu region's growth to increase over one million in 1961

Phase 2 Peak (1962-1979): Kitakyushu City becomes a city ward in 1963 by the merger of five cities and becomes seven administrative districts by the division in 1975, reaching its peak population of 1,068,415 people in 1979

Phase 3 Early Decline (1980-2004): Population continuously declines until it reached below one million in 2004, and the decline is temporarily recovered from the 1990s, however, continued decline in long-term

Phase 4 Decline by National Population Trends (2005-): Decline is severe in later years in the 2000s, where the shrinking population is a major trend in Japan as national level

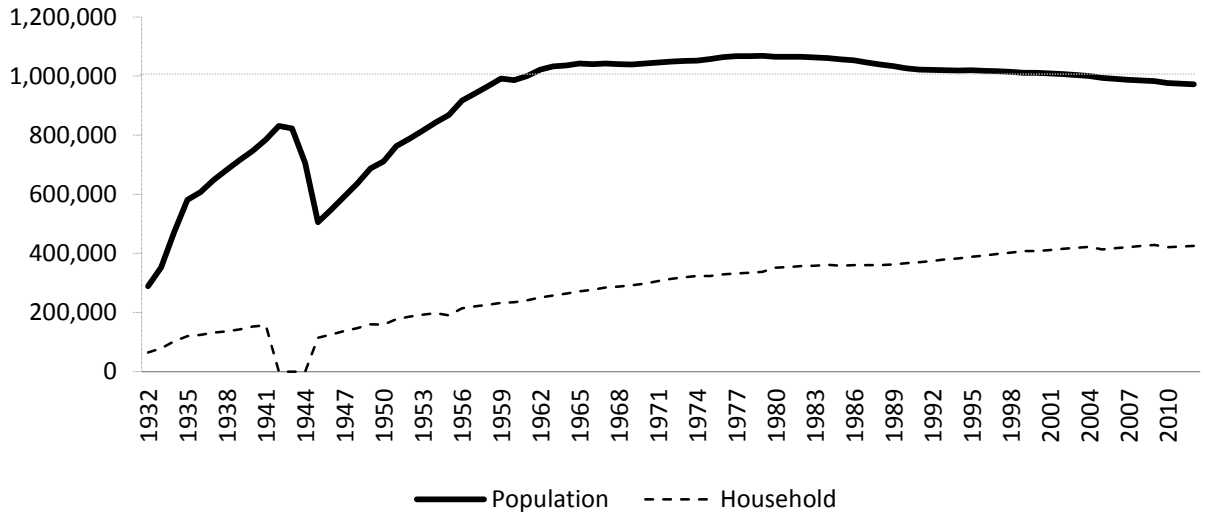


Figure 4-2 Population and Household of Kitakyushu City (1932-2010)

Source: Kitakyushu City

4.3. Multi-Dimensional Transition

The analysis identifies multi-dimensional transition divided into the economic, social, environmental, and physical dimension of changes. Key events and critical turning points explained in each dimension by visualizing trajectories of quantitative data and explanation from qualitative data. A synthesis of all dimensions is showing the complex process of transformation of Kitakyushu City and implies the inter-dimensional effect of factors for decline and transition.

4.3.1. Economic Changes: De-industrialization and City Economy

4.3.1.1. Industrialization to De-industrialization

Industrialization of Kitakyushu City started early 20C locating major companies such as Yawata Steel (1901), Yasakawa Electronics (1915), Toto Ltd. (1917), and Zenrin HQ (1954). Early mining industries decline happened due to energy transition from coal to oil, not only Kitakyushu City but Japan early mining industrial cities experienced a major decline. Figure 4-4 shows the industrial structural changes in Kitakyushu from 1963-2010[4]. The growth of some employment in each industry reaching its peak level and decline further, the industrial transition was successive in forms of advanced industries. Early industrialization brought the city for its identity of the representative old industrial city in Japan.

Kitakyushu experienced major de-industrialization of pre-existing manufacturing industry from the 1970s due to the oil crisis and national economic recession. Industries hard hit from manufacturing employment and massive layoff especially steel and chemical recession, and decline started after the oil crisis in 1973 and 1976 (Mainichi newspaper western headquarters, 2013, 2015). Manufacturing employment further declined after Yawata steel factory move-out to Chiba. Also, Nippon Steel Company and Sumitomo Metals shut down in the region. Mitsubishi chemical-full stop in 1997. However, advanced industrial development started from the 1980s to 1990s; general machinery and electronics began to grow in the region. Nissan Motors 2nd plant (1991) build up. The phases imply how manufacturing industries advance over time and growth of service industries in a specific type. Nevertheless, the employment and economic benefit from the major steel industry was irreplaceable regarding its size.

Service industries grew and exceeded the size of manufacturing employment in 1981. The city had growth in wholesale and retail, finance and insurance which took place from its urban growth. Construction also increased in a similar pattern related to city redevelopment projects during the

[4] Each of the peak level implies the maximum number of employees in the categorized industries, and by identifying the similar changes of group, the average value was defined as phase 1, 2, 3, and 4

Renaissance. The business employment in three industries shows a pattern of decline from 1995 related to the population decline and outflow. The decline of service industries possibly due to the regional competition where companies headquarters moved out to Fukuoka city, the first and very event was, Japan Railway HQ moved out to Fukuoka in 1974, originally located with fixing factory in Moji area. Consequently, the growth of Fukuoka city commercial center affects Kitakyushu City in the less favored area for business in the region.

High-tech industrial development increased with city government plan of promoting science and technology city. During the late 1990s to 2000s, the Renaissance Plan included the vision for having advanced industries with technological improvement. Kitakyushu Science Research Park developed in 2001. The eco-town project increased around 2000 workers in field and 5000 in related business and R&D related to later developing environmental industries[5] as major development strategies. However, the major employment hasn't been identified with the effect of planning that the size of the economy remains smaller compared to that of the industrialized period.

4.3.1.2. City Economy

The de-industrialization firstly hit City economy that unemployment reached its first peak level in 1985. The level of unemployment shows temporal decline but continuously increasing which the labor market is unstable since de-industrialization (**Figure 4-9**). The recent GRDP data implies how the city is in decline process (**Figure 4-8**). However, the Financial Strength Index (FSI)[6] shown in increasing trend in Kitakyushu as tax balance is showing more stabilized after the massive physical redevelopment and construction due to Renaissance plan (**Figure 4-7**).

[5] Based on the inquiry on Kitakyushu City government, the exact data of employment which classified as environmental industry doesn't exists but generally includes the workers of major projects such as Eco-town (1997) and environmental technology and R&D.

[6] The financial strength index is derived by dividing basic financial revenue by basic financial demand. A financial strength index score above 1 shows that financial resources exceed the amount of ordinary allocation tax and hence there is no tax allocation.

Y: Number of employees (person) (Maximum value =1)

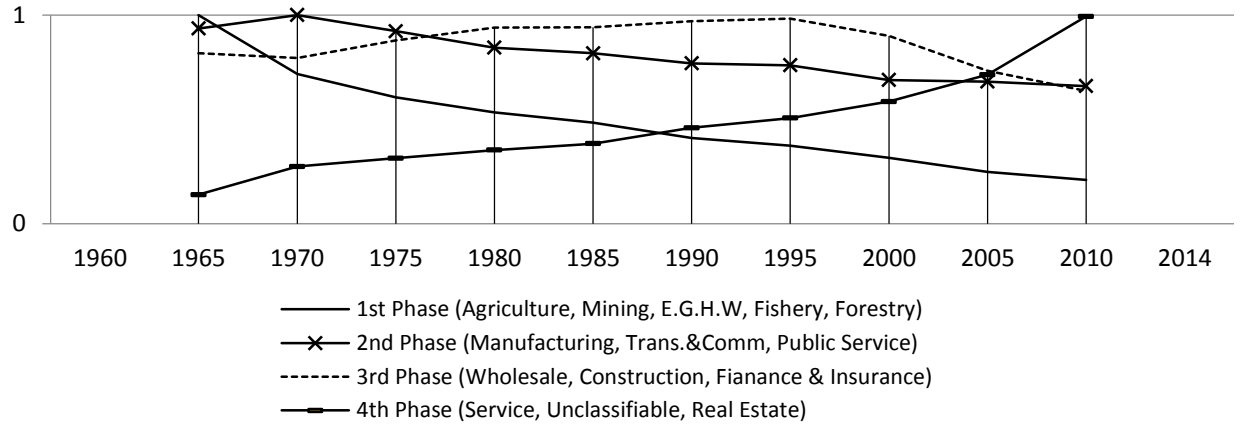


Figure 4-3 Employment by Industry of Kitakyushu City (1965-2010)

Y: Number of employees (person) (Maximum value =1)

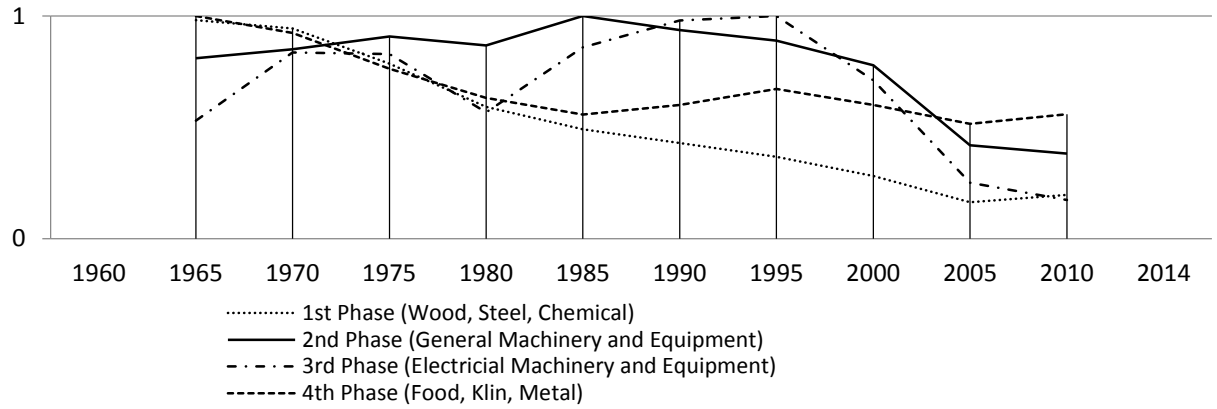


Figure 4-4 Employment by Manufacturing Industry Sub-Category of Kitakyushu City (1965-2010)

Y: Manufacturing industry value added (Japanese Yen) (Maximum value =1)

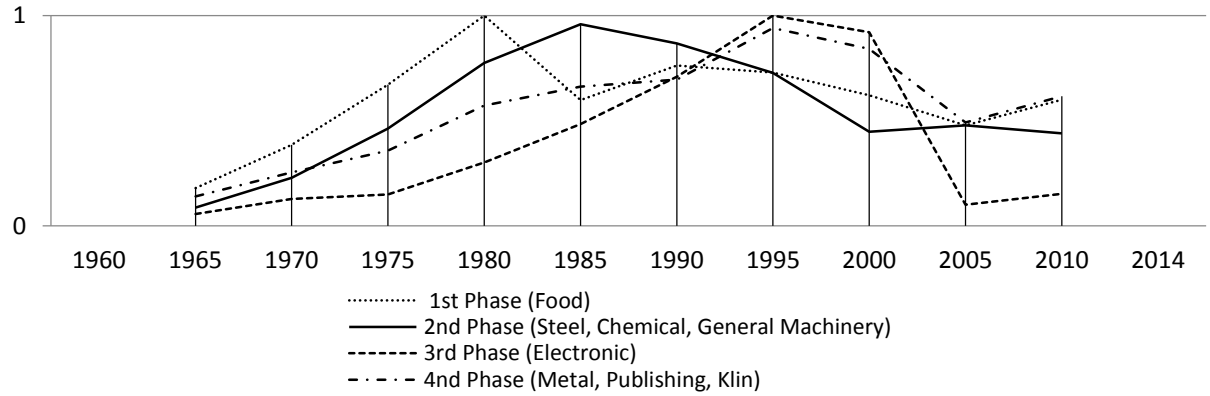


Figure 4-5 Value Added by Manufacturing Industry Sub-Category of Kitakyushu City (1965-2010)

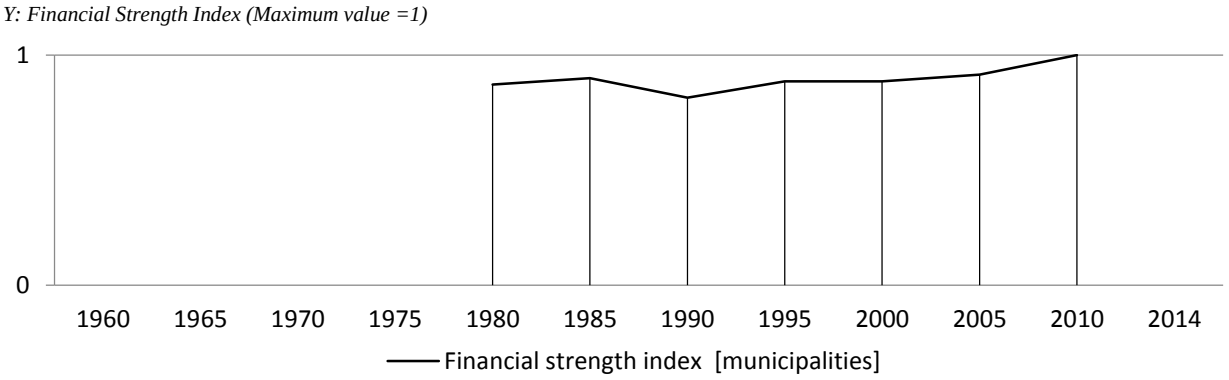


Figure 4-6 Financial Strength Index of Kitakyushu City (1980-2010)

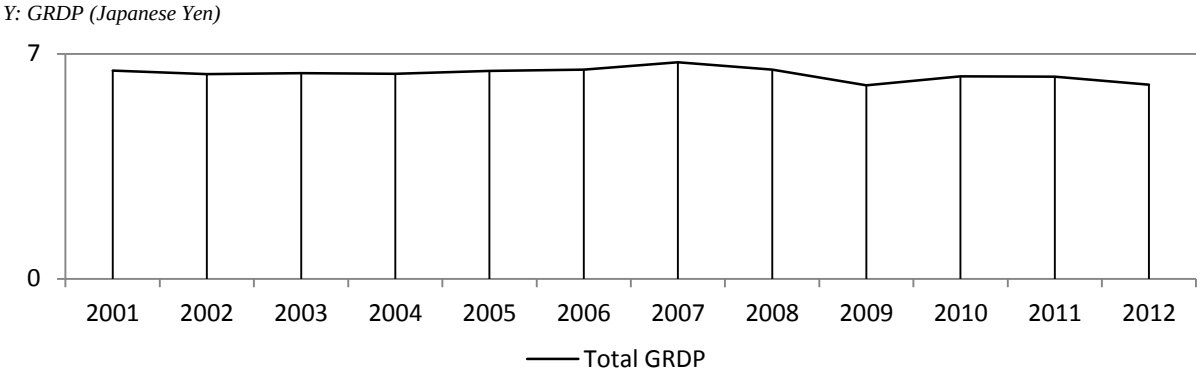


Figure 4-7 Total GRDP of Kitakyushu City (2001-2011)

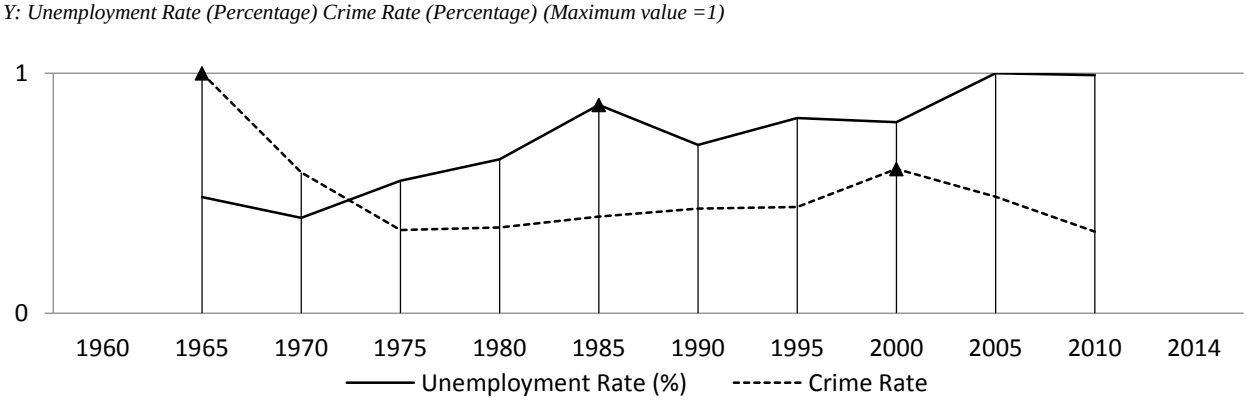


Figure 4-8 Unemployment Rate and Crime Rate of Kitakyushu City (1965-2010)

4.3.2. Social Changes: Population Structure and Social Environment

Social structural changes and social environment are considered variables for the changes. As the city grew with the increase of industrial workers, the dominant male population began from the 1920s and balanced out after the war period. Kitakyushu City, although heavy industrial city the female to male ratio (MF Ratio) shows equivalent until the aging with older female population increased.

Aging issues in the region increased as nationwide decline. Male dominance as heavy industrial cities has been reduced in early stages where. Education level increased in Kitakyushu. Unemployment issues have been due to industrial downturn from the 1970s. Social crime issues have been massive due to the historical development of mining and heavy industries. Gambling rate and gangster issues have been creating negative images for people especially woman and children. (Mainichi newspaper western headquarters, 2013, 2015)

4.3.3. Environmental Changes: Pollution and Waste Management

Pollution has been a major problem from the 1950s where citizens suffered from air and water pollution and health issues. The citizen's action toward environmental pollution was initially from Woman's Association from concern with children's health and started learning and investigate, requested company and city government to take measures. During the 1970s and 1980s local government effort to regulate and to clean the polluted area and private sector's cooperation to reduce pollution with technology innovation - Cleaner Production (CP) – became the factors for the decline of pollution. From 1968 the Air Pollution Control Act and Noise Regulation Act, 1969 a smog alert issued in Japan. By 1980s significant improvements, especially level of dust fall and sulfur dioxide, and water pollution.[7]

However, consumption related substance increase over time. Due to an increase in car use and waste incineration, the increase of car rate during the 1980s and incineration bring the problems in Kitakyushu City with different types of pollutant.

Notable, waste recycling rate increase in Kitakyushu due to its environmental material recycling from building Eco-town [8]in 1997. City government separated garbage collection for cans and bottles in 1993 and designated plastic bag use for municipal waste from 1998 (Kitakyushu City, 2014).

Bai & Imura (2000) classified Kitakyushu City following stages of environmental evolution from phase 1-4. Phase 1 (1955-1970) heavy industrialization due to economic growth, deterioration of environment Phase 2 (1970-1985) reduced significantly for air and water by control and system, use car increase. Phase 3 (1985-1990) raw material industry decline, assembly and service increase, car ownership increase and car pollution control plan, living-environment, urban amenities. Phase 4 (1990- Recent 2000) new urban environmental problems with consumer lifestyle, toxic chemical, and human health issue, municipality recycling-based society.

[7] Kitakyushu City's environmental pollution overcoming history was introduced in OECD in 1985 for 'Gray town to Green town' and city was selected as 'Starry town contest' by Environment Agency in 1987. In 1990 the city received the 'Global 500 Ward' from UNEP the first local government to win the award in Japan. Also selected as 'local government honors award' in 1992 at the Earth Summit in Rio de Janeiro. (Kitakyushu City, 2014)

[8] Eco-town project in 1997 national government first designated in Kitakyushu. Zero emission and material recycling business with industrial revitalization. The project three comprehensive area for education and research (eco-town center in 2001), technology and incubation research collaboration with Kitakyushu Science and Research Park, and business creation.

Y: Pollution Level (ppm) (Maximum value =1)

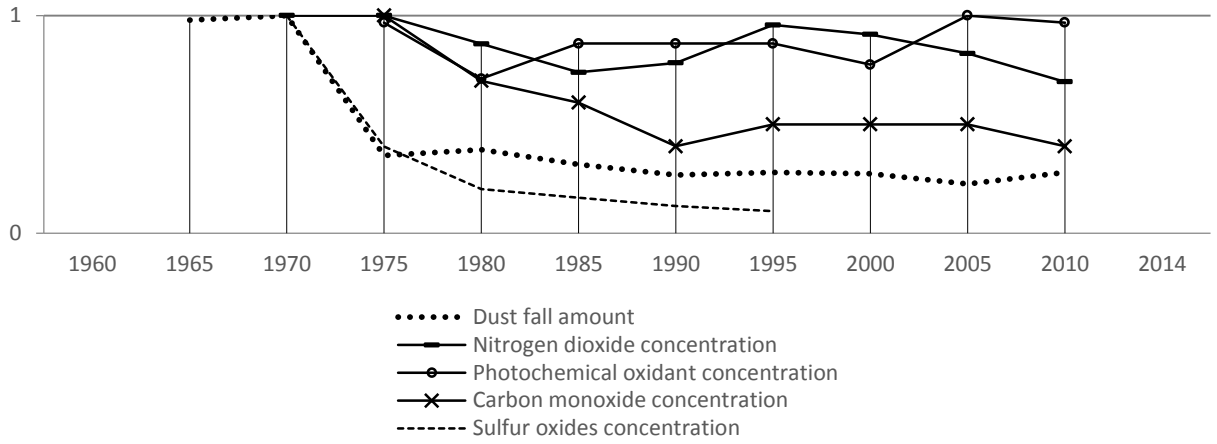


Figure 4-9 Air Pollution by Pollutant Substance of Kitakyushu City (1965-2010)

Y: Waste Treatment Volume (m^3) (Maximum value =1)

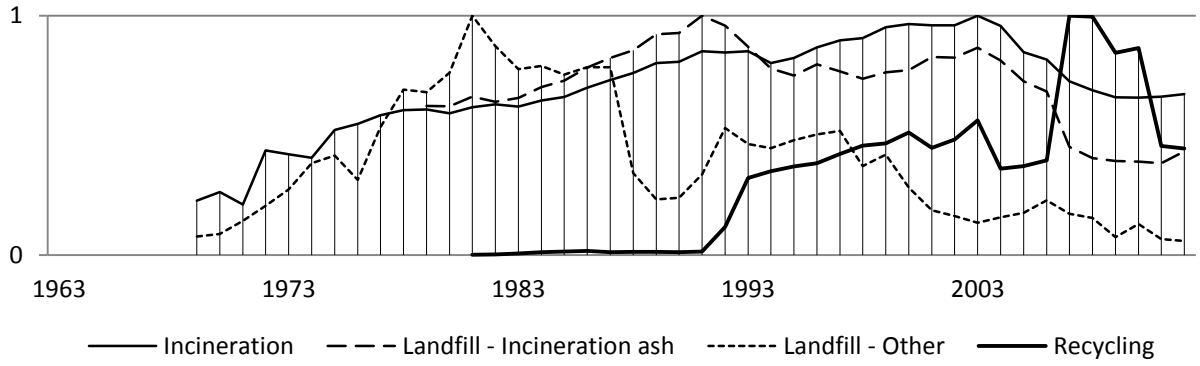


Figure 4-10 Waste Management System Change of Kitakyushu City (1970-2012)

Y: Number of Vehicles (number)

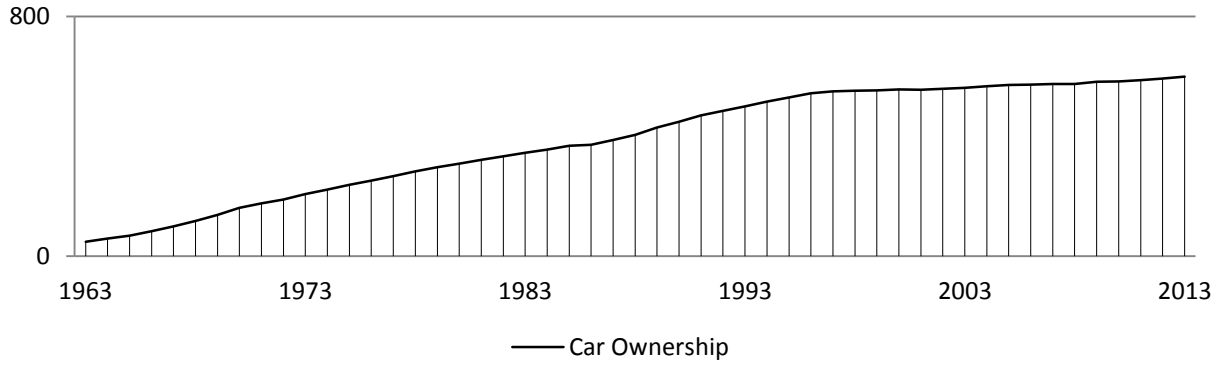


Figure 4-11 Car Ownership of Kitakyushu City (1963-2013)

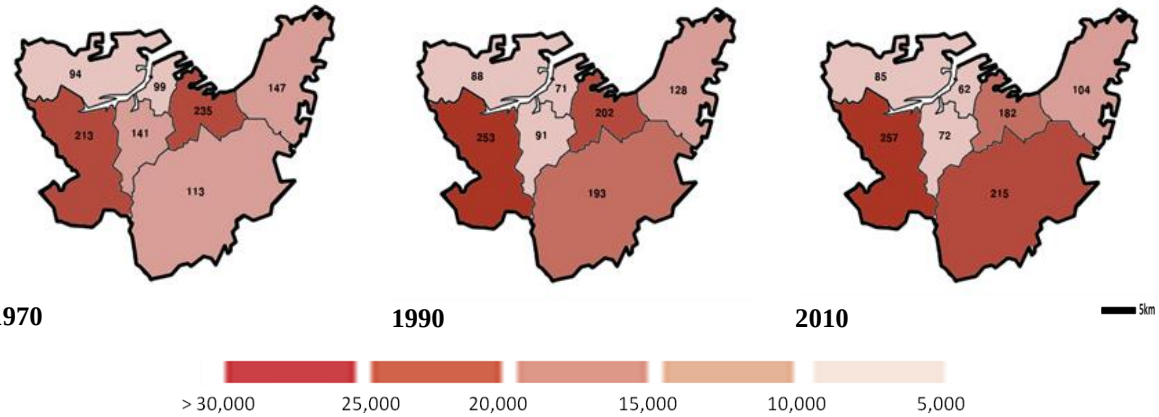
4.3.4. Physical Development

Land use change is significant from the 1980s when deindustrialization affected the residential development and commercial development in the area. Population change by the district shows the decline pattern of the city center in Tobata, Yawata, and Kokura Kita districts during the 1970s to the 1990s. The change rate declines from the 1990s however, continuous suburbanization is shown from the change of population by the district which massive during 1970 to 1990s.

Transportation models developed from shipping port, railway (including Shinkansen), motor road, monorail, and airport. Located in the northern part of Kyushu island, the city expanded its transportation connection with the construction of Kanmon Bridge (1972) and Shinkansen development (1974), and the Kokura Station developed as central city station. During 1980 to the1990s, Kitakyushu City experienced the massive development of road system with the increase of industrial automobile production in the region. Development of Kitakyushu City Expressway (1980), Wakato Bridge (1983), Kyushu Expressway (East Kokura– Yawata, 1987) increased the regional connectivity. The multiple transportation systems development of Kitakyushu Monorail (1984) with the renewal of Kokura Station (1996) and the new Kitakyushu Airport (2006) developed. The transportation improved to connect the suburban region with the development of Chiku Honsen Rail Way (2000) and Shinwakamatsu Road through Wakato Bridge (2011).

Hibikinada area the landfill started in 1980 and completed in 1986. Formerly waste disposal site became a Biotope where currently became new eco-town and low carbon emission programs developed under three theme 1) low carbon emission 2) resource recycling 3) symbiosis with nature. ‘Next generation energy park’ collect and exhibit energy resources, ‘Kitakyushu New Eco-town’ recycling resource base targeting zero emissions, and ‘Hibikinada Biotope’ create green space corridors with vegetation and bird sanctuary. ‘Kitakyushu Expo-Festival 2001’ with redevelopment of Higashida area under ‘Kitakyushu Renaissance.' Creating ‘Green Village’ in Yawata Higashida started from 2003.

Population by District



Transportation Development

~1970

1972 Kanmon Bridge
1974 Shinkansen (Kokura Station)

1980-1990

1980 Kitakyushu City Expressway y (No.10)
1983 Wakato Bridge
1984 Kitakyushu Monorail
1987 Kyushu Expressway (East Kokura–Yawata)

2000-2010

1996 Kokura Station Renewal (Monorail)
2000 Chiku Honsen Rail Way
2005 Kitakyushu Road (~New Airport)
2006 Kitakyushu New Airport
2011 Shinwakamatsu Road (Wakato Bridge)

Urban Development Projects

1970-1980

① 1974 Central Wholesale Market
② 1976 West Japan Convention Center
③ 1977 Industrial Medical University
④ 1978 Kurosaki Redevelopment
⑤ 1980 Kitakyushu City Hall Relocation
⑥ 1980 1st Tachinoura Container Terminal 1986 2nd terminal

Late 1980 – 1990

⑦ 1989 Space World, Kitakyushu Prince Hotel, 1992 Yawata Roal Hotel
1998 Higashida First Finance Historical Cultural Asset
⑧ 1992 Kokura SOGO 1999 Kokura chacha town
⑨ 1994 Moji Retro
⑩ 1997 Kitakyushu Eco-town

2000-2010

⑪2000 Kitakyushu Science and Research Park
⑫2001 Environmental Museum 2006 Kitakyushu Innovation Gallery (KIGS)
⑬2002 Riverwalk Kitakyushu 2003 Kokura Isetan
⑭2004 Hibiki Container Terminal
⑮2008 Hydrogen station and energy Town

Figure 4-12 Population, Transportation, and Urban Development Trend of Kitakyushu City

4.4. Synthesis

The synthesis of each dimension of transformation shows the complex process of the industrial city. The trajectories of quantitative measures show the relation among variables and show the critical turning point for each dimension. The population peak to decline is not significant from the peak level, however, the continuous decline of population in Kitakyushu City and reaching the below one million as a city, is now impacting the local government for its awareness of the shrinking city problem. However, the population decline is common for cities in Japan in the recent era; thus, the population decline can be regarded as two different stages. First is the decline from de- industrialization during the late 1970s and 1980s, and social decline with shrinking starting from late 1990s.

Economic development stages are relevant to its social changes, city experience the highest unemployment level and the lowest financial status after the economic crisis in the 1980s. The economic crisis in industries shows the second impact from the latter transition stage with the second peak from unemployment level. The industrial city is no longer dominant in pre-existing manufacturing industries and service industries are not in favor of the city to further develop. As service industries as construction, wholesale, finance and insurance decline from the transition period the city experienced the downhill of employment. Therefore, the economic situation also has a binary turning point, the first is in the late 1970s to 1980s, when the impact of oil crisis brought economic crisis on the major steel industries, and the second is the decline of service industries in the late 1990s.

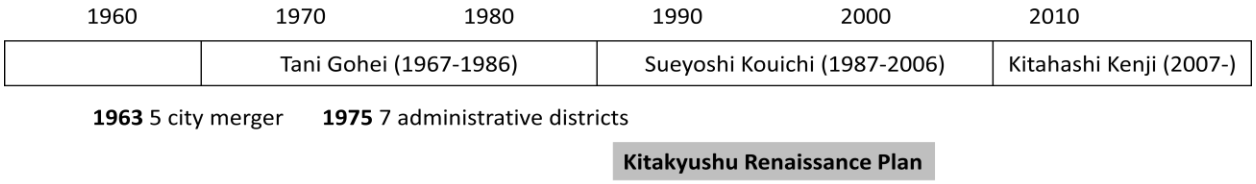
The social structure shows the shift from male dominance to female dominance, and aging issue is dominant from the recent 20 years. This trend is not only for Kitakyushu City, but also from the impact of a social trend at the national level. The education level shows the exceeding number of high school graduates going to college than employment during the early 1990s, which brought the outflow of young populations. Due to its high level of crime rate during the economic crisis, the social environment has been deteriorating after the first decline. The city conclusively has three different stages of social changes which are; Early development as an old industrial city (1920-1960), the peak of the modern industrial city and the deterioration of social environment (1970-1990), and later as socially declining city with aging issues.

An environmental feature of the city shows the distinctive characteristics of the development stages. First, the industrial pollution peak of the 1970s, the city went through extreme recovery with the collaboration of local stakeholders. Then, during the 1980s to 1990s, the consumption related problems arise and the continuous increase till a recent period. The new transition is the time that city declares to be the

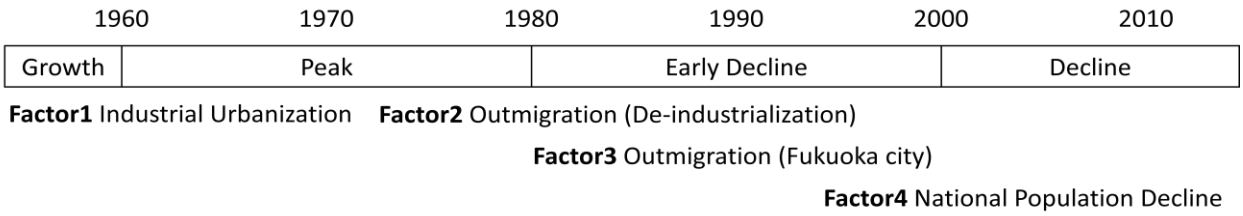
environmental model city and having relevant initiatives which transition seems started from the late 1990s with the national government implementation of the eco-town project of recycling industries.

The physical development shows the concentration of population from near industrial sites during the 1960s and the continuous suburbanization took place during 1990s, when the city center redevelopment projects were ongoing with the Brownfield of Yahata station area. The physical development of rail to vehicle road brought the spread of population to suburban areas. The industrial development also occurred outside the city boundary. Therefore, the physical development shows the three different stages of its development. Industrial city center and concentration (till the 1970s) and development of rail systems, suburbanization due to development or road systems and city center redevelopment after de-industrialization from the 1980s and 1990s, and finally the shrinking and decline of the whole city area.

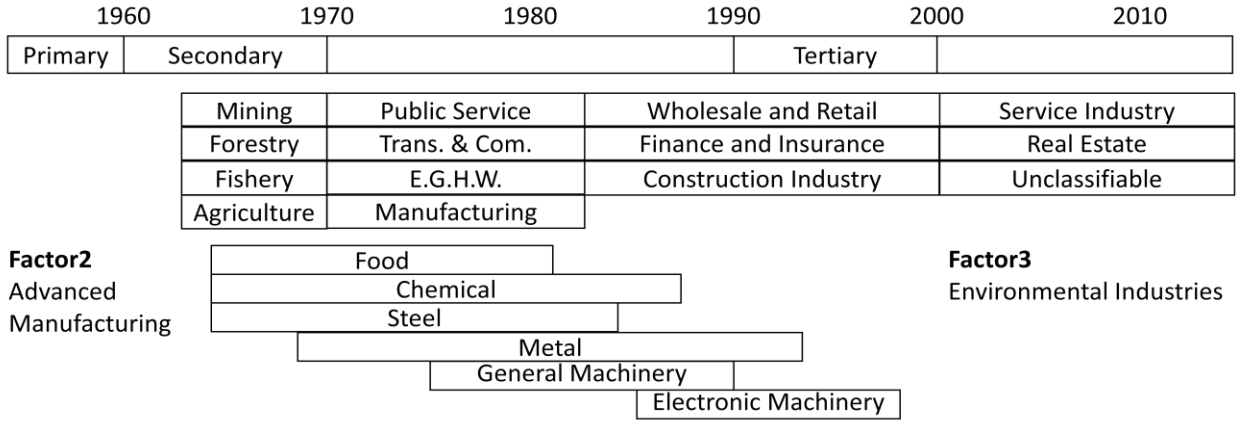
Key Event and Political Background



Population



Economic



Social

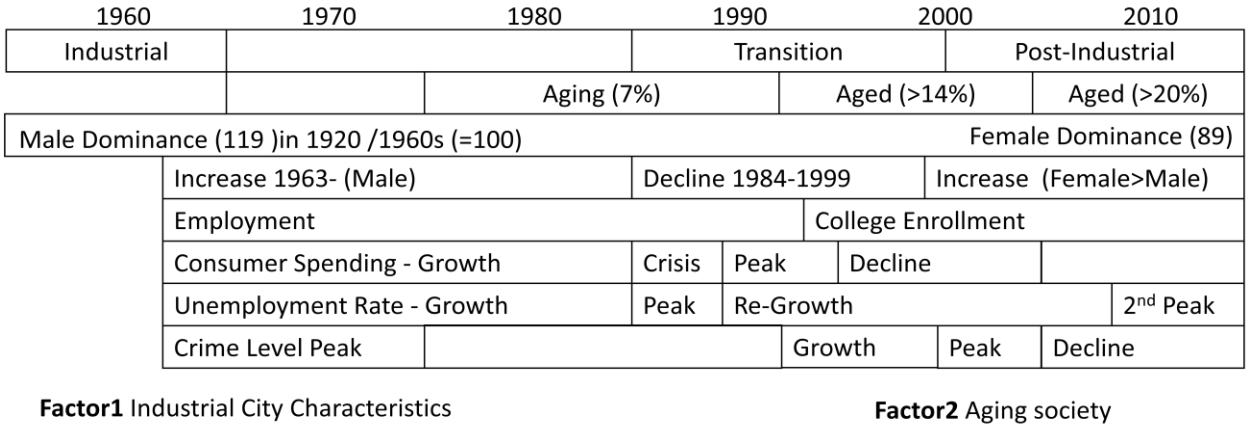
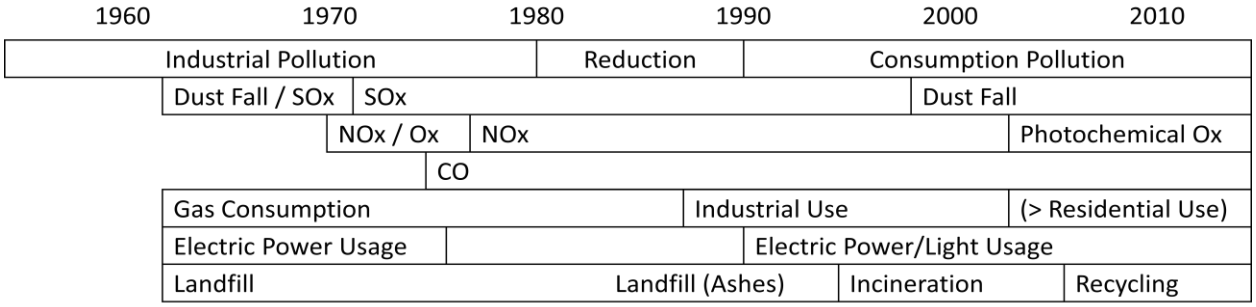
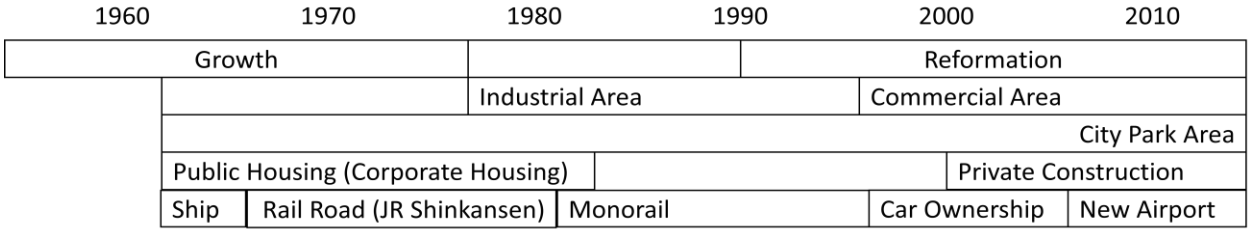


Figure 4-13 Synthesis of Timeline of Multidimensional Transition of Kitakyushu City

Environmental



Physical



Factor1 Industrial Area **Factor2** Urban Growth **Factor3** City Center Redevelopment

4.5. Conclusion

4.5.1. Summary and Key Findings

The study analyzed the detailed transformation process of an industrial city with a case of Kitakyushu City, Japan. Overview of the urban historical development process of the city, the timeline is created with multiple variables in sustainable dimension. Quantitative data and qualitative data were collected to identify critical turning point and key events during 1960-2010. A synthesis was shown to connect interrelated factors in economic, social, environmental, and physical dimensions.

The summary of the key findings of each dimensions are below:

1) Economic Issues

a) **Continuous industrial development as an old industrial city**
   Kitakyushu City as the old industrial city developed from 19C mining industries; major turning point is the 1970-1980s for the economic crisis of major steel industries. De-industrialization had an impact on the decline of industrial employment, however the economic status of industries lasted longer.

b) **The industrial advancement of all sectors, but planning decision to be consistent with manufacturing as a major industry in the period of critical turning point**
   Service industries show the advancement from different stages.
   Renaissance plan during 1980s, strategies to keep manufacturing industries as major identity this led to the advancement of manufacturing industries in the region locating production facilities in outwards of the city boundary.

c) **Environmental industries as major industry expect smaller employment size**
   Although the city aims create an environmental business as an environmental model city plan, the employment size is smaller than major industrial development period.

2) Social Issues

d) **Population decline and aging society issues are critical**
   Kitakyushu City population development has five phases of growth, peak, and decline. The growth stage during 1960-1970 population reaches its peak after the integration of the five cities in 1963 and steady until the 1980s and slowly decline afterward.

e) **Disadvantage of industrial city in postindustrial society**

Demographics show the social structure of Kitakyushu City shifting from industrial characteristics to post-industrial. Population decline due to aging issues will be the main challenge towards future development. The increase of the female population and out-migration of a young woman in the city should live quality for woman and children. The change of the social group with mismatching employment results in higher unemployment level reaches highest in recent years.

f) Old industrial city characteristics give negative impact of the transition

Social security issues such as crime considered as distinctive features of Kitakyushu as an industrial city. Having the history of mining and blue-collar labor industrial cities, cultural dominance in sports and gambling has its impact on the location decision of business and have possible relevance with living condition preferences of social groups such as woman and children.

3) Environmental Issues

g) History of management in environmental pollution gives new direction for the city to develop as an Environmental Model City

In the case of Kitakyushu City, the city strategies focused on environmental pollution during 1960-1970, physical redevelopment during 1980-1990s with Kitakyushu City Renaissance by promoting advanced industries, research and technology, and tourism. The city moves towards the environmental model city from 2008.

h) National and regional government support for new industrial development

A new transition phase starts from 2000 after the government initiated the environmental industries with the Ecotown development. The new transition stages show the peak of aging, unemployment, consumption, pollution, and urban decay.

4) Physical Issues

i) New housing and transportation development caused suburbanization and out migration

The mode of transportations led to the suburbanization that with an increase in car use, and new housing development.

j) City center redevelopment enables the compact city urban form from further decline

Kitakyushu City integrated in 1963. To create city center and sub-center brought the diversion between the areas. Kokura area developed as city center ad concentrated redevelopment projects created an urban center with commercial and administrative functions. However, another former central industrial and residential areas such as Wakamatsu, Tobata, Moji, Yawata declined due to old housings in the area.

The city faces the major issue for the future as a continuous industrial dependency, social aging, unemployment, consumption pollution, and urban decay. Future development should focus on the decline of population and compact city. The population density level drops while aging issues increased.

4.5.2. Implications for Industrial City Transformation based on Kitakyushu City case

The analysis in this Chapter has its significance in capturing the complex process transformation at the city level by adapting the concept of multi-dimensional transitions. The outcome shows the complex transformation process of Kitakyushu City.

First, the transformation industrial city should be considered earlier from the stage of industrialization expecting the decline stage. Having a history of the industrial city, somehow the dominance of the major industrial cities is another reason for lacking the economic diversity and regarded as the detachment period. The decision of further advancement in manufacturing industries, in the end, brought a lack of the economic diversity. The industrial city tends to stay industrial cities as the decision made during the 1980s of keeping the major industries. The timely management of expected decline should consider beforehand.

Second, considering not only economically, but social and environmental is the key to the transition. The decline is not only due to economic dimensions, but also from social aspects to increase the diversity in human resources and natural and cultural resources. Historical recovery measures in serious environmental pollution problems reversely created a unique identity of the city. Environmental modelling city initiatives connected from the past experiences, as the global acknowledgment brought national investment in the recycling industry and now promoted the city to increase energy and environmental technology related business requiring high-skilled workers. However, social security issues combined with direct and indirect effect to reluctant in business and residents. The increase of connectivity to overcome a detached period of industrialization will be important.

Third, the new direction of physical development should come from the local context utilizing various resources. Tourism is one of the major industries, an increase of attentions of industrial heritage and preservation or increased commercial areas and amenity of city center improve positively impact for revitalization. Until the environmental industries became the major promotion theme, redevelopment measures varied in developing high- tech and tourism which wasn't recognizable. Especially measures detached from local context are not proven to be effective, such as the failed attempt of promoting tourism from amusement park (space world) and only temporal events. Therefore, utilizing the resources and experience developed during the industrial, and preservation of pre-existing cultural and the natural asset will be critical for future transition.

Fourth, planning should be made regarding smaller and compact size, especially regarding the economic and physical development of the city. The city should expect a quantitative decline for its pre-existing industries. Therefore, the future is challenged by downsizing the city. Employment of new industries and

economic status will not be equivalent. Regarding physical development, the selective decline of the area is expected. Kitakyushu City plans to concentrate the city center has been positive for its urban center.

Lastly, national government support and the regional planning and collaboration are necessary. The decline is also due to external factors. Kitakyushu City declines affected from the growth of the neighboring city of Fukuoka, service industries and information, logistic business, competed to locate in Fukuoka.

4.5.3. Direction for Future Studies

The single case is difficult to represent the commonalities. The comparison of a different case of cities will be needed. The framework improved with the different case study regarding the difference in time of the development. The specific issues and challenges might be different from city context and also its time of development.

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Chapter 5 Korea Industrial Cities

Current Status and Future Strategies

CHAPTER FIVE
KOREA INDUSTRIAL CITIES: CURRENT STATUS AND FUTURE STRATEGIES

5.1 Introduction

In this chapter, examines the current status of industrial cities Korea and strategies for development. By selecting two case cities visualized the detail process of transformation and identified related issues and challenges in the transition.

5.1.1 Background

Korea has been one of the fastest developing countries in the world from the 1960s, reaching a high GDP per capita. During the fast economic growth, Korea experienced fast urbanization which correlated to industrialization with the influx of workers and capital investments in the urban region. Industrial cities in Korea took the leading role and position of national economic growth and local development and expected to grow further with continuous development. **Table 5-1** and **Figure 5-1** explains the historical development of national industrial complex and industrial city growth. In the 1960s, Korean government built modern infrastructure and supported enterprises to expand export-oriented. Manufacturing especially heavy industries developed in the cities, such as Ulsan, Pohang, and Yeosu. In the 1980s, the government invested in more advanced industries with a higher value in IT and R&D by locating many high-tech industrial complexes. In the 1990s, many companies in labor-intensive industries relocated production to overseas (i.e. China) to lower production cost, resulting in the drop down of manufacturing employment and also reduced employment trend continued more severe during economic crisis IMF in 1998. Service industries are continuously increasing in cities still the portion is below the OECD average (OECD 2013).

The dominant characteristics of industrial cities in Korea are that mostly specialized in a specific type of industries by locating national and local industrial complex. However, Cities in manufacturing industries are still dominant in growth as manufacturing, industrial activities are a key economic driving force in Korea (ref). The industrial cities experienced growth in 1970-1980s, continued to grow after the 1990s with service industry development (Bucheon, Changwon, and Cheonan). However, local medium cities with the absent industrial development in manufacturing and stay as the traditional administrative city has population declined or congested (Jeonju, Chuncheon, Mokpo, and Andong).

Recent studies revealed the weakness of the cities in economic structure and especially in utilizing local resources for innovation and economic development in the region (Jang & Lee, 2015). Deviation exists among the cities for post-industrial development that some industrial cities are making industrial diversification and transition while others still maintain their industrial concentration but lowering the level of specialization and labor insecurity. Traditional industrial cities like Daegu and Busan, initially developed with light industries, for example, textile and apparel, lost the economic competitiveness in the 1980s and experienced deindustrialization. New industrial transition begins with developing advanced industries with technologies (i.e. Machinery and automobile) and also improved cultural and knowledge industries with support from the local and central government. (Park, 2015)

However, the industrial transition and its development of local industrial cities and region hasn't been a major concern for the economic crisis in the late 1990s and also due to its stability in growth. The sense of downturn in heavy industries has increased the attention of the governments of its upcoming risk and also treats for deteriorating citizen's livelihood. The arguments rise of industrial cities to acknowledge its limit on maintaining past centralized structure is focused on manufacturing and attract advanced industries and designate new development direction to achieve timely investment for future transition (Park, 2015). Therefore, it is important to understand the historical industrial and urban development and its finding potentials from the local context in the case of a transition issue.

Table 5-1 Korea National Development Plan and Industrial Development

1960s	1970s	1980s
Dispatch of troops in Vietnam war	1973 1st Oil Shock 1979 2nd Oil Shock	1988 Seoul Olympics
1st period (1962-1966)	3rd period (1972-1976)	5th period (1982-1986) "Economic, social development."
Expansion of key industries, energy source (coal, electricity), social capital	Economic independence Heavy industrial development	Price stability Vitalizing market economy
2nd period (1967-1971)	4th period (1977-1981)	6th period (1987-1991) "Economic, social development."
Self-sufficiency of food Industrialization Promotion of science and technology	Establishment of growth structure Technology innovation	Opening trade competition and establishing market order Improve income distribution
	1st period (1972-1981)	2nd period (1982-1991)
	Extension of national power Industrialization Large scale industrial foundation Transportation, communication, water resources, and energy supply network Local area enhancement	Improvement of living environment Ease Overcrowding of Seoul Metropolitan area
1962 Act 982 "Exemption law on land expropriation for industrial zone development." 1964 "Export industrial complex development act"	1970 "Local industrial development act (A)"and Local industrial development promotion policy 1973 Industrial site development promotion act (B)	1977 Master Plan of Seoul Metropolitan Population Relocation (1982 Seoul Metropolitan Area Readjustment Planning Act) 1977 Industrial Arrangement Act (E) 1983 Rural Area Income Source Development Promotion Law ©
1960s Most of industrial complex for light industries	1970s Two main types (1) Southeastern Maritime Industrial Belt: Heavy and chemical industrial base (2) Local Industrial Complex	1980 National Industrial Complex (again with large industrial site development due to lacking industrial sites) 1980s City and regional government led development industrial complex 15 1984 Agricultural industrial complex pilot (Active during 1986-1990)
1962 Ulsan (1st industrial complex, heavy and chemical industrial location) 1966 Seoul (1st export industrial complex) 1967-1969 Gwanju, Daejun, Jeonju, Cheongju, Daegu, Chuncheon 1970 Iksan (Iri), Wonju, Mokpo	1974 Initial 6 industrial sites: Changwon, Yeocheon, Onsan, Pohang (Jukdo), Okpo 1974 Ulsan Mipo, Pohang 1977 Gumi *Industrial Base Ulsan, Yeosu: Chemical Pohang: Steel Gumi: Electronics Busan, Ulsan, Geoje: Shipbuilding Onsan: Smelting refining	1976 Banwol, Sihwa; Namdong industrial complex 1980 Gwanju Hanam Industrial Complex 1986-1990 Myungji-Noksan District Gwangju Hightech industrial complex, Banwol and Shihwa area (special sites) Gunjang, Gunsan, Daebul national industrial complex

1990s	2000s	2010s	
1998 IMF			National Events
New economy 5year plan (1993-1997)			**Five year National Economic Development Planning**
Strengthen business competitiveness Enhancing social and regional equity			
			Key Objectives
3rd period (1992-1999)	4th period (2000-2020) "21C Integrated Land."	4th period the amendment (2011-2020) "Global Green Land"	**National Territorial Planning**
Expand social overhead capital facilities Autonomous regional development and deployment	Balanced regional development Dispersion and ease of overcrowding Seoul Metropolitan area	Characterization of regional economic center and enhancing global competitiveness Low carbon, energy saving Compact City	Key Objectives
1990 Industrial Location and Development Law (Integration A+B+C=D) Industrial Arrangement and Factory Establishment Law (Integration of E and Industrial Complex Management Law) 1995 Special Measures on Deregulation of Corporate Activities	2001(D), High-tech Industrial Complex Regime 2008 Exemption Law on Simplifying Procedures for Permission and Approval for Industrial Complex		**Industrial Complex Development Law & Policy**
1990s Increase of local industrial complex due to long-term under development or unsold issues of national industrial complex during 1980s Discourse on Science & Industry Research Park, but lack of government policy support, municipality led	2000s Diversification of industrial complex (ventures, software, information and communication new industries, science research, cultural industries) Simplifying procedures for industrial development		Industrial Development Characteristics
1989 Local Industrial Complex (42) 1990-1999 Local Industrial Complex (112) 1997-2002 New industrial complex (35) 1991 Seokmoon National industrial complex 1990 Gwangju High-tech industrial complex			Major Industrial Complexes – New Development

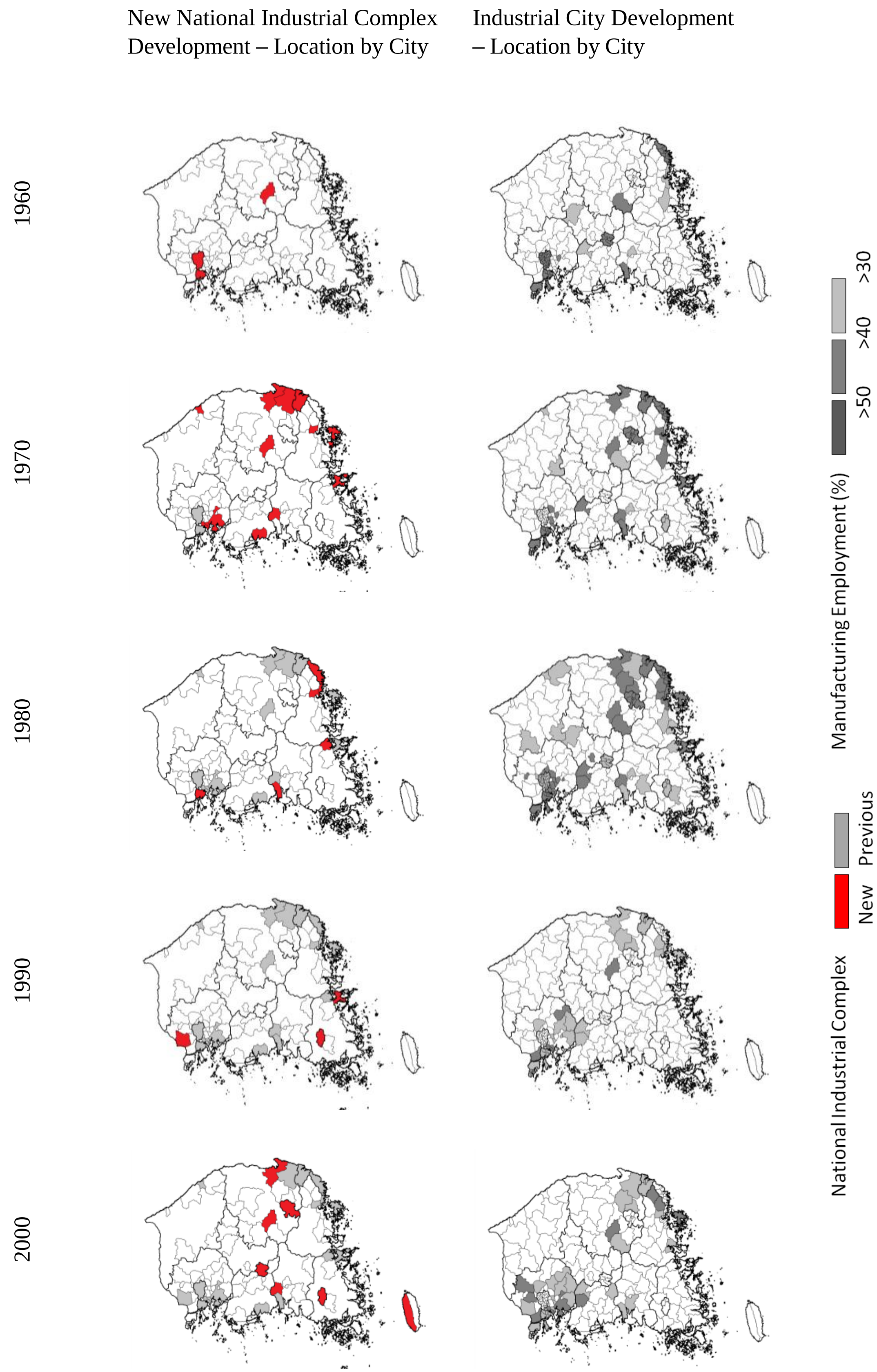


Figure 5-1 National Industrial Development Complex and Industrial City Development

5.1.2 Objectives

This chapter aims to demonstrate the transformation of industrial cities in Korea and clarify the specific urban issues related to its post-industrial transition. The study first examines the change of population, industrial development, and economic status to diagnose the current status of industrial cities in Korea. To understand the transformation process more in detail, selected two case cities which Pohang and Yeosu, and identified the issues, challenges, and strategies for the post-industrial transition. To suggest local industrial cities in Korea to avoid sudden collapse during the major industrial transition and to achieve sustainable development The study accomplishes the purpose by answering the questions below.

What is the current status of industrial cities in Korea? Which industrial cities most expecting transition? What would be the transitional factors of industrial cities in Korea? How do social and environmental factors affect the stage of transition? What are the strategies of industrial cities and the critical issues to achieve sustainable development in the future?

5.1.3 Data and Methodology

The study uses both quantitative and qualitative data to analyze urban transformation. Statistical data gathered from 1970-2010 at the city level. Other sources of information are from the municipal government, previous research, news, and media. Also, the study conducted semi-structured interviews with individuals from different groups of local stakeholders to gather opinions about the city transformation and the future prospect of the city.

5.1.3.1 Definition of Industrial City

As in the previous chapter, the study defined industrial cities as manufacturing dominant local administrative area. Industrial dominance measured by the higher percentage of manufacturing employment and population growing over 100,000. Therefore, variables are (a) the number of workers in manufacturing industries (person) (b) total labors (person) (c) population (person).

The average percentage (a/b) is 43% during 1970-2010 years of available data, cities above 50% recognized, highly dominant, 30% in dominant, and less than 20% as low. Maximum population size above 100,000 during the time frame selected whether in ‘city’ or ‘county’ status to locate heavily industrialized area more accurately.

Therefore, among total 78 areas in Korea (metropolitan, small-medium sized cities, county wards) are included in the definition above.

5.1.3.2 Selection of the City: Population Decline Group

Variables to measure decline are population change rate and employment change rate over the years. The secondary selection also considers the economic status of the industry and the city. Therefore, the economic decline is measured from the change in total GRDP and value and percentage in the manufacturing industry. Available data only exist from 2000-2015, annually. Still, the trend changing within 15 years represents the economic resilience in industries and cities after economic crisis, IMF in 1998 and global financial crisis in 2008.

Identified five local cities in decline phase; continued declining or at the peak stage which expecting further decline. These cities compared for their development agenda and strategies referring to city government plan and policies.

5.1.3.3 Case study: Pohang and Yeosu

Pohang and Yeosu City are both heavy industrial cities in peak-to-decline phase, preparing for transformation after deindustrialization. First by giving basic information and historical background of industrialization the study identifies the economic, social, and environmental issues related to the development of the city. The study created a timeline of the historical development of the cities to visualize the process of transformation, by identifying important events in the city, drawing trajectories of statistical data, and mapping physical urban development. The process summarized by indicating each of the turning-point. Then, diagnose the symptoms of deindustrialization from the early 2000s and identified key challenges of post-industrial development. Finally, overviewed the city government's strategies in recent ten years to understand the city's transformation process and further improve future development direction.

5.2 Decline of Industrial Cities in Korea

5.2.1 Variables

In Chapter Three, the result of the macro-level analysis shows the classification of the cities in Korea. Among the cities in decline group, economic status is measured by following variables:

- Population (person)
- Population change rate (Py+10-Py/Py: P=population, Y=year)
- Manufacturing employment (person, %)
- Manufacturing Value Added (million KRW, %)
- GRDP (million KRW), available 2000-2013

5.2.2 Classification

Among the cities in population 'decline' and 'peak to recent decline' group, economic status of the cities is listed in the **Table 5-2**.

Economic status of the most cities is increasing except the case of Masan and Mokpo as old traditional industrial cities experience a further decline in manufacturing industries and having heavy population decline. Mokpo as known as well known historical port early industrial development with export declined with absent investment during 1980-1990s. Masan integrated with neighboring city Jinhae and Changwon in 2012 as it became the administrative district in Changwon Metropolitan.

Large cities as Busan and Daegu has made its transition from the early 1980s, however, two cities differ in the percentage of manufacturing industries in total GRDP. Busan changed its economic structure with service and cultural tourism industries while Daegu invited technological improvement creating new industrial and research centers.

Smaller cities decline for its population irrelevant to industrial decline. For example, cities population group less than 100,000 including Naju, Gimcheon, Milyang, Youngcheon, and Sacheon, experienced a continuous decline in population due to out-migration of the younger generation to bigger cities. Some of the cities newly developed its manufacturing industries showing new economic growth together with manufacturing industries after 2010. These include Tongyeong as in food manufacturing relevant to the major fishery, Gyeongju, and Gunsan for its recent heavy industrial complex development. More importantly, Pohang and Yeosu are the cities having a singular structure in heavy industries and still dominant over 50% of manufacturing in total GRDP. Pohang City as a steel city basic metal (0.58) and

fabricated metal (0.14) and peak employment rate as 61% in the 1990s. Yeosu has been specialized in chemical industries (0.73) with more than half of employment in manufacturing in the 1980s.

5.2.3 Typology

The study created the typology to understand major industrial development and population trend in Korea by classifying cities for its change in the manufacturing industry and population. Figure (No.) shows the types and example of cities.

Korean urbanization made two extremes which the first is population concentration in the metropolitan region, especially around capital city Seoul. More recently, the growth is shown from medium-sized cities but still in the boundary of Seoul metropolitan region. Large cities with dominant heavy industries still in growing with economy and population while medium sized heavy industrial cities situated in the local area is expecting further decline. The industrial transition showed from light to high-tech industries in large cities and new development of high-tech industries in smaller cities also related to the growth of population in the region.

Industrial cities in Korea differs due to its population size, location, type of industries, and time of development. Industrialization and urban economic growth, or deindustrialization and population decline detected from the trend of population change and industrial transition. Based on the typology, industrial cities in Korea with a smaller population, located in the rural area (opposite from Metropolitan), dominant in heavy industries, and without industrial transition or new investment in high-tech innovation will be expecting massive transition cost for future development. ***See Appendix 5-1*.**

Table 5-2 Decline Group Cities and Economic Value

Population Change/Size		Cities	Industrial Characteristics					City Economy	
			Manuf. Emp. Peak(%)	Type (Light/Heavy)			Major Industry	GRDP 2000-2010	Manuf. VA (%)
Continuous Decline	10	Busan	0.75	M	0.46	0.53	Textile, Clothes, Wool, Leather Apparel(0.14) Machinery(0.14)	(+)	0.20(-)
	2	Masan	0.76	HD	0.18	0.81	Video Audio(0.29) Machinery Equipment(0.11)	(-)	0.25(-)
	2	Gyungju	0.46	HD	0.13	0.86	Motor Vehicle(0.32) Electronic Equipment(0.16)	(+)	0.40(+)
	2	Gunsan	0.60	HD	0.29	0.70	Motor Vehicle (0.27) Basic Metal (0.12)	(+)	0.45(+)
	1	Naju	0.42	M	0.57	0.42	Food(0.36) Non-Metal Minerals (0.15)	(+)	0.23(-)
	1	Gimcheon	0.64	HD	0.30	0.69	Chemical (0.15) Video Audio (0.14)	(+)	0.42(-)
	1	Milyang	0.45	M	0.42	0.57	Textile (0.29) Non-metal Minerals (0.28)	(-)	0.13(-)
	1	Youngcheon	0.64	M	0.49	0.50	Textile (0.30) Motor Vehicle (0.26)	(+)	0.35(+)
	1	Sacheon	0.47	M	0.34	0.65	Food (0.31) Machinery (0.26)	(+)	0.42(+)
	1	Tongyeong	0.47	LS	x	x	Food (0.67) Other Transportation (0.26)	(+)	0.45(+)
Peak to Decline	10	Seoul	X	LS	x	x	Clothes Wool (0.31) Printing (0.19)	(+)	0.05(-)
	10	Daegu	0.62	M	0.49	0.50	Textile (0.35) Machinery (0.12) Motor Vehicle (0.12)	(+)	0.24(+)
	5	Anyang	0.75	HD	0.28	0.71	Video Audio (0.17) Electronic Equipment (0.14) Machinery (0.10)	(+)	0.25(-)
	5	Pohang	0.61	HS	0.07	0.92	Basic Metal (0.58) Fabricated Metal (0.14)	(+)	0.50(-)
	2	Gwangmyung	0.81	HS	0.13	0.86	Motor Vehicle(0.63)	(+)	0.32(-)
	2	Yeosu	0.50	HS	0.19	0.89	Chemical (0.73)	(+)	0.60(+)
	2	Iksan	0.64	M	0.45	0.54	Clothes Wool (0.14) Video Audio (0.13)	(+)	0.25(+)
	2	Mokpo	0.39	M	0.47	0.52	Food (0.31) Non-metal minerals (0.29)	(-)	0.05(-)

1 Excluded cities: Decline Group (Naju, Gimcheon, Milyang, Youngcheon, Sacheon) Peak to Decline (Jinju)

5.2.4 Selected Cities

In this study, Pohang City and Yeosu City are selected to identify the current status of decline and relevant factors for the transition. **Figure 5-2** shows the location of selected two cities. Taking two different cities for the examples compared the process of historical urban development and recent strategies for post-industrial development to acknowledge Korea industrial cities in transition. Two cities have much in common in the urban growth of national industrial development in the 1970s to 1980s and population change showing 'peak to decline' and city economy in peak stage of growth. Also have the singular industrial structure (Pohang: steel, Yeosu: chemical) which has a higher risk for its impact from the economic crisis.

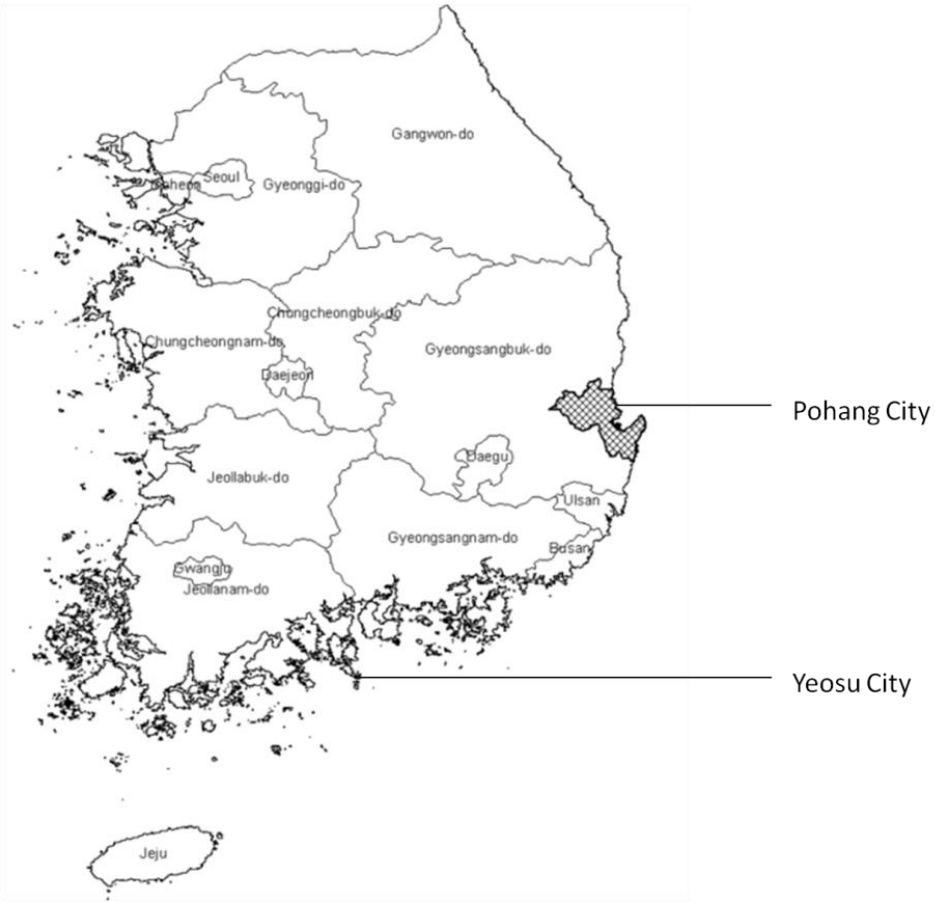


Figure 5-2 Location of Case Cities

Pohang City is a representative case of the Korea industrial city as known as ‘steel city.' Pohang City was a small fishery town before the industrial development. The city became a Korean navy base in 1956 after the war. Industrialization started from the late 1960s with the inauguration of the POSCO[1] steel factory which national government implemented the project along with five-year economic development plan.

Yeosu City also has a history of the defense location for marine during the 18C Chosun dynasty leaving cultural heritages. Industrialization started in the 1960s as part of the national heavy industrial economic development plan, and Yeosu became the Korea’s largest center of petrochemical industries.

First by giving basic information and historical background of industrialization, the study identifies the economic, social, and environmental issues related to the development of the city, then, diagnose the symptoms of deindustrialization and identified key challenges of post-industrial development. Finally, the study examines the city government’s strategies in recent ten years to understand the city’s transition.

[1] Pohang Iron and Steel Company (POSCO) is founded in 1968 as national company. The construction completed in Pohang City (1981) and Gwangyang City (1990), ranking the single largest steel industrial zone at the time. In 2000, the company was privatized and grew its business in global market, while ranking the world's 5th largest steelmaker in 2010, output of 35.4 million tons of crude steel and largest steel manufacturing company by market value. POSCO built oversea factories in Mexico, Vietnam, Indonesia, India, and Brazil (2009-2010).
- Source: POSCO (www.posco.co.kr)

5.3 Pohang City

5.3.1 Basic Information

5.3.1.1 Location and Administrative Boundary

Pohang City located in a Southern Eastern part of Korea peninsula, the city, is close to the Daegu metropolitan region and Ulsan, Busan and capital city Seoul while the closest Gyeongju city. The city is one of the most populated cities in Gyeongsangbuk-do prefecture. **Figure 5-3** shows the location and administrative boundary of Pohang City.

In 1995, Youngil gun and Pohang City integrated as 'Urban Rural Integrated City'. The current administrative system consists total 29 districts (4 eups, ten myeons, 15 dongs) divided into two wards, Nam-gu (3 eups, four myeons, 7 dongs), Buk-gu (1eup, six myeons, 8 dongs). The city has the area 1,127km^2 (435.23 square miles) where 70% of the land categorized as forest and field (791.5). The industrial area located in a Southern eastern part of Young-IL bay.

Table 5-4 shows data collected from Pohang City.

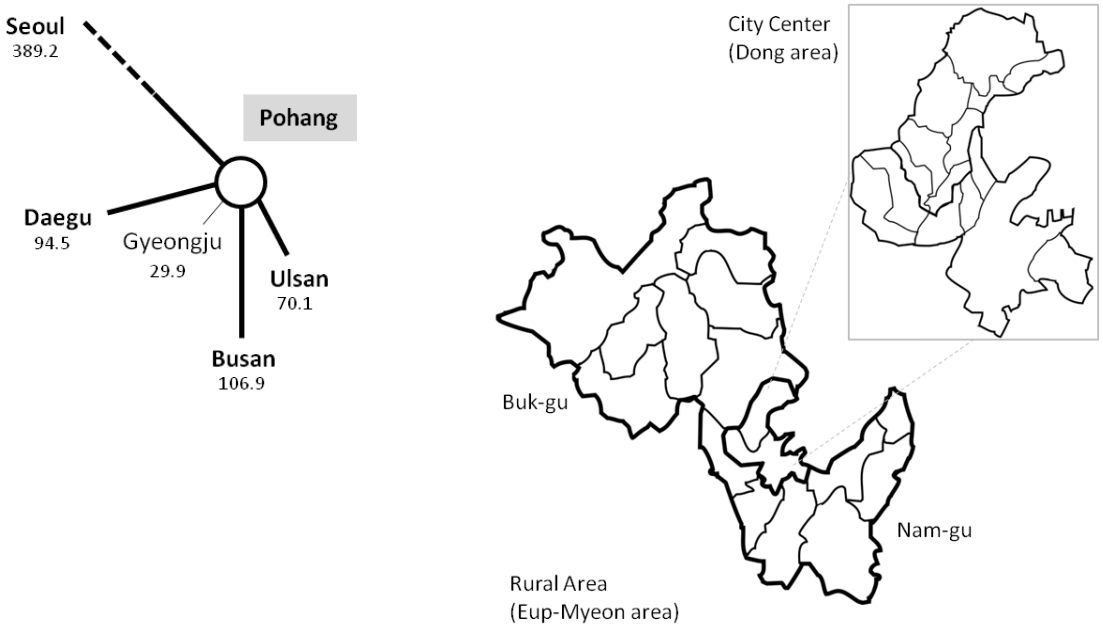


Figure 5-3 Location by Distance from Central Cities and Administrative Pohang City Area

Table 5-3 List of Variables of Pohang City

Category		Variables	Unit	Years
Economic	Industry	Employment by Sectors	person	1998-2011 (1)
	City Economy	Manufacturing Industry: Sub-category Employment, Value Added	A person, million KRW	1971-2000 (1)
		Industrial Complex (employment)	person	2011-2014
		GRDP	million KRW	2000-2014 (1)
		Financial Self-Sufficiency Rate (FAR) Financial Independency Rate (FIR)		1999-2011 (1) 2000-2014 (1)
		Unemployment	%	2008-2014 (1)
Social	Structure	Population: Age, Gender, Education, Foreign Population Education (higher education)	person person, % %	1925-2014 (1) 1972-2012 (1) 1990-2010 (5)
	Integration	Social Inequity, Labor Strikes, Resident Conflict	qualitative	
Environmental	Pollution	Air pollution (O_3)	ppm	1994-2012 (1)
		Water (Supply) Wastewater, BOD, COD)	ppm, tons ㎎ / ℓ	1996-1997, 2000-2012 1989, 2003, 2005-2012
	Environmental Management	Waste management:	m^2, kg / year	2000-2012 (1)
		Major events	qualitative	
Physical	Land Use	City Planning (Industrial, Residential, Commercial), Green Area (Park Area)	ha	1992-1999 (1) 2000-2014 (1)
	Transportation	Road pavement, Car ownership	m^2, cars	2000-2014 (1)
		New development of infrastructure: Road, Industrial Complex, Residential Area	map	
	Urban Structure	Suburbanization: Population by district	person, %	1941-2014 (1)
		Out-migration: Population inflow an d outflow	(+)(-)	2000-2010 (1)
		City Center declines: number of redevelopment and reconstruction registered	numbers	1998-2014

5.3.1.2 Key events and Population Development

The population of Pohang City is 520,305 as in July 2011, and population density 461/km2 (1,196/sq mi). Among 77 small-medium sized cities in Korea, population ranks11th and has the second largest urban area[2].

Figure 5-4 shows the population and number of household change since 1925. The population started to grow explicitly during the 1970s with an inflow of young workers employed in steel industries. The population of the Pohang City area exceeded Young-il gun by 1980s and constant increase till 1995. The population reached 500,000 in 1992 and with the integration of Pohang City and Young-il gun area population peaked 517,250 in 2000. See **Figure 5-4**. The city shows a direct effect of industrial urbanization and maintaining the largest populated city in the Gyungbook region. However, after the integration the population decline in till 2005 which due to the layoff from 1998 IMF. Population decrease has been temporally since it shows recovery from 2006 maintaining around half million at the peak level. However, the population being constant peak level since 20years ago, Pohang City is expecting a downturn without the strategies for new development.

The history of industrialization and population growth of Pohang City summarized with five phases:

Phase 1	Pre-industrialization (1949-1970)
Phase2	Early industrial and urbanization (1971-1985)
Phase 3	Industrial growth and integration (1985-1995)
Phase 4	Economic crisis and post recovery (1998-2004)
Phase 5	Postindustrial strategies (2006-2014)

[2] Among 77 Small-Medium Sized Cities in Korea, Pohang City ranks:

Population	11th	511805	(Suwon 1067425 ~ Geryong 41579)
Administrative Area	5th	1128km^2	(Andong 1521 ~ Gimpo 33)
Urbanization Area	2nd	69.010	(Yeosoo 81.677 ~ Dongducheon 3.360)
Residential Area	2nd	36.023	(Suwon 41.910 ~ Pocheon 2.5)
Commercial Area	3rd	4.858	(Suwon 5.410 ~ Donducheon 0.15)
Industrial Area	3rd	28.130	(Yeosu 52.527 ~ Gimpo, Namyangju,Dongducheon 0)
Green Area	8th	215.179	(Gyeongju 363.916 ~ Boryung19.025)

**Urbanization Area: Residential+ Commercial+ Industrial Area*

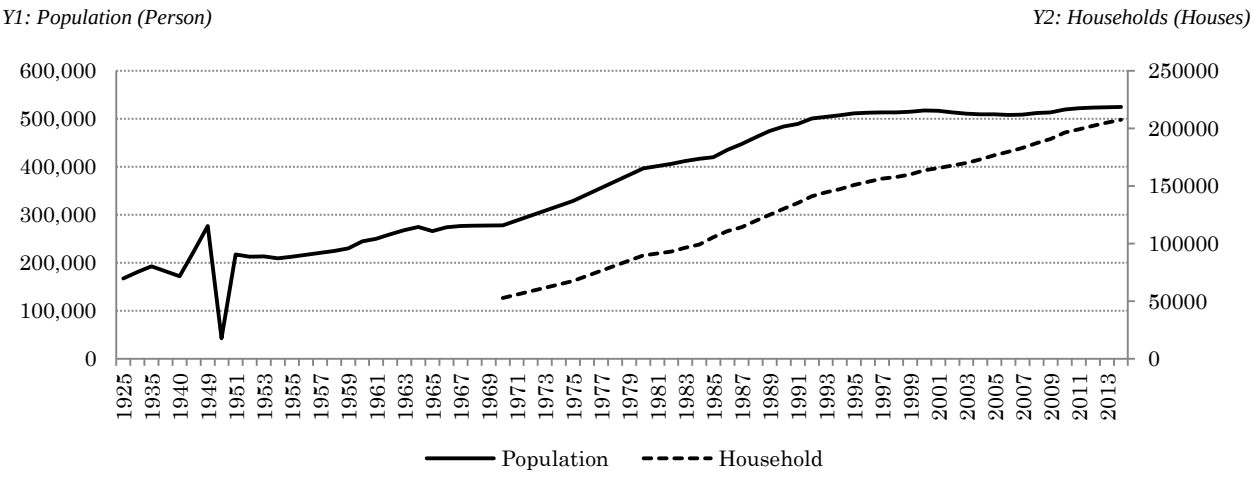


Figure 5-4 Population and household, Pohang City (1925-2013)

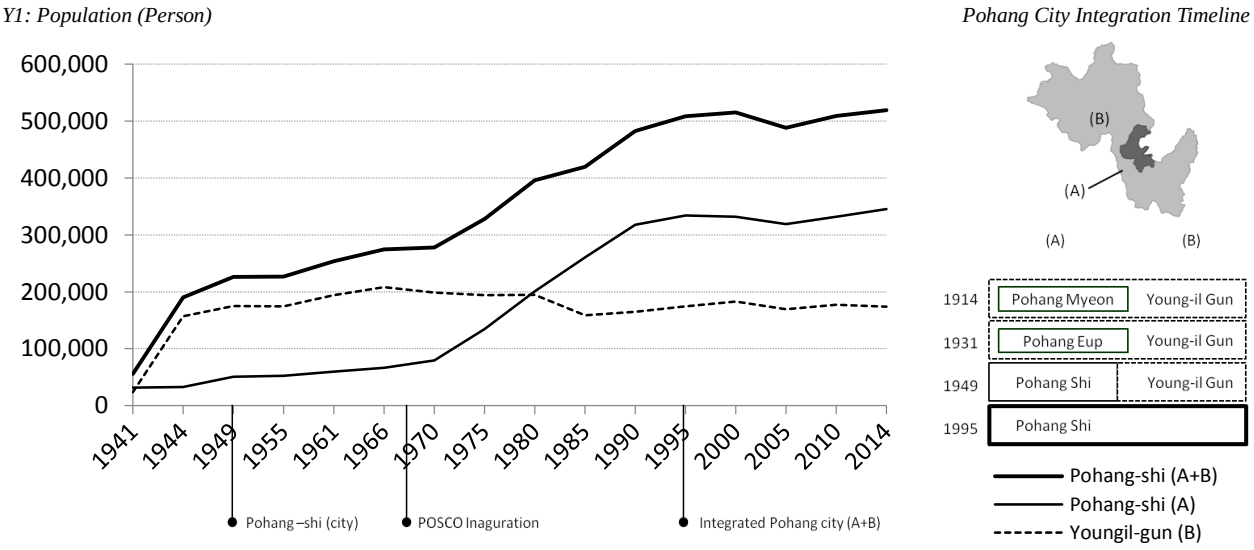


Figure 5-5 Population change by area before integration of Pohang City (1941-2014)

5.3.2 Multi-Dimensional Transition Issues

The study collected multi-dimensional variables both quantitative and qualitative data to understand the transformation process more in detail, Classified economic, social, environment, and physical dimension, the method is to identify turning point and issues in each dimension and clarify how social and environmental factors affect the stage of transition. Table 1 shows the classification of dimension and variables and sources of data.

5.3.2.1 Economic Dimension

1) Deindustrialization: 1997 IMF and recent recession in 'Steel Industries' and POSCO

The symptoms of de-industrialization started after the national economic crisis of IMF in 1998 when industries (mainly POSCO steel) early retirement policies and layoffs. The report from The Bank of Korea Pohang Branch (2014) explains the structural economic changes in Pohang; that city is now expecting changes in world steel production regimes which due to prices of raw materials, domestic steel demand, exchange rate decrease, electricity bill increase, and emerging steel industrial competition in China. From the 2000s, due to the mergers and acquisitions of world steel companies and low price products from China was accelerating the industrial decline and insecurity of economic status. Due to the situation, POSCO also experiences recession after the company's stock price reached a peak in 2007.[3]

The industrial structure:

Pohang City has been primary, secondary, tertiary (60%). Before sector service increase started from integration 1995, the city remained as a singular industrial city. Manufacturing industries, especially steel industries are steel dominant in Pohang City industrial structure. POSCO the large company has been the largest firm and other small and medium size companies are creating industrial clusters (Koo 2008a).

Manufacturing industry:

Total value added is slight increasing during 2000-2010. However, manufacturing percentage is slowing down from the year 2004 due to the recession from steel industries. The values are fluctuating together which explains the vulnerable economy easily affected by manufacturing industries.

[3] Change of world steel production rank: POSCO steel 3rd in 2007 and dropped to 6th in 2013. Top producers are from Luxembourg (Arcelor Mittal), Japan (Nippon Steel & Sumitomo Metal with integration from 2012), and China (Hebei Iron and Steel, BaoSteel Group, Wuhan Iron and Steel). See Appendix

City economy, unemployment:

The level has recently been declining after the recession. Economic status of the city is relatively wealthy due to steady growth and employment in the steel industry.

> "FAR[4] -5.4% decline from average 74.4% (2003-2009) to 69.0% (2010-2013) (national average change rate -2.5 regional -0.7). FIR[5]-9.0% decline from average 51.0% (2000-2009) to 42.0% (2010-2013) (national average change rate 3.8 regional -0.8)" –(Kim, 2014)

2) Economic restructuring

Many studies find Pohang's future development at risk, especially on the growth of industrial development in the region (Lee 2014; Kim 2014). The previous studies state critical challenge of the city is firstly due to the mono-industrial structure as manufacturing industry dominant (especially steel) which has been a major risk to the economic sustainability of the region. Secondly, employment has been quantitatively increasing, but the quality decline is a potential threat to cultural and service industrial growth which will relate to the decrease in household income. Thirdly, industrial workers aging problem and women's economic participation is relatively less and finally, certain food, and agricultural product shows high-value chain due to ineffective distribution system compare to the steady consumer price in general.

Current leaders acknowledge the POSCO's economic recession and how the risk of the financial crisis which will make the city focus on economic revitalization might lead to a lack of cultural, social welfare and infra system. Pohang City's future viewed as High-tech green city and university partnership through a case of Pittsburgh City, US. (Research Institute of Pohang Community 2014)

High-tech industries and advanced technology:

The direction of Pohang City development discussed from the local research institutions. Lee (2014) finds the most relevant industry as interdisciplinary research on steel and advanced materials including Nano, Mega-structure, and Zero emission in the steel industry; High-tech industry and robotic parts for automobiles and business; and energy industry such as fuel cells. Marine

[4] Financial Autonomy Rate (FAR) = (local tax income + external income + local subsidy + fiscal compensation + adjustment grants) / general account budget x100

[5] Financial Independence Rate (FIR) = Financial independence = = (local tax income + external income - municipal bonds) / general account budget x100

infrastructure and logistics, medical instrument and industry with biotech and atomic medical care, a hub city Pacific area with international exchange port have also been possible strategies.

Image of the city and tourism:

According to Pohang City social research report (2010), Pohang City image and future vision for 21C was Ocean, culture, tourism (53.6) followed by the High-tech industrial city (25.1) higher in male respondent, local amenity city (20.2) in female respondent. Logistics hub city (15.6) and Education City (8.2) considered as a future image of the city.

> The number of tourists is increased from 2005, during the summer. According to a survey in 2014, a tourist in other region visited mostly from near Daegu city and Kyungbook region for multiple visits while the purpose of the trip in general local food but looking for viewpoints and attractions in the case of visitors. The image of Pohang City has been dominant as ‘steel city’ but also ‘beach’ and ‘seafood’. (Pohang Techno Park 2014)

5.3.2.2 Social Dimension

1) Aging issue

Aging Society and Massive Retirement Expected during 2015-2020, Aging rate is increasing in 2003, and reaching aged society in 2023. This rate is faster than national and regional average. Currently, aging issues are mostly in rural areas where district of population declining as well as female dominance,

However, a large group of workers is planned for retirement within ten years (peak 2015-2108). Estimation is 58,320 among 223,812 total labor workers in 2012 (Korea Bank Pohang Branch, 2011). The major effect will be from manufacturing labors with 59.6% (7,144) are from large enterprises having more than 300 employees among total manufacturing retirement (36,880). Non-manufacturing labors are relatively evenly distributed with all ranges if age and mostly in small companies less than 49 people. Employment increase for the age of 50s and types are wholesale, food and accommodation, construction, health and social welfare. The problems are the quality of the job. Startup business to make up living after retirement and child service preschool, increased day laborers in local development and construction projects. However, the growth of employment is in lower income job and part-time. A negative impact towards the growth of service industries such as education and culture, sports and leisure which industries based on the income of households.

Social Structure: the age bracket of 40-50s, shows dominance in population structure. Pohang City also has large age bracket of population age in the fifties (50-59). The city had a massive influx of young workers around 80,000 people (mostly born in 1954-1963) during the mid-1980s and early 1990.[6] More recently out-migration of the younger generation (especially from 20-24 age brackets) is dominant from the year 2000. The reason might be the children going to universities and employment in larger cities. Gender balance shows male dominance and decreasing young female population. Unbalance between female population and male population in younger age (15-19 and 20-24) shows a lack of young female in the region due to university and employment[7].

[6] According to Pohang city social research report 2010, more than half of people answered their residence period over 30 years (52.5%) and over 10 years (83%). The reason for Pohang city residency is due to work and employment (45.9%) especially for men, while continued living from previous years (33.2%) are dominant for women.

[7] The women's economic participation rate is 43.0% in 2011 (national 51.0, region 53.4). This is due to lower employment of woman in especially manufacturing industries.

2) Social integration

The city has known as company town[8] of POSCO (Yeum, 2005), the portion of POSCO worker in total employment shows major in 2004. POSCO labor management strategies have been consistent from its establishment in 1968, provision and support in employee stable living environment which human resource department had exclusive charge since the 1990s. The company provided complete employee service including residential apartment, health care system, and welfare support. This exclusive welfare system gave negative effects for social integration in the city as a whole, a sense of alienation and disharmony between workers and non-worker residents due to its labor relation (Park, 1996).

The income gap between POSCO workers and non-workers exists as the income level is higher than average citizens. Pohang City's manufacturing labor wage 47,875,000KRW is 37.3% higher than national average 34,870,000KRW (Korea Bank Pohang Branch 2011). The steel industry is 57,018,000KRW. Pohang City's GRDP per capita gap between manufacturing and food and accommodation is 25.4 times (National 7.0).

Social inequity issues have been raised during the 1990s the peak of industrial development. In the 1990s, POSCO worker's housing development and issues have been raised for the privileged class. POSCO planned worker's residential area as a company town in the 1980s to provided housing and commercial, cultural facilities and amenities for migrated workers. Real estate transaction was only available between POSCO employees. The town had the relatively high quality of life with privatized education and managed the environment. Schools were open only for children of POSCO employees and town environment managed by POSCO. Citizens living in another town of Pohang claimed that POSCO brought pollution to the whole city, yet only employees were thought privileged. However, due to increased numbers of retired workers and financial, budgetary concern for the management of town, POSCO opened the residential complex in 2009 and enabled buying and selling for general public (Research Institute of Environmental Planning Seoul National University 2004). The biggest social conflict was between POSCO and citizens for environmental pollution. According to survey towards POSCO, 'air and water pollution problem' as 56% and 'lacking local social contribution' as 26% of total 77 respondents (Koo 2008b). Therefore, POSCO made compensation with the environmental issues. Pohang City has smaller foreign population group, labor strikes, and criminal rate. Due to domestic employment from POSCO and company's regulation for no labor union policy, and relatively high-income level of manufacturing workers creating a safe environment.

[8] Company town is defined. Local large enterprises tend to strengthen the control and political power and control of production and settlement in the region. (Ref)

Labor strike is unrecognizable that POSCO didn't have labor union capital-labor conciliation policy. However, there was truckers strike (2006) and construction labor union strike (2007).

The crime rate has been not as high as national average.

Foreign population is smaller less considered in the local city.

Education population shows increase foundation of POSTECH University (1985). The University ranks top university for a new establishment in 50years (The time 2012.5.31) and top in Joon-and newspaper domestic university evaluation. Handong University (1995) is also a local university.

5.3.2.3 Environmental Dimension

1) Pollution

In the 1970s after the inauguration of the POSCO steel plant, dioxin level of Hyung-san river and neighborhoods near the industrial area. The demo increased from residents of Hae-do-dong was for compensation of 30 years pollution damage. In 1967 POSCO industrialized area 1km boundary has been designated as a park area, but 1969 changed to a residential area and 1977 the inflow of residents started. Regardless of direct consequences from the industrial activities, the dispute was more focused to unequal investment and distribution of the services in the area.

The relation between POSCO and Pohang City government has worsened, in 2003 Pohang City reported POSCO's illegal emit of polluted water and claimed the loss of Songdo beach sand due to young-il-man reclamation last 30years.

Pohang City publishes an environment white paper since 2005 to manage and improve the city environment.

> ***Pollution*** Air pollution factors from industrial activities and heating system. The increase of Car use is contributing to increasing of NO2 during 2000-2004. According to Pohang City social research report 2010, the used car rate is high like other local cities, according to the survey that 30.3% use the car for commuting, bus (8.4%), walking (8.2%), commuting time 15-30min (48.9%).

2) Waste management

Total waste generation is increased in the city, however, compared to before the national law for pay-per-volume in 1994 the city waste decreased (-24%), and recycling increased (+212%). The waste treatment methods are landfill, recycling, and incineration. The incineration facility closed in 2004. Total 17 landfill sites existed and except three facilities for living waste, other local areas closed in 1994-1999 and finished land stabilization. Among total industrial waste, 65.99% is from POSCO as

3) Energy

Pohang City the electricity use increased over time. The electricity is from the thermoelectric power plant and a nuclear plant in Youngduk. The type of fuels for buying diesel mostly due to a large portion of transportation trucks from industrial production sites. In 2008, POSCO opened fuel battery factory.

5.3.2.4 Physical Dimension

1) Industry centered urban structure

The Urban structure of the Pohang City shows the large industrial region and clearly divided from Hyungsan river.

Land use Old city center and large industrial complex till the 2000s. Land use has been steady until the late 2000s.

Industrial complex there are four national industrial complexes in Pohang.

Industrial Port which Young-il-man port, capacity 11million ton, 16 ships (Container 4, General Pier 2), 12-15m depth, 5,120m length. Young-il-man new port – container (opened in 2009) 1,000m 0.6km2 yard, volume 35,000TEU, capacity 480,000TEU, Harbor accommodation about 4 boat in 30,000DWT. Operation 4 companies seven routes, nine voyages[9]

2) Suburbanization and city center decline

Suburbanization first started from POSCO worker's residential housing locating in the further west of center city region. New development of housing in northern east part has incurred serious suburbanization. Due to the increase of accessibility, the population outflow might increase.

Along with the suburbanization and out-migration to larger cities, city center redevelopment is a major problem (Koo 2013; Kim 2013).

Before the first relocation of city hall the city center (currently 'Yeocheon' and 'Sangdo' area as an administrative center and commercial in 'Jukdo' and 'Daedo') since the late 1990s, a decline of city center living and cultural function has been showed. The problem led to congestions from commuting road in the inner city and designated as a first residential area which makes less floor area ratio and capacity and lack of commercial use. Disconnection of the pedestrian road to inner city market places and commercial area and lack of park and green spaces has been the problem.

According to the survey on citizen's perception of the decline of the old city center and redevelopment, 89.5% of the citizens (total 317 people) has been feeling decline and stagnation in the city center. The reason has been due to city hall relocation (20.9), POSCO's environmental pollution (15.0), and suburban new-town development (15.0). Among 317 respondents 39.5% visit every day 30% 1-2 times per week

[9] Source: Pohang City Report (2013) pg.111-113

for work 34.6%, and 44% entertainment such as a meeting (17.0%), shopping (15.4), and cultural facilities (11.6). Others include banking and administrative (14.8). Therefore, the old city center located in between Buk-gu and Nam-gu has much importance and accessibility. (Ahn, 2010)

Urgent revitalization of the city center is the priority of city government. There is total 14 of redevelopment and reconstruction projects on-going (Pohang City, 2014) Bukgu area (10) and Namgu (4) area where the first reconstruction of Doo-ho-dong in 1998 authorized for project implementation after ten years. A half of the projects initiated in 2008.

Residential area and housin:

Jigok-dong 3.37km2 6,600 households, 30,000 population 8 schools (preschool 1, elementary 3, middle school 1, highschool 2, university 1). Civic Center 1, police station 1, post office 1). Newly developed Yang-deok area near young-il-bay industrial complex, 6.5km2 7,565 household 23,495 population.

3) Outmigration from transportation development and regional network

Out migrations from 2000-2010, the most popular region to move out destination is Daegu City (35.3%), Seoul Metropolitan (30.9%), Southern-east, including Busan, Ulsan, and Gyungnam (19.2), Daejeon and Choongcheong regions (8.4%).

Transportation developed from automobile-oriented with less public transportation. Pohang City has two expressways total 23.2km length, between Daegu and Pohang (KWR 19,950 billion) constructed from 1997 opened in 2004. It is 13.5km (out of total 68.42km distance of Daegu-Pohang), and Pohang to Ulsan (KWR 17,711 billion) 10.74km (out of total 53.5km distance of Ulsan-Pohang) opened in 2010. Pohang beltway built from 1995 and finished in 2011 and contributing to ease of inner city congestion.

In 2009, the study revealed 45.2 percent of people (total 824 people) from Pohang City and other five neighboring cities in Kyungbook, are for integration with Pohang City. The possibility of mutual partnership towards integration is high between Pohang City and the Gyungju City (Pohang 78.5 in Gyeongju, Gyeongju 80.3 to Pohang) and other regions showed positive opinion towards Pohang City (such as rural region as Youngdeok 90.1, Youngcheon 73.7).

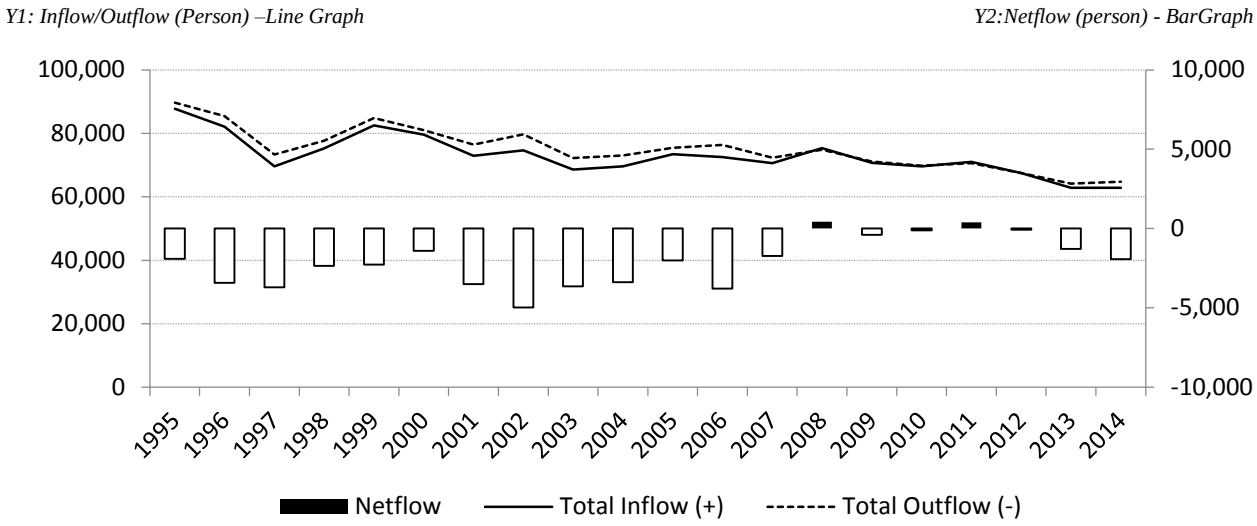


Figure 5-6 Population inflow and outflow of Pohang City (1995-2014)

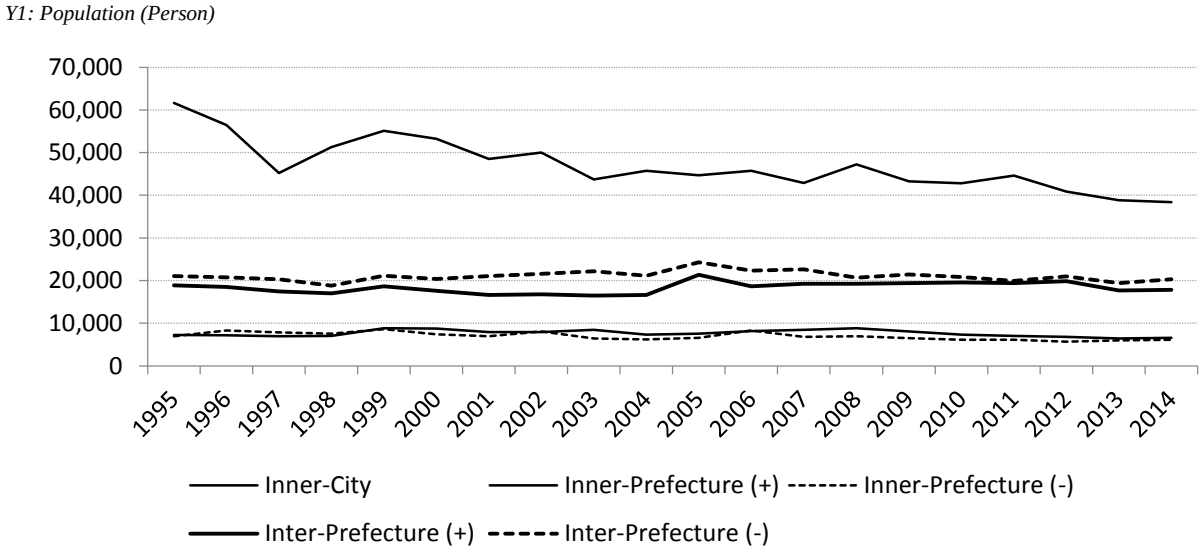


Figure 5-7 Population inflow and outflow by location of Pohang City (1995-2014)

Source: Pohang City Statistics

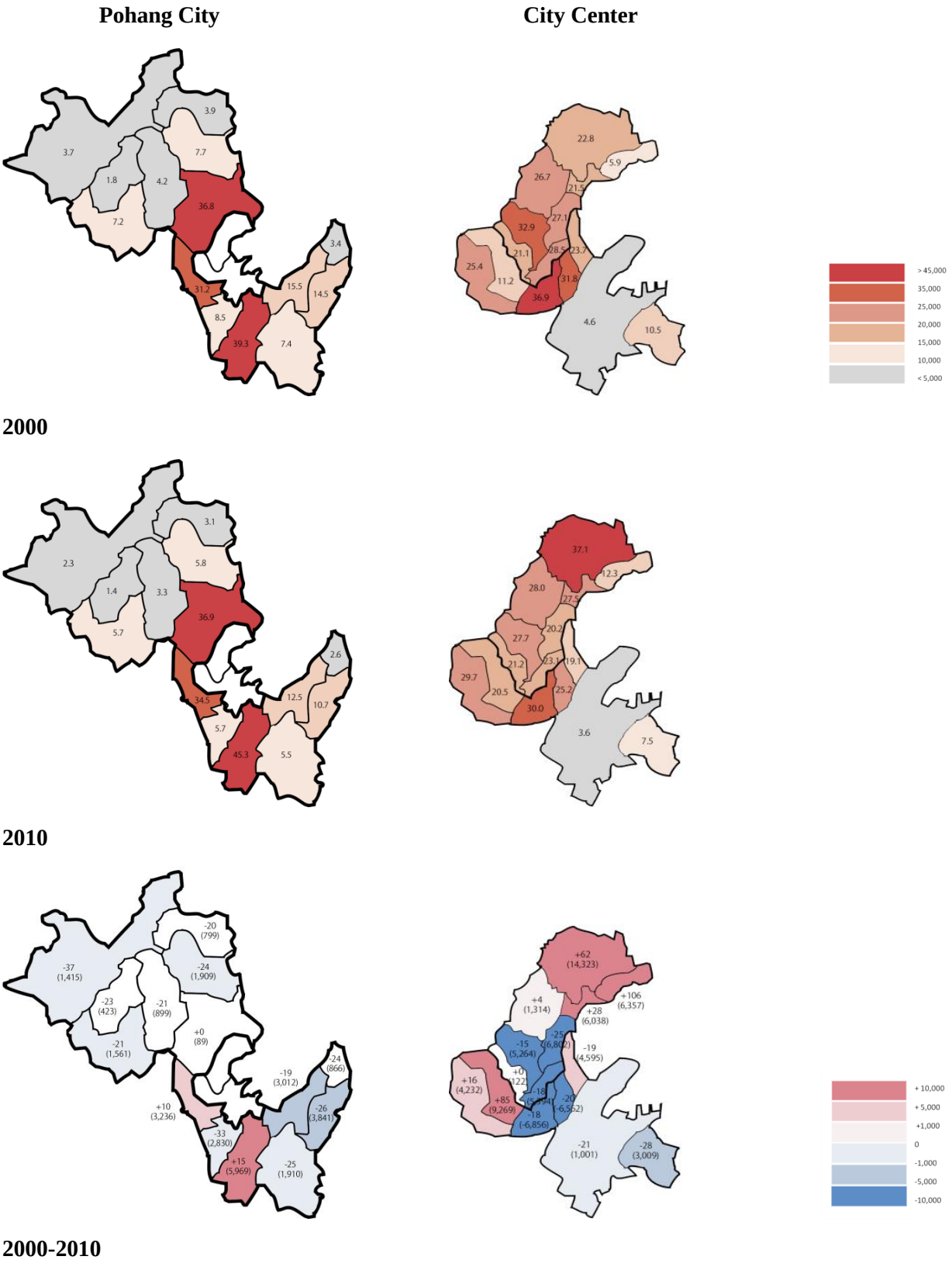
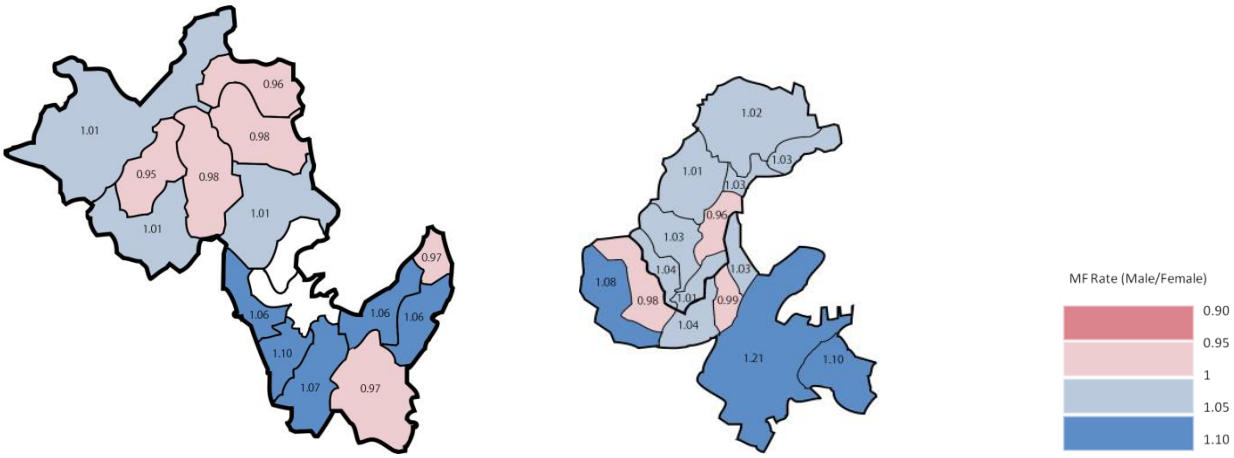
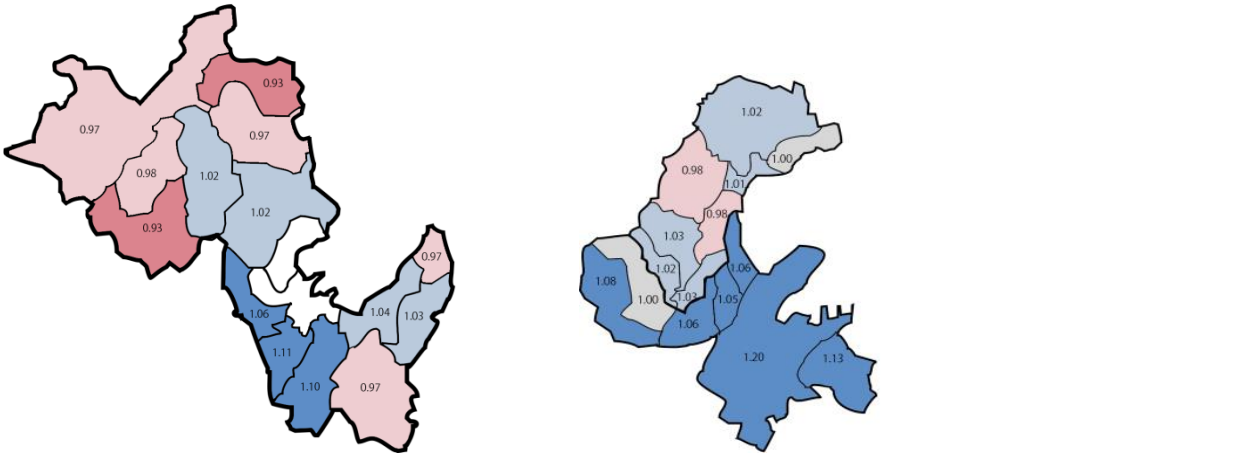


Figure 5-8 Population Change by District of Pohang City (2000-2010)

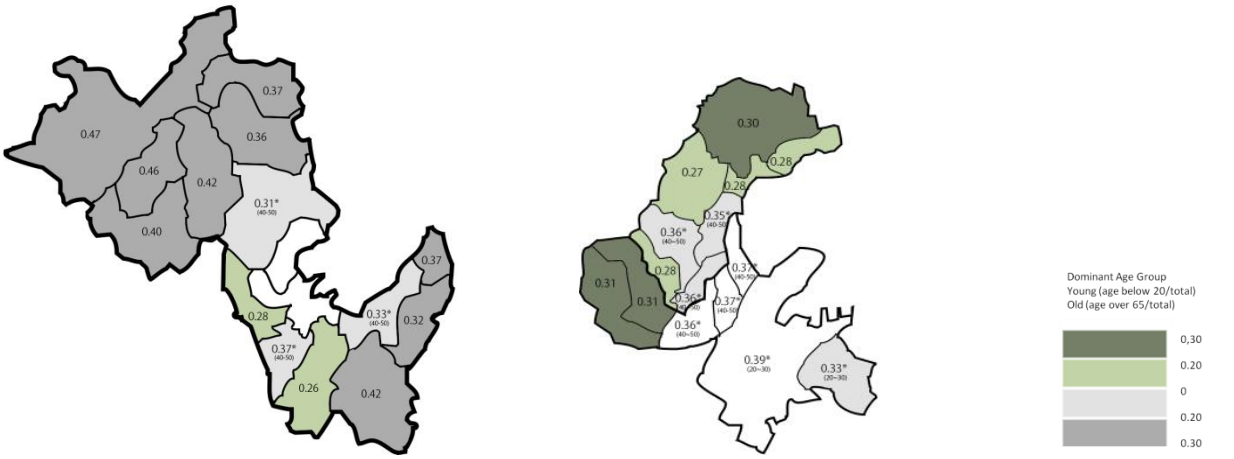
Pohang City **City Center**



2000 Gender



2010 Gender



2010 Age

Figure 5-9 Population by Age and Gender of Pohang City (2000-2010)

5.3.3 Urban Planning and Transition Strategies

5.3.3.1 Political Background

Korea started local administration from 1995, Pohang City had elected government since 1998. The transition considered with the vision and the plan of the municipal government.

5.3.3.2 Development Plans and Strategies

Pohang City developed as an industrial city until 2000 and changing its vision and strategies in recent ten years. National and regional planning designated Pohang City as the industrial city and central regional city from the 1970s and invested. The table shows related national and regional government planning and the role and direction of Pohang City.

The city of Pohang developed plans 'Global Pohang' for the slogan, the base for international trade in March 2009. In this plan, the government listed 'High 5' projects and 'Happy 5' projects. Aiming for 'Global City Pohang: Dream and Future', the High 5 projects consist prior investment in Social Overhead Capital (SOC) business as the mostly development of the new economic environment and industrial infra including city center renovation. The development projects include; 1) Young-il-man port and industrial complex development 2) Free Economic Zone (FEZ) 3) Pohang Techno Park 2nd complex 4) Dong-bin inner port redevelopment. 'Happy 5' projects are to improve living quality for citizens to create 'better living happy city' with cultural, social welfare, green growth and ecological, environmental city, global human resource and educational city, and job creation.

The major focus of global 2020, 'Young-il-man Renaissance' suggested visions for the transition. Young-il-man Renaissance promoting council act abolished in 2014. After the Young-il-man Renaissance plan, the new government included T7 Ocean Renaissance to the vision of the city.

In 2014, Along with the national government plan, the Pohang City developed its 'Creative City initiative' creating a partnership among local university, industry, and local government and designated each role (Pohang City 2015).

Table 5-4 National and Regional Government Planning for Pohang City

Level	Plan	Year (Renewed)
National	Fourth Comprehensive Plan Land modified plan	2006-2020 (2012)
	National transport plan period	2001-2020
	National Environmental Master Plan	2005-2015
	Regional Development Five-Year Plan	2009-2013 (2014-2018)
Regional	Gyeongsangbuk-do a comprehensive plan modification plan, 3rd	2008-2020
	Fourth Gyeongbuk Regional Tourism Development Plan	2006-2016
	Daqing economic development plan	2009-2013
Municipal	2020 Pohang City Master Plan	2003-2020
	Knowledge creation type Pohang Daegu-Gyeongbuk Free Economic Zone District Development Plan	2008-2020
	Pohang City traffic maintenance plan	2009-2017

Source: Pohang City Global 2020

Table 5-5 Pohang City Municipal Government Plan

	Young-il-man Renaissance	T7 Ocean Renaissance[10]
Time	2000-2010	
Vision	-International distribution and exchange based city -Green & Environmental city -Advanced Welfare City -Science & High Technology City -Marine culture & Tour City	-high-tech based industrial city - creative and environmentally friendly city -Marine life and tourism.
Major Development	'High 5' projects and 'Happy 5' projects 1.Young-il-man port and industrial complex development 2. Free Economic Zone (FEZ) 3.Pohang Techno Park 2nd complex 4.Dong-bin inner port redevelopment	1. Pohang cannel amenity and park facilities (panel area) 2. Pohang canal city area renovation (vicinity) 3. Pohang old port design waterfront 4. Dong-bin inner port renovation 5. Song-do beaches sand restoration 6. Pohang old port function redevelopment 7. Tower bridge construction 8. The Seaside new town 9.Young-il bay bridge - Seaside new town 550billion KWR, 1.674m2

[10] Pohang Cannel T9 Ocean Project (revised version)

5.3.3.3 Major Events and Significant City Development Projects

1) High-tech Industrial Development

Pohang Technopark is an industrial complex locating 24 high-tech research institutions to promote network between industry and academia. From 2000-2005, total 188,000 square meters with 500billion KWR (POSCO invested 165,000 square meters land and 100billion KWR). The plan is to integrate industry, academy, and research by creating a cluster of Information Technology (IT), Biotechnology (BT), Nanotechnology (NT), Environmental Technology (ET).

2) Industrial Infrastructure and Development of Social Overhead Capitals

Total 143,866TEU in 2013, 68% of the quantity of goods transported are automobile from Pyungtak (Ssangyong, disassemble) and mid-port from Japan to Russia (Matzuda, disassemble). However, Young-il-man port and container terminal operation have been falling short to meet expectations of utilization and construction of industrial complex is behind schedule (Koo 2013). The city provided shipping yard for free. Companies in Daegu and Gumi avoid using with a lacking number of routes and service frequency compared to Busan harbor.

3) City Center Redevelopment and Environmental Restoration

Pohang Cannel project completed in 2013, the total length is 1.3km and area of 33,988m^2.[11] Construction was initiated by the city government to improve water pollution problems which occurred in Dong-bin inner port due to river redirecting the paths developed during industrialize era. The development also to improve the commercial environment and preventing slums in old city center area for renovation and meet the agenda to promote the city as environmental ocean tourism and opened (2013.11.2),

4) Partnership

POSCO has also been a major partner for local development. According to a survey in 2007, 92.5% of 253 respondents answered and supported the positive effect of POSCO to local society (Koo 2008c).

[11] Planned area includes Hotel and Accommodations(8331) Commercial Area (15,211) Observation (549) Park and Stores(759) – Source: Pohang city

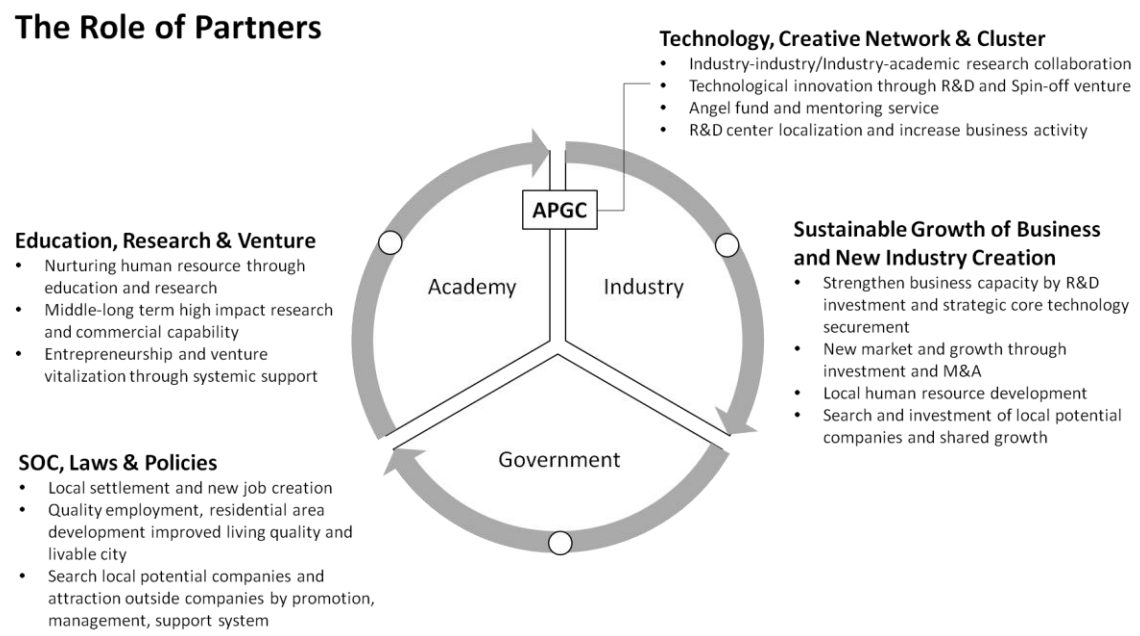


Figure 5-10 Role of Partners in Pohang City Model of Small and Strong Business (SSB) Nurturing System in Creative City Initiative

Source: Retrieved from Pohang City Creative City Initiative Report 2014

Social contribution of POSCO was including broad aspects from education and scholarship, research support, culture and art, physical activities, social services, and environmental support. Action for local cooperation since 1991, financial support for more than 1,63,420,000KRW (1990-2002) and worker's social contribution with volunteering activities.[12] POSCO reinforced and systemized local strategies afterwards.

The privatization in 2000 that increased need and importance of local relation as a company supervised without national and local government's protection. The public relations department takes the role of improving brand image. Pohang City and POSCO holds quarterly conference meeting since 2004 improving local collaboration dealing issues such as local culture, residential and green area, and the environment. During the transitional phase, POSCO invested environmental improvements and beautification of the city with installing lights to POSCO environmental tower and Hyung-san generator for scenic tourism in 2005 (5.5 and 11.7 billion KWR each) or developing Hyung-san River walking the

[12] Pohang firework festival (2004) 1billion KWR, vitalize traditional market with purchasing market products and gift vouchers, establish sisterhood relation with local area and social service mileage system, free soup kitchen and financing support low income households 4mil KWR (2005)

trail in 2005 (4.7 billion KWR). Cultural events for Pohang firework festival from 2004 till 2013 also been financially supported from POSCO.

Creation of partnership between Pohang City government, POSCO, and POSTECH was recently highlighted for transition (Hong et al. 2007). However, the local universities remained mainly focusing on educational functions and less involvement in development due to the specialization of universities. Partnership with local universities and institute stressed in a transition phase. In 2012, advanced Pohang Forum (AP Forum) was created for local leaders to initiate learning and create a future vision for Pohang. The group visited advanced case of cities in the US, UK, and Germany in the former industrial city in transition. For example, Seattle and Pittsburgh in the US, Manchester and Sheffield in the UK, and Dresden in the UK. **Figure 5-10** shows the role of partners in Pohang City model of Small and Strong Business (SSB) Nurturing System in Creative City Initiatives since 2014.

There are small numbers of partners with local organizations, NGOs, and resident groups, however their works remain a minor role in the society.

5.3.4 Summary

The major transition started from 2005, ten years after the local autonomy and seven years after the IMF, which is a significant turning point for national economic transition. It is also five years after the peak of population in 2000, and industrial peak reached in 2010. Therefore, the downturn of population and recession from the manufacturing industries is a relatively recent problem.

National and regional plan, designate the Pohang City as an industrial city with possible strategies of high-tech, science, and technology, research. The city is positioned as an important center in Kyungbook region with increased connectivity. The recent accomplishment of transition suspected from unverifiable advantage from political landscape exists as Pohang City. As the city being politically conservative parties since the 1970s, the city kept playing an important role as an industrial base and regional hub since1970s. The transition to post-industrial and receiving related support from the government was absent during the 1990s, when the government switched growth pole strategies to achieving regional equity and started to invest in the western region for high-tech industries. National government strategies are still focusing on the industrial development of Pohang City and its advancement.

Municipal government effort to transition started from the 4th municipal government that Mayor Park using the word ‘Renaissance’. New attempts to start in considering post-industrial development, but mostly focused on S.O.C. Development. The name of the project changed afterward, but vision and strategies are not far off from the initial plan. The investment in mega structural infrastructures such as Pohang industrial complexes and ports is mainly developed and funded by the national government. Recent strategies are a more targeting increase of tourism with the development of historical and cultural resources and design project for the city center such as Pohang canal and inner port renovation. Much more, environmental values noticed from song-do beach sand restoration and redirecting water flow from Pohang Cannel. The POSCO largely funded those inner city redevelopment projects.

Synthetically, the plan and strategies imply that Pohang City still lacks fundamental measures considering future challenges of economic restructuring and social-environmental challenges to achieve sustainable development. The municipal plan for focusing on physical design and development criticized for its superficial, temporal, popularity of the politicians, but the partial effect on transition are valued.

Pohang City is in a transition phase at the stage of development. Transition phase started during 2005 with the economic crisis and after reached its peak in 2010. Pohang City industrial and population development shows the recent decline and expecting further decline. Continuous industrial development support by the national government and resulting in population re-growth shows optimistic future of the city.

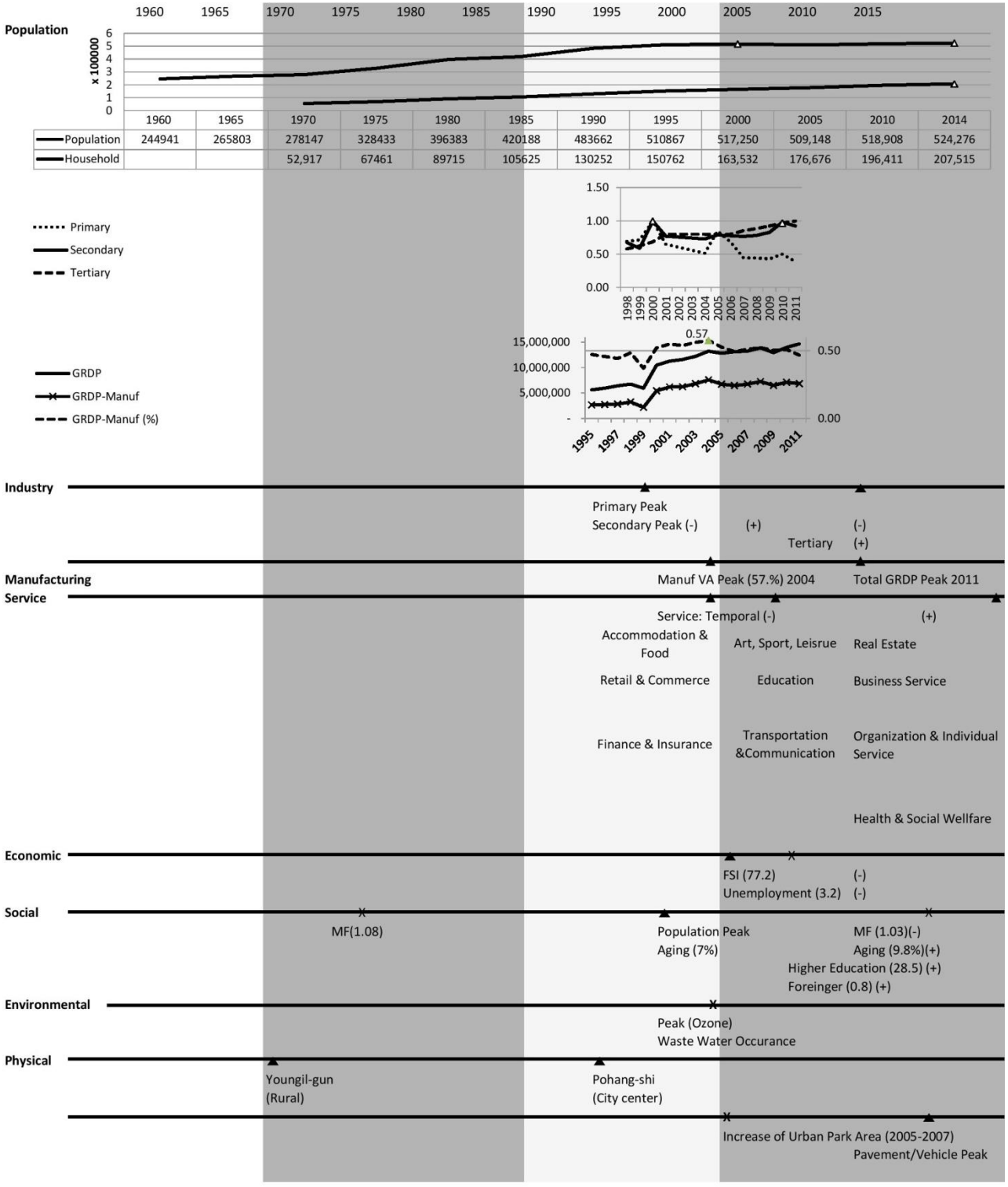


Figure 5-11 Synthesis of Multidimensional Transition of Pohang City

However, Pohang City seems to maintain its structure from manufacturing industries, while post-industrial vision is lacking key anchor industries from 2010. The city effort to enlarge S.O.C projects, for example, Young-il-man port aiming to be an international hub port, didn't match the demand from industries and another region. Also, economic restructuring has not been a major concern for the city despite the economic crisis in 1998, the reliance for the POSCO is consistent. Therefore, the municipal plan seems to be achieving less due to its belated recognition to future crisis. More recently, promotion for tourism is initiated as processing the physical renewal of the city design during 2005-2010. Nonetheless, the vision for post-industrial Pohang City is converging into two main areas high-tech and tourism. The city's natural resources such as beach and seafood, historical and cultural story making are expected to increase. The human resource from the research institute and universities which developed during the industrialization period also became a critical asset in the region.

Regarding the impact on social and environmental aspects of transition, there are two major impacts from social factors which considered as power relation of POSCO and resident composition. The city has been financially dependent on the company, and the relation is worsening with the economic recession. Individually, since the establishment of POSCO, the large migration resulted in the higher proportion of the outsiders leaving after the retirement, citizens lacks interests in the future of the city. The social structure and power relation ongoing from the industrialization period is becoming a barrier to post-industrial transition. Environmental aspects not fully considered as major transition concern in the case of Pohang City. However, environmental pollution problem partially correlated to center city decline since the residents moved out from central region where often concentrated smoke, noise, relatively closed to production facilities. In fact, misdirection of a government plan is another factor for city center decline especially moving city hall from the central region that accelerated the suburbanization and sprawl. Other issues as aging issues and increase of consumption related issues (waste, energy) are a critical challenge for transition, however, at the municipal level the city plan and projects are not directly considering these issues. These issues often managed by national government level that policies and implications have not yet fully activated and recognized. The city is stressing economic measures from creating job and developing new industries and expects to bring younger generation in the region.

5.4 Yeosu City

5.4.1 Basic Information

5.4.1.1 Location and Administrative Boundary

Yeosu is located midway along the south coast of the Korean Peninsula. It borders Namhae, South Gyeongsang Province, to the east and Goheung, South Jeolla Province to the west. It also shares boundaries with Suncheon to the east and Jeju Island to the south.

Inside the Yeosu City boundary, there are 365 islands (5 connected by land, 49 inhabited, 316 uninhabited) and coastline length 879.03km including two marine national parks, Hallyeo Marine National Park, and Dadohae Marine National Park. The area of Yeosu City is 508.84km^{2,} which 60% is forestland (305.23) and 21.8% of agricultural land (107.03).

The area of industrial land (19.77) is the largest in Korea with four industrial complexes along the coast. Following the integration of the three Si (cities) and Gun (districts) of Yeosu City, Yeocheon City and Yeocheon-gun in 1998, Yeosu has been classified as an "urban-rural complex city" having administrative division 1 eup (town), six myeon (townships), 20 dongs (communities).[13]

[13] 1949 : Yeosu-eup upgraded to Yeosu-si with the remaining nine myeon (townships) renamed as Yeocheon-gun; Yeosu Harbor opened
1976 : Yeocheon District Office of South Jeolla Province opened (Samil-myeon and Ssangbong-myeon in Yeocheon-gun)
1980 : Samil-myeon and Dolsan-myeon (townships) upgraded to eup (town)
1986 : Yeocheon District Office of South Jeolla Province upgraded to Yeocheon-si (with 7 dong)
1998 : Yeosu-si, Yeocheon-si, and Yeocheon-gun incorporated into the unified city of Yeosu on April 1
- *Source: Yeosu City Government - Historicy*

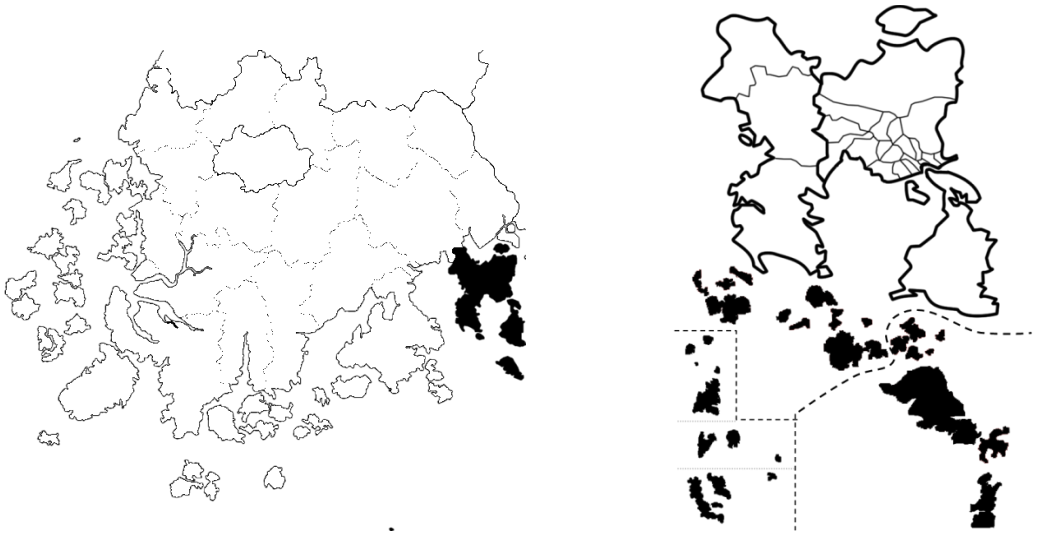


Figure 5-12 Location and Administrative Boundary of Yeosu City

Table 5-6 Land Area by Category of Yeosu City

Land Category	Area (㎢)	Percentage
Forest land	305.23	59.99
Agricultural land	107.03	21.8
Developed areas	22.21	4.36
Public space	21.24	4.10
Industrial sites	19.77	3.89
Other	54.00	10.61
Total	508.84	100.00

Source: Yeosu City government (Dec. 31, 2014)

Table 5-7 List of Variables of Yeosu City

Category		Variables	Unit	Years
Economic	Industry	Employment by Sectors	person	1997-2013 (1)
	City Economy	Manufacturing Industry: Sub-category Employment, Value Added, Export (Chemical industry)	person million KWR	1997-2013 (1)
		GRDP	billion KWR	1997-2012 (1)
		Financial Self-Sufficiency Rate (FAR) Financial Independency Rate (FIR)	index value	2011-2013 (1)
		Unemployment	%	1997-2013 (1)
Social	Structure	Population, Household Age, Gender, Education, Foreign Population Education (number of university students)	A person, houses A person, % person	1964-2013 (1) 1997-2014 (1) 1998-2014 (1)
	Security	Crime Rate		1997-2013 (1)
	Integration	Social Inequity, Conflict, Labor Strikes	quantitative	
Environmental	Pollution	Air (CO_2, SO_2, NO_2, PM10, O_3)	ppm, $\mu g/m^3$	2006-2013 (1)
		Waste: Waste treatment facility capacity	M	1997-2013 (1)
	Environmental Management	Waste water (penetration rate)	$(km^2/person)_{/100}$	1997-2013 (1)
		Energy: Oil (use), Gas (supply, use), Electricity (all use, manufacturing, power generation)	1000 m^2, HWh, MW tons	1997-2013 (1)
		Major events	quantitative	
Physical	Land Use	City Planning (Industrial, Residential, Commercial) Industrial Complex (utility rate)	ha %	2013 1997-2013 (1)
	Housing	New Housing Development (by district)	houses	1997-2013 (1)
	Transportation	Road pavement	%, m^2	1997-2013 (1)
	Urban Structure	Out-migration: population inflow and outflow	person (+)(-)	2000-2010 (1)
		Suburbanization: (population by district)	map	

5.4.1.2 Key even and Population Development

Yeosu has a population of 294,459 (149,725 males and 144,734 females) divided among roughly 116,100 households, making it the largest municipality in South Jeolla Province.

Industrialization started in Yeosu from 1967 with the construction of Yeocheon Industrial Complex as national level. The major company GS-Caltex[14] Yeosu Factory located in 1969, the population has consistently growing from is the 1960s and reaching a peak in 1992 with a population of 333,194.

In 1998, the city integrated three cities in the region (Yeosu City, Yeocheon-Gun, Yeocheon City) and became a urban-rural integrated city. Despite the enlarged area, the population declined from 1998 due to out-migration of people from the old-town and rural area.

Industrialization affected different paths of population development previously in (b) Yeocheon City and (c) Yeosu City. As population decline is severe in (a) Yeocheon gun a rural area including island regions and increases in (b) Yeosu City rapidly declined after the 2000s. Yeosu City (c) area is a newly developed with industrial development as it continuously grows and reaching the peak level. Yeocheon City inflow exceeded Yeocheon gun area population outflow since 1993.

Development of Yeosu City divided into four phases;

Phase 1	Pre-industrialization (1949-1966)
Phase 2	Early industrialization and integration (1967-1993)
Phase 3	Population peak and integration (1993-1998)
Phase 3	Post-integration and population decline (1998-2007)
Phase 4	Post mega-event and future post-industrial development (2007-2014)

[14] GS Caltex was founded in 1966-1969, the 1st private oil company in Korea. Joint venture agreement with Caltex Petroleum Corp of the US, Yeosu refinery was first built in 1969 and Polypropylene plant in 1986. The company also has lubricant plant in Incheon city since 1988. Independent management by Korea started from 1996 and changed its name from LG-Caltext Oil Corportatoin to GS Caltex and now jointly owned by Chevron and GS group. - Source: GS Caltex (www.gscaltex.com)

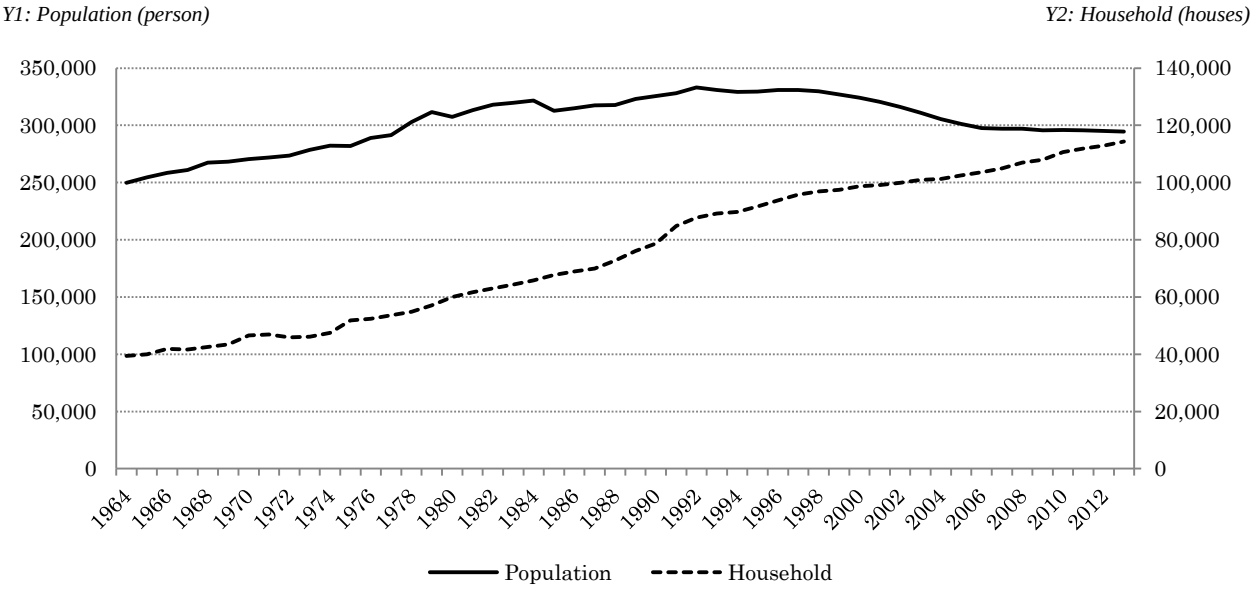


Figure 5-13 Population and Household of Yeosu City (1964-2014)

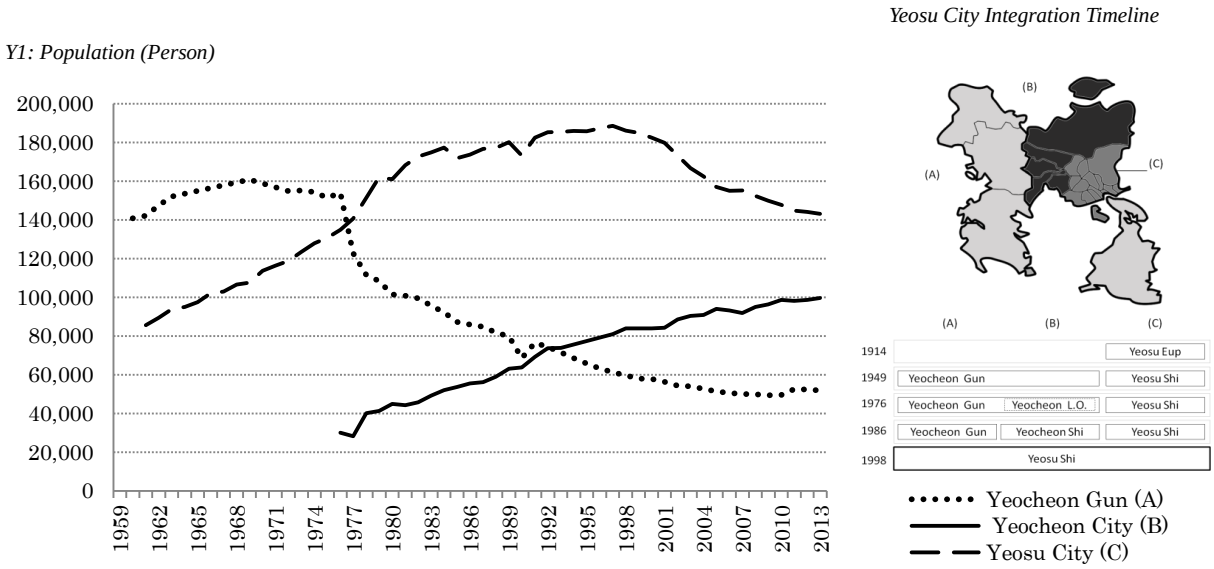


Figure 5-14 Population change by regions before integration of Yeosu City (1959-2013)[15]

[15] Data after 1998 is aggregated based on the past boundary of cities

5.4.2 Multi-Dimensional Transition Issues

5.4.2.1 Economic Dimension

1) Continuous economic growth with industrialization

Yeosu City is continuously maintaining manufacturing dominant industries and planning for growth. The city is dominant in heavy chemical industries with over 50% of employees and values still dominant. The dominance of chemical industries is not much different from 1998.

Industrial Structure Industrial structure from employment in primary, secondary, tertiary that secondary manufacturing business increased in late 2000 due to continuous industrial development. Primary industry was dominant in Yeosu before with fishing. Service industries are shows growth-decline-re-growth.

- The primary industrial decline started from 1997 (7,719) and reached the lowest in 2004 (279). However, a slight recovery in 2013 and 1,329 people. The largest was in fishery and decline is severe until 2004. The Recent increase is in agriculture.
- The percentage of the secondary industry reached 33% with industrial growth. Manufacturing employment is the largest. Construction shows temporal increased during 2006-2010, mostly daily labor workers due to the development of Expo and new industrial complex. The situation is same with transportation business, electricity, gas, water facilities which tightly connected with manufacturing and construction.
- Tertiary industries began to grow from 2008 while the percentage grows from 54% (51,873) in 1997 to 61% (64,476). Continued decline in wholesale and retail and lodging shows re-growth from 2012 due to Expo.

City Economy show that Yeosu City economy is growing regarding gross production value, and manufacturing industries are still dominant. The percentage of manufacturing is high 0.44 in 2011. The change in 2002 and 2009 shows recovery from economic crisis. Economic active population declines from 1997 then increase in 2010. Unemployment level has dropped from the peak level of 4.3% in 1998 IMF. The rate is below the national level.

2) Post-industrial development and tourism

Advanced industries and marine institutions are advanced possible industries for Yeosu in the future.

Service Industry Among service industries the largest number is in education and shows an increase in Health and social welfare services. Business facilities and support from late 2000. The decrease in finance and insurance, public administration. Low developed professional, real estate, arts, media. The Yeosu City has mere urban characteristics.

Knowledge Industry and Education there is only one university in Yeosu University, student enrollment around 3621-6610 per year and accumulated graduation count 12,423 from 1998-2014. Some students peaks in 2002 and decrease rapidly. The number of professors 138-168 (declined from a peak in 2006, 182) and the number of major increased till 42 in 2009 and changed to 15 in 2010. Graduate school of Jeollanamdo University campus began from 2011 with major in the general course, industry cooperation course, oceanic and fishery course. Graduate school of education and graduate school of industry exists from 1999-2006 and disappeared. The nubmer of students peaks 542 masters from 2002-2005, doctoral students from 117, each 152, 59 in2014.

Tourism a survey of Yeosu City resident, the future of Yeosu City was Tourism and Leisure (40.2%), Yeosu Industrial Complex (28.3%), and Agriculture and Fishery product (13.6%).

Therefore, Yeosu City has been less developed and remaining as a local city without large industrial complex; the city is lacking its development infra. Tourism has been the most critical power of Yeosu City since Yeosu City held World Expo in 2012 the local development. Tourist increased, however, shows declining after the event.

5.4.2.2 Social: Aging and Declining Local City

The city division worsened due to environmental pollution accidents and many people in the primary industry left the city. Yeosu City is also described as a closed society for outside migration due to not many employments in the area.

Aging issue is a concern in Yeosu City as the population over 65 years old reached 40,000 in 2013 at 14 percents of the total population. The aging rate is below the national average but slowly moving from Aging Society in 1997 and Aged society. Regionally older population is living in the island area working in agricultural and fishery.

Social Structure *shows that* Yeosu City is a male dominant society still maintaining a male to female ratio of 103%. High school education is the largest group in Yeosu. Education level increased as the number of college graduates increased during 2000-2009. Male population shows high school graduates dominance (0.41-0.39), female population shows elementary school or less (0.55-0.43).

- The Foreign population is increasing from 2000. Around 3,000 foreign nationality people live in the city which 10.85 in each 1000 person. However, this is below the national average.

2) Social integration between Yeosu and Yeocheon City integration

Social integration issue is among the old Yeosu City residents and Yeocheon City before integration. There were opposed parties in 1998 to vote for integration for two regions; the Yeocheon City remains as old city center with new industrial development in old Yeosu City area. The city hall and other administration office divided into three areas with two different city congresses and elections. Yeosu City Expo held in2012, during the preparation there were disagreements between the citizens.

Social security crime level of Yeosu City is not high. There is a temporal increase in 2003, mostly assault and battery (0.18) intelligence crime (0.20), and again for theft crime (0.13) in 2007.

5.4.2.3 Environmental Change: Oceanic Pollution and Industrial Consumption Issues

1) Water pollution from oil leak and revitalization

Pollution The biggest water pollution incident was in 1995, the ocean water pollution with oil leak has been a serious problem to fishery business.

2) Increase of industrial waste and energy use

Waste Water treatment rate[16] increased as the city developed. The capacity of the waste landfill site is increasing.

Energy The major power supply is from Honam and Yeosu thermal power plant. Total power generation fluctuated, however, peaks 7,648,757(MWh) in 2007. In 2012, Yeosu Thermal power plants decreased from 625.60 to 340.00 (MW).

- Total electricity uses increase during 1997-2013. About 90% of power is use in manufacturing industries and 98% which is in petroleum and coal chemical compound rubber and plastic products manufacturing.
- City gas supply rate[17] was 71% in 2013.
- Oil use industrial use. Diesel and bunker C for transportation as a truck.

[16] Penetration-sewage treatment rate = B/A*100
(A) Sewage treatment (B = b1 + b2 + b3) population sewage treatment zones (people)
(b1) physical treatment (primary) (b2) biological treatment (secondary) (b3) advanced treatment (tertiary)

[17] City gas supply rate (=A/B)
City gas demand households (A) The total number of households supplied zones (B)
(A) 60,373 – 61,568– 64,735 (+) (B) 100,918–98,293–91,236 (−) during 2011-2013

5.4.2.4 Physical: Development of Old- Town

1) Population decline in old city and rural area

Land Use divided from industrial use and old city area.

Industrial Complex: total five industrial complexes in Yeosu City. Yeosu national industrial complex[18] founded in 1969, the complex is connected with nearby Gwangyang City as Gwangyang Bay Area Free Economic Zone. City According to Yeosu Development Plan[19], seven complexes are built by the year of 2020 in the area of 32,099,000m².

Housing: new development of housing locates in the city area.

2) Out-migration and city center decline

Population out-migration is a severe problem in the case of Yeosu. Among 10992 employees of 32 Industrial complex in Yeosu City, 11% lives in nearby Suncheon City, 1% in Gwanyang City and 10% in other location (reference). About 1400 people live outside of the city area. Integration with Gwangyang and Suncheon city considered since 2010, and Yeosu City is struggling for keeping the population of the city area.

Transportation: There was no expressway in Yeosu till 2008.

- Road network improved from 2008 with completion of Yeosu-Suncheon motorway (2008), and bridges between Yeosu-Namhae (2010), Dolsan Bridge 2 (2008). Yeosu Lee Sun Shin Bridge planned in 2002, fully opened in 2013. Industrial complex (Myodo island and Gwanyang, two bridges, 2010) and construction between Gwangyang-Gurey expressway, Mokpo-Gwangyang in 2007 and Gwangyang-Jeonju completed in 2010.
- Construction of the Mokpo-Gwangyang, central South Jeolla Province expressway in 2007. National Highway 77 traversing south coastal region (11 island and bridges between Yeosu-

[18] Feb. 1967: Construction began on Yeocheon Industrial Base
Jul. 1969: Construction completed on GS-Caltex Yeosu plant (daily production: 60,000 Bbl)
Apr. 1974: Announcement of designation of the Yeocheon Industrial Base Development Zone
Oct. 1979: Construction completed on Yeocheon NCC plant (ethylene production: 250,000 tons annually)
Mar. 1981: Announcement of Yeocheon Industrial Base Development Zone basic plan
Oct. 2001: Yeocheon IBDZ renamed the Yeosu National Industrial Complex

[19] Stage 1 (2003~2010): 1,5438,000m² (3,140,500m² in Hwayang District, 2,314,000 m² in Yeosu Airport and 9,983,500m² in Yulchon Industrial Complex I)
Stage 2 (2011~2015): 11,702,000m² (9,554,000m² in Yulchon Industrial Complex II, 2,149,000m² Yulchon Container Pier and a part of the Hwayang District)
Stage 3 (2015~2020): 4,959,000m² (4,959, 000m² in Yulchon Industrial Complex III)

Goheung) in 2008. Rail system double line Jeolla (Iksan-Yeosu) 2008 and double-track electric railway in 2010.

There is one airport in Yeosu (runway 2100m) in 2005. Plan for an international airport expanded (runway 2800m). Harbor use for regular passenger boat service to Jeju, Busan, and Mokpo. Operation of cruise ship between Japan (from 2004)

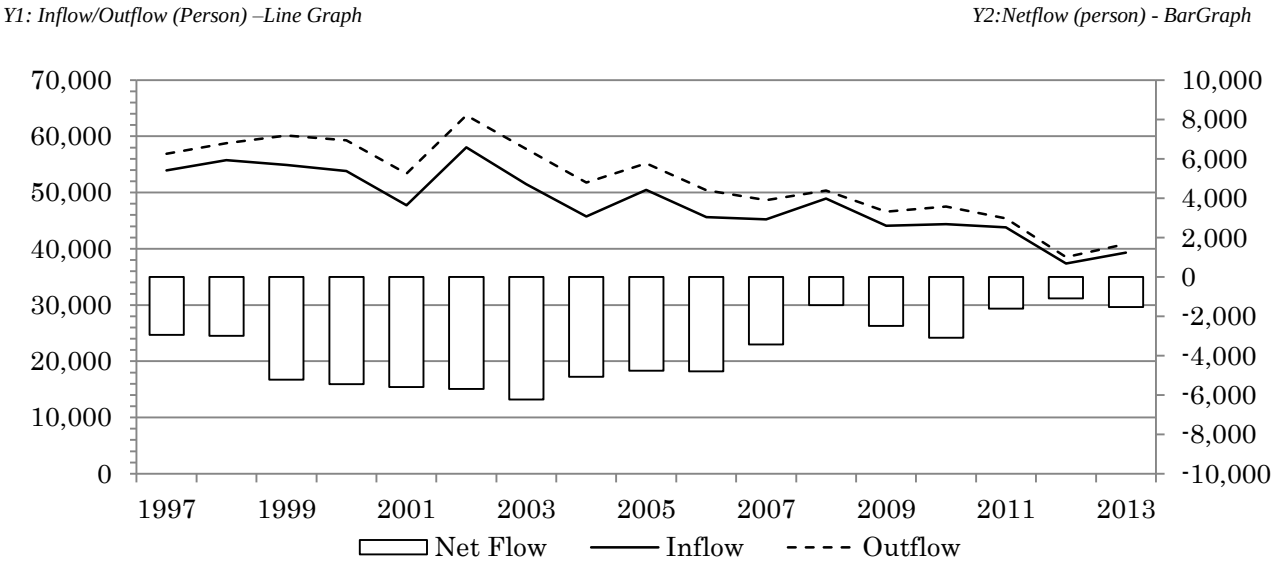


Figure 5-15 Population Inflow, Outflow, and Netflow of Yeosu City (1997-2013)

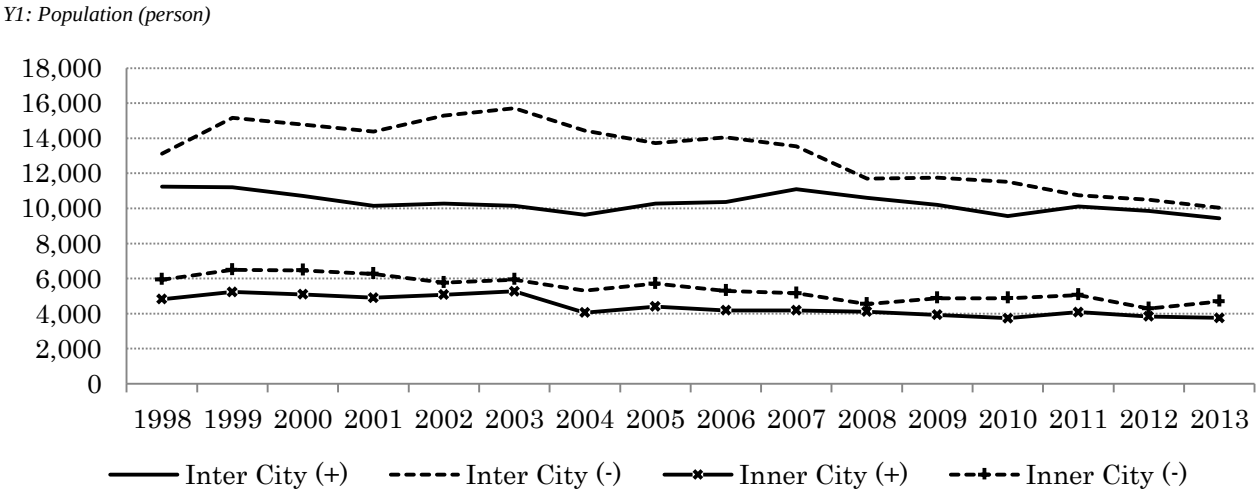


Figure 5-16 Population Inflow and Outflow by Destination of Yeosu City (1998-2013)

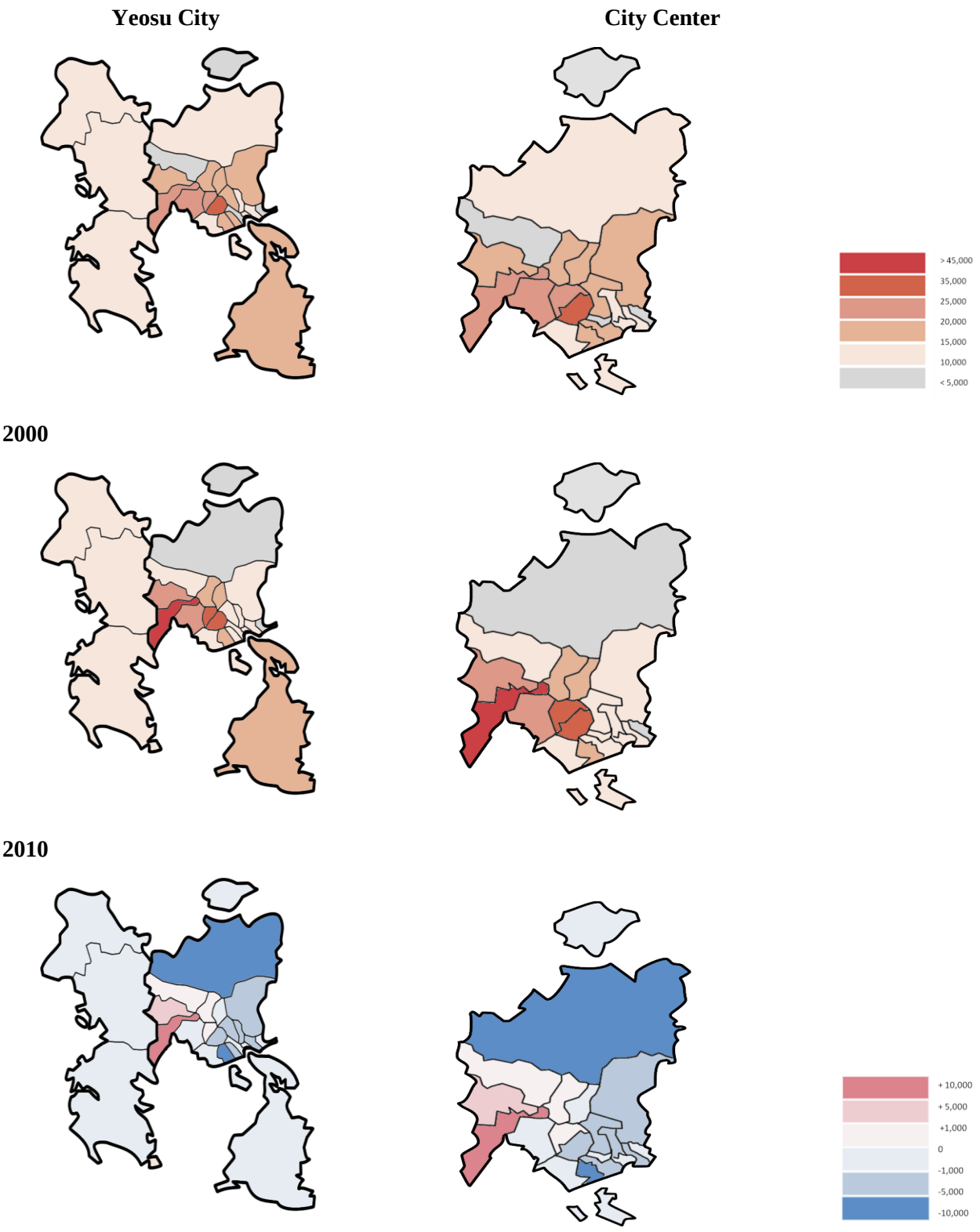


Figure 5-17 Population change by district of Yeosu City (2000-2010)

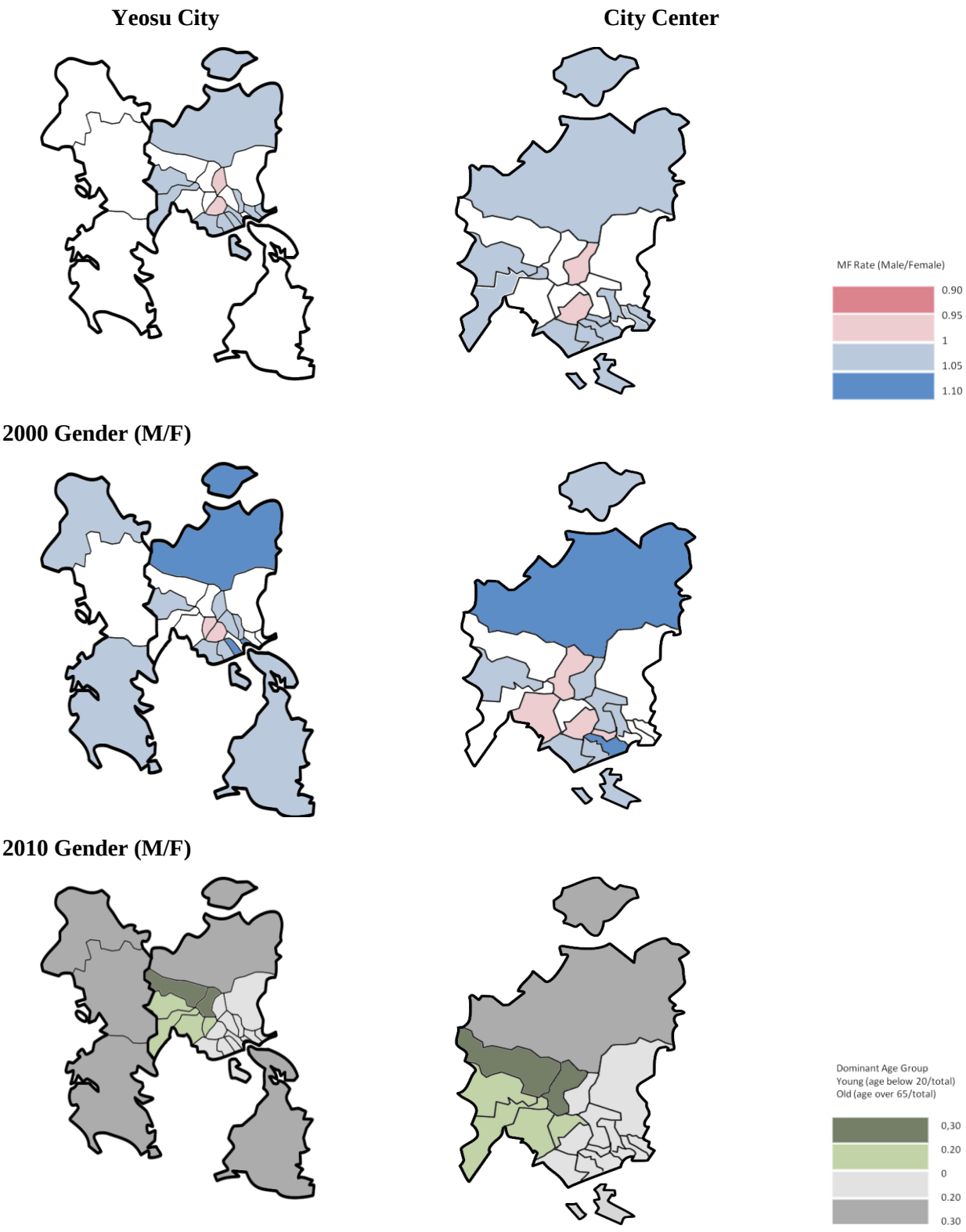


Figure 5-18 Population by Gender and Age of Yeosu City (2000-2010)

5.4.3 Urban Planning and Transition Strategies

5.4.3.1 Political Background

Since integration of Yeosu City, the municipal government has been changed from 1998.

5.4.3.2 Development Plans and Strategies

1) National and Regional

The national comprehensive land development aims to culture Yeosu City with international industrial and logistic exchange with neighboring Gwangyang city area. The major plan for Yeosu City can be

Other plans include oceanic harbor and port management[20]

2) Municipal Planning

According to Yeosu City long-term comprehensive development plan (2001) three big major vision of the city are oceanic tourism, marine industrial and research development, and cultural. Management of industrial complex exists however the possible post-industrial measures began to increase from the late 2000s. The city is aiming for 350,000 of residents and 10,000,000 tourists per year by 2020.

Yeosu City's planning dramatically changes for tourism with Expo development. The vision of the cultural city and increased during the Expo with Yeosu Expo Master Plan and Future Management Plan (2011-2015), Yeosu Tourism Master Plan (2025). Design Culture Creative City Content Development, Yeosu attractions basic and management plan (2012 to 2025)

Issues of social and environmental concern managed by Low Fertility and Aging Society Plan (2011-2015) and Yeosu Environmental Vision General Plan (2006 ~ 2017 years), Climate Change Adaptation Model Development

[20] 3rd Port Master Plan (2010-2019), 1st Marina Harbor Plan (2010-2019), 2nd Coastal Management Plan (2010-2019), Ocean Development Planning (Ocean 21) till 2030

5.4.3.3 Major Events and Significant City Development Projects

Yeosu Expo 2012

Yeosu Expo held during May 2012 ~ August 2012 for three months; the area of 1,983,000m² in the Yeosu new port district, Expo centers were built in the size of (1,322,000m²) and other facilities (661,000m²). Participants were 15 million persons from more than 120 nations.

The expo provided new development opportunities to the region, including Gwangyang Bay and Jinju areas. Economic Benefits from the city production attraction: KRW 10.7894 trillion, added value creation about KRW 5.3840 trillion, and 157,000 the number of jobs created. Location of cultural contents, citizen participation increased, locating old-town and redevelopment turning point.

Yeosu City is promoting tourism with international marine tourism and leisure complex, such as Yeosu City Park Resort Yeosu Marine Resort. The increase in private capital investment, such as hotel, marina, resort and golf courses also a water park and convention center.

Table 5-8 National and Regional Development Plan of Yeosu City

Level	Plan	Region	Yeosu City
National	4th Comprehensive Land Development Plan Amendment (2011-2020)	International industrial logistic exchange Industrial hub for East Asia	Marine tourism
	2nd National Transport Plan (2001-2020)	Increase of connectivity from southwest	(Not listed)
	Southern Coastal Area Comprehensive Development Plan (2010-2019)	Coastal preservation and marine tourism development	Marine sport and leisure
Regional	Jeonlanamdo Comprehensive Plan Amendment (2008-2020	Regional industrial cooperatoin	
	Gwangyang Bay area Regional Planning	Industrial complex and management	Cultural tourism with EXPO facilities

Table 5-9 Yeosu City Municipal Government Plan

	Yeosu Comprehensive City Plan (2001)	Yeosu City 2020
Years	2001-2020	2011-2020
Vision	Industrial hub and marine tourism	International Marine Tourism, Leisure, Sports Yeosu
Major Projects	1. Marine research institute 2. Integration of Yeosu City area 3. Global event and marine tourism	1. Yeosu port beautification world tops four enlisting 2. Expo cultural tourism with Manseongli beach 3. 365 Island tourism 4. Nature resort town (Yeoja, Jangsu, Gamak area) 5. Marina city development for yacht and ferry
Related Issues	Strategies for integration	Redevelopment of old town Tourism

5.4.4 Summary

As Yeosu City, the transition started from the 2000s, the major strategy for industrial development shifts towards tourism and oceanic development. During the period, Yeosu City started for its redevelopment project and aimed to hold Expo in the region. Industrial function and tourism the Yeosu City was successful strategically developing and securing resources in the area. However, since the beginning of industrial development, Yeosu City is planned with neighboring cities for industrial areas and management of the coastal area.

Yeosu is industrial growth-to-peak phase of the stage of development. Economic reached its peak in 2010 and still growing. The risk of industrial decline is less in Yeosu City as locating national government-industrial complexes, but in the long-term the resource-oriented industries and extraction and refinery have a higher risk of its extinction. Therefore, a decline of the city is mostly related to population decline from the 1980s due to the aging and rural decline. Transition without de-industrialization assumed from late 2000 that in 2012 Expo was held in the area which became a big local transition turning point. Therefore, tourism industry began to take an important part in post-industrial transition measures also due to the lack of other measures and resources.

Regarding the impact on social and environmental aspects of transition, there are two major impacts from social integration and environmental pollution. Social integration viewed positively in the case of Yeosu City in transition due to the history of regional integration. Industrialization caused disparate group the Yeosu City and Yeocheon City at the initial stage of development, but resulted in the integration of the three city areas in 1998. The resident's of Yeosu City has a strong background of participation, and the effort of citizens shown in the preparation of Yeosu Expo.

Environmental pollution has been a negative effect of transition in fact, fishing went under due to its impact. Yeosu-city has known for fishery and aquaculture before industrialization. Especially the oil leak incident in 1995 affected the region, made impossible to revival, a lot of people left or move to another region for business. The impact of the environmental accident has been severely damaged the area and decline of fishing industries, and absence of advanced industrial opportunities brought continuous population decline.

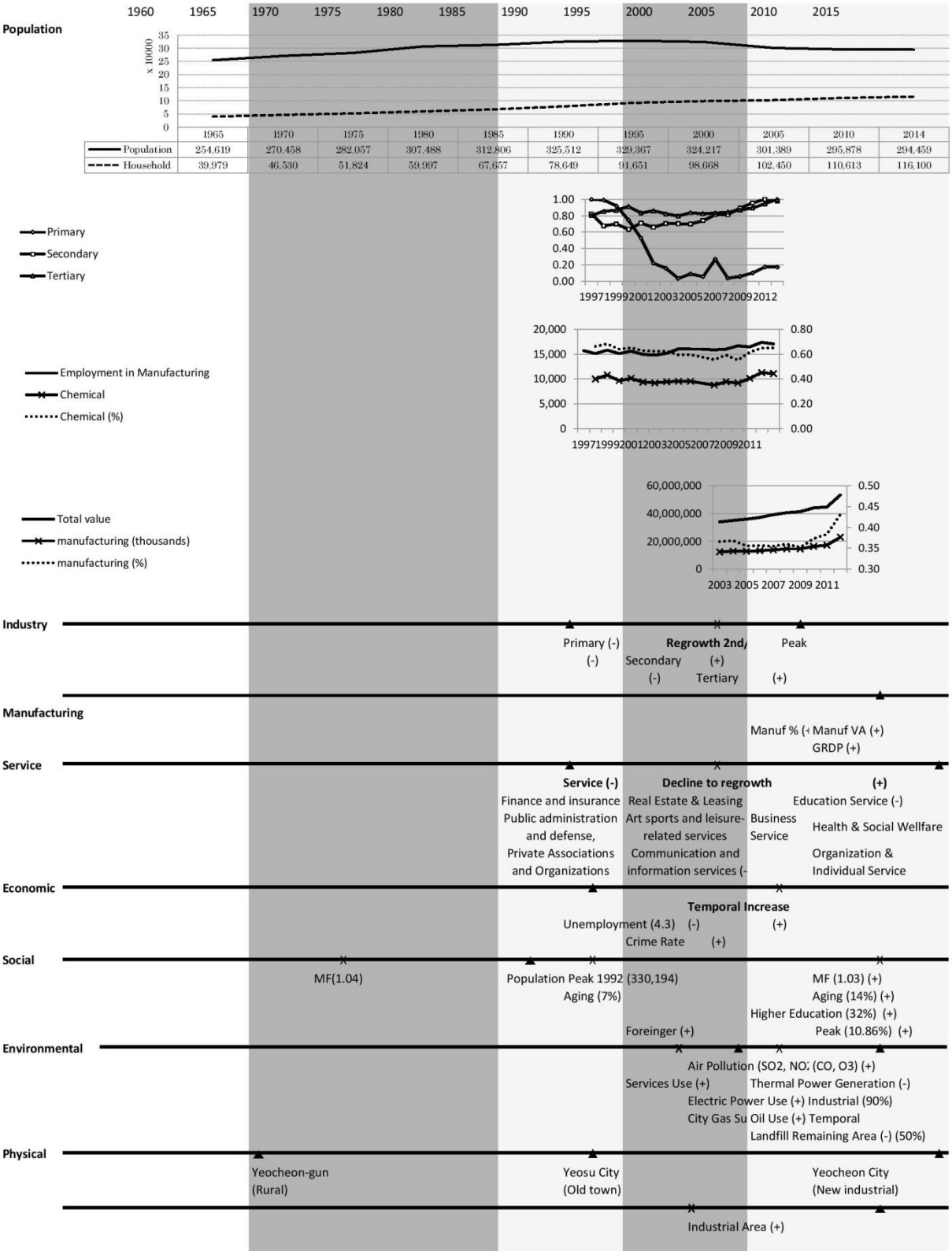


Figure 5-19 Synthesis of Multidimensional Transition of Yeosu City

Aging issues and increase of consumption related issues (waste, energy) are not critical in case of Yeosu, which mostly due to current industrial activities ongoing, the population is younger than other region and decrease of consumption rather than industrial use. However, the city is highly exposed to decline after de-industrialization because of no other strategies is dominant rather than functioning as industrial production.

The municipal level the city plan and projects are not directly considering post-industrial development in Yeosu, but rather keeping the population in the region. With the situation given, the city is more likely to be integrated into other neighboring cities and experience further decline without manufacturing industries.

5.5 Conclusion

5.5.1 Summary

This chapter explained the background of Korea national development and examined the stage of development in industrial cities by classifying industrial characteristics and population changes. Then, selected two industrial cities in Korea in its transition period to understand the process of transition related factors, and strategies.

Korea industrial cities are now expecting further challenges in decline as a few cases exists in peak to declining phase. The Korea national government developed industrial cities in the late 1960s and decline of industrial cities found with a few cases in the former mining industry and light industries usually located in larger cities. Deindustrialization issue in heavy industrial cities is now a concern, although the majority of the cities is increased in population. Locally located small-medium cities are more vulnerable and higher risk for the decline during economic restructuring. An old industrial city such as Mokpo city is further declining, and Masan city was integrated with larger metropolitan region Changwon city. The declining cities are commonly abandoned from political benefits or losing independent executive powers, which can lead to a lack of social services and welfare in the region.

Historical development of Pohang City and Yeosu City reviewed to understand the process of development and current status of de-industrialization. Also identified related issues in economic, social, environmental and physical dimension and pointed out challenges for future development. Finally examined the city government strategies in recent ten years and by assessing local actions towards transition suggested the implications for future direction. Pohang City and Yeosu City are at the peak or recent decline. Two cities have still had dominance in industrial activities and the steady city economy, but the percentage decrease in the manufacturing industries which inferred as a transition period. The detailed comparison of two cities summarized as below.

5.5.2 Comparison of Two Cities

Population and industrial characteristics, issues and challenges, and strategies are summarized in **Table 5-10** through **Table 5-12**.

Both cities grow in 1960-1970s due to national industrialization. Previous to the industrial development Pohang City and Yeosu City was a fishing village and port. Export-oriented location. Pohang City grew bigger with integration with Young-il-gun growth until the peak in the 1990s with population 5million. The population of Yeosu City reached a peak in 300,000, but population difference in the city area is around 100,000 both include in small and medium sized city. Both cities have higher economic status than the national average and GRDP in growth. Value added is more than 50%. However, symptoms of de-industrialization are detected from the decrease in the percentage of employment in manufacturing and

economic recent situation of the major company. Both cities have higher economic status than the national average and GRDP in growth. Value added is more than 50%. However, symptoms of de-industrialization are detected from the decrease in the percentage of employment in manufacturing and the recent economic situation of the major company. Pohang City as ‘Steel City’ locates steel industrial complex with POSCO and subcontracting companies. The largest heavy chemical industrial complex is in Yeosu and other industries. The biggest industrial company is GS Caltex.

Economic transition, the service industrial growth of the city is related to the process of economic restructuring. Population change are not direct effect from deindustrialization is not yet visible, but growth in manufacturing labors decreased. Pohang City shows a temporal decline from 1998 IMF; unemployment level increased. In social dimension more recently, aging issue has been a major concern. Gender or foreigner issues are less dominant and not related to unemployment and crime level for both cities and Korean cities in general. Social integration issues with the migration of new workers. Key local partners are different. Pohang City has a private company and university, however, Yeosu City has a major partnership with citizen groups. Both cities environmental conditions are improved. However, oil leak and water pollution issues are serious factors for Yeosu, contradicting the important resources in the area. Waste and energy use is increasing as city development. Also, consumption increased related to industrial production. The major population of physical decline shows in the rural area. The physical development shows divided structure between industrialization. Transportation development increased regional connection. Physical development issues related to suburbanization and out-migration to the larger neighboring city. New town population is increasing in both cities. Yeosu City out-migration due to lacking service. Pohang City out-migration to Daegu city and capital region, however, the larger portion is inner city movement. Suburbanization with the new development of housings.

Table 5-10 Population and Industrial Characteristics

Category		Pohang City	Yeosu City
Historical Events	Pre-industrial	Harbor Port Fishery Navy Base	Harbor Port Fishery
	City Wards	1949	1949
	Integration	1995	1998
Area (㎢)	Total		305.23
	Industrial Sites		19.77 (3.89%)
Population	Year 1965	265,803	254,619
	Peak	517,250 (in 2000)	333,194 (in 1992)
	Year 2015	524,276 (+)	294,459 (−)
Industrial Characteristic	Major Industry	Steel	Petro-Chemical (67%)
	Major Company	POSCO	GS Caltex
Manufacturing Industry	Employment Peak (person)	53,331 (77.4%) in 1978*	18,706 (21.6 %) in 2001
		54,025 (33.7%) in 1997	20,111 (19.5%) in 2011
	Employment Avg.2000-2010	35,291 (22.1%) (−)	17,540 (20.2%) (+)
	Value added Peak (KWR)	9,145,096 (56.9%) in 2008	23,607,028 (43.8%) in 2011
	Value added Avg.2000-2010	6,089,836 (49.8%) (−)	12,306,149 (35.5%) (+)

***** Only for Pohang City area before integration
**(+)(-) are trend of changing value

Table 5-11 Issues and challenges

Category		Pohang City	Yeosu City
Economic	Deindustrialization	Impact of IMF in 1997 and recent recession in 'Steel Industries' and POSCO	Continuous growth of chemical industries
	Economic Re-structuring	Increase of service industries	Increase of service industries in education and health care
	New Industries	High-tech industries and advanced technology Tourism	Expo
Social	Aging Issue	Aging labor and retirement	Rural aging and population decline
	Social Integration	POSCO vs. resident conflicts	Resident group cooperation
	Local Partnership for Transition	POSCO, POSTECH, National government	Global and Regional Network
Environmental	Pollution	Consumption related pollution	Industrial pollution
Physical	Suburbanization	New housing development	Outmigration to another region
	City Center	Redevelopment project	Old town decline

Table 5-12 Strategies

Level	Pohang City	Yeosu City
National	High-tech industrial Science and technology	Industrial center of East Asia International hub for exchange
Regional	Advanced industries Recycling, high-quality steel	Oceanic tourism Cultural capital
Municipal	Phase1 Industrial City Phase2 Post-IMF Recession Phase3 Young-il-man Renaissance Phase4 Creative City Initiative	Phase1 Industrial City Phase2 Integration and social conflict Phase2 Expo Preparation Phase3 Post-Yeosu Expo
Development Plans	Global 2020 Vision	Yeosu City 2020
Key Development Projects	Pohang Techno-park Young-il-man new port Dong-bin inner port	Yeosu Expo 2012

5.5.3 Implications for Future Development of Korea Industrial Cities

Of the two cases, the transition is expected to the future development of Korea industrial cities.

First, the industrial city transition cannot be prepared without a national government support and regional network and cooperation with neighboring cities. Pohang City and Yeosu City as a small-medium sized local city located far from metropolitan region are usually disconnections to the international airport and business and cultural, infrastructural deficit. A limitation for every local city in Korea considering the situation of the concentration of capital region. However, industrial cities to achieve development in long-run government support for an increase of accessibility in transportation development and expanding regional network and cooperation with the neighboring city will be important. The national government should be supporting economic restructuring also with the industrial city in economic prosperity. Policies should support new industrial development in the area before the crisis and the actual decline of industries. The decline of cities will enlarge the national and regional government cost. Local authorization and support should be flexible in the timely management of the city. The national government should also consider such as aging issues with aging manufacturing labor workers in industrial cities. Further issue and challenge policies for an aging society and concrete plan should regard urgent matters. Regional government should intervene competition among the cities and encourage collaborations among cities. Developing plans to keep the diversity of the region and consider collective planning is important and prevent the integration of cities after a decline.

Second, local government to draw vision and strategies in long-term involve the private sector and residents' group in local development. Industrial dominance is still dependent on the development of industries. Continuous development in manufacturing industries shown from both cities. Realization of current status will be an important challenge. Create a partnership among local stakeholder also includes in this context that participation in the transition. In the case of Pohang, POSCO has been recognized as a key factor, contribution, and partners for local development. During industrial development, Pohang City located the University POSTECH which initially the industrial research, development and became the major partners. Yeosu City, the citizen participation is noticeable in creating event has been successful from the integration. Therefore, social integration and institutional level collaboration are expected in the future.

Third, utilizing the local natural and cultural resources in the local area became most important strategies as tourism industries are important for future development. Two cities were both located in ocean fishing industries from the pre-industrial stage and beach area. During the industrialization, despite the conflicted value of economic production and environmental preservation, both cities were able to utilize clean ocean with beach, food, and combined with tourism in the later transition period. Also cultural and historical

asset strategies, for example, Yeosu City has its history as a marine port and the development of cultural heritages. Also, the industrial production site itself is a major tourism spot for night view. The impact of pollution was more severe in Yeosu City with the decline of marine aquaculture while Pohang City the responsibility was covered with financial subsidies and effort of POSCO.

Fourth, industrial development and old-city regeneration projects will be a major challenge in a transition period. Yeosu held EXPO in 2012 as a counter measure of center city decline. Post-event management and utilization of facilities in a local event and tourism. Pohang City also increased city center amenity. However, suburbanization is still considered in two cities.

Lastly, planning in two cities should be more future-oriented with the issues such as emission of carbon, energy consumption, and aging issues. Current strategies for development are much economic growth oriented, with the physical development of promoting tourism. The vision for the city needs consideration of local context with long-term consideration.

5.5.4 Direction for Future Studies

The single case is difficult to represent the commonalities. The comparison of a different case of cities will be needed. The framework can improve with the different case study regarding the difference in time of the development. The specific issues and challenges might be different from city context and also its time of development.

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Chapter 6 Conclusion

CHAPTER SIX
CONCLUSION

6.1 Introduction

This chapter concludes the key findings of the analysis and case studies on transformation of industrial cities. Furthermore, it derives the meaning of sustainable urban development from the result of analysis. Afterward, it puts forward recommendations for possible future studies related to this topic for current industrial cities to prepare upcoming challenges and future industrial city development.

6.2 Overview

This research focused on the issues and challenges of industrial city transformation and transition towards the future in the context of Japan and Korea. Countries are now facing its de-industrialization process due to rising international competition the industrial decline possibility of its impact on the city decline is similar to many cases proven in Europe or US cases. The study aims to identify the status of industrial city development in Japan and Korea, setting five objectives:

1) **To associate** contemporary industrial city discourses and urban transformation theories.
2) **To identify** the impact of de-industrialization to city decline
3) **To identify** the issues and challenges for industrial cities
4) **To examine** the process of transformation and transition strategies from Japan and Korea cases.

The case studies acknowledge the common processes of transformation of industrial cities and specific transition strategies based on issues and challenges for sustainable development.

Chapter one introduced the background of research and major objective of the study. Chapter overviewed the two major areas of study as theoretical background that is the industrial city discourse and urban transformation theories and developed a conceptual framework. The framework applied to the following analysis on a national level, and city level conducted from Chapter three to five. Chapter three identifies the common trend of industrial city decline in the US, Japan, and Korea. In this chapter, Transformation of industrial cities is described with two main factors, industrial transition, and population change. First, identified de-industrialization timeframe for each country and compare at the city level and find a relation between industrial characteristics and population change patterns. Lastly, the study compared demographic patterns of industrial cities in three countries. Typology created from industrial dominance,

type, structure and population size, and change. Chapter Four analyzed the transformation of an industrial city at city level with a case of Kitakyushu city, Japan. Overviewed the timeline of historical urban development using multiple variables and synthesize the trajectories of changes. Determined the stages using both quantitative and qualitative data and determine the stages of transformation by specifying each turning point which the transition variables classified in each category as economic, social, environment, and physical dimension. This part of the study has its significance in capturing the complex process transformation at the city level by adapting the concept of multi-dimensional transitions. Lastly, Chapter Five examined the current status of industrial cities Korea and strategies for development. By selecting two case cities visualized the detail process of transformation and identified related issues and challenges in the transition.

6.3 Key Findings

The main findings of this research can be categorized into three stages as follows:

6.3.1 Key Points from Theoretical Study

6.3.1.1 Industrial city declines and transition

Industrial city discourses shows that the industrial city decline is a major pattern and has unique factors and processes for its transformation. Globalization and economic diversity as external and internal factors known for a decline to occur, more recently, studies have found the impact of social and environmental factors in sustainable development dimension. Despite the problem of decline is broader the current situation of industrial cities is still under the phases of growth. Uncertainty exists in many of current and future industrial cities whether the city would decline or make the transition.

As many pre-existing studies reveal, the industrial city decline is not a new problem in advanced industrial countries. Economic advancement brought the similar challenges to the later industrialized countries such as Japan and Korea. The individual cases found, and recovery measures introduced, however, the successful transition from the downturn seems impossible.

Accordingly, Chapter three, empirically proven the common decline pattern of industrial cities, emphasizes that heavy industrial cities tend to decline further to find applicable solutions and study the common process, factors, and problems.

The following points are the key points from industrial city discourses.

a) The industrial city defined as a city as the local administrative boundary with dominance in manufacturing industries. The study uses the technical definition of using a percentage of employment in manufacturing industries.
b) Common characteristics exist among the typical type of city for the development, industrial urbanism.
c) Industrial city decline at the local level related to global dynamics of industrial relocation the common trend of developing countries and developing countries the growth, and
d) Among decline discourses, the industrial city decline has been distinctively massive, which the deficit of the structures of the economy.
e) After a decline, how cities emerge from post-decline has been also highlighted, only a few cases and not yet proved to be the solution.
f) There are no common strategies to the redevelopment of the industrial city.
g) The study challenges to understand the complex process and management of transformation.

6.3.1.2 Urban Transformation Theory

Based on the industrial urbanism the study look further possibilities of capturing downturn and decline as a common phase. Literature from the urban transformation theories shows the concept of growth and decline of industry and city. The stage theories have shown each transition and long-term transformation at the city level. Also, urban transformation theories explain the limitation of industrial growth, which is the fate of industrial cities and environmental transition stages.

Urban transformation theories require an understanding of transformation and transition.

a) Transformation is an ultimate long-term change from one system to another which involves many different transitions from one phase to another.
b) Adapting industrial city decline and future transformation will require different sets of multiple transitions in various aspects.
c) Stage theories of national level and urban transformation towards sustainable dimension can be a useful setting for understanding the industrial city transformation.

6.3.1.3 Application of Conceptual Framework

Overview the two major fields of studies, developed a conceptual framework for setting the relevant indicators. The industrial city-specific characteristics come from industrial city discourse describing in each stage characteristics. Division of stages in the quantification of multiple data adapted from transformation theories.

As a result, the conceptual trajectory of industrial city specific transformation is comprehensively showing the series of transition ad in a different dimension. The development stages are divided into five stages of industrialized, growth, peak, decline, and transition. The multidimensional transition level is explaining the different aspects of economic, social, and environmental, and physical dimension. The new framework enables to revalue the industrial city despite quantitative decline the growth of different dimension will follow and reach its new system equilibrium. Phases identified from growth, crisis, decline, and transition:

Phase 1 Industrial growth, population growth
Phase 2 Population peak, Economic Crisis
Phase 3 Deindustrialization, population decline
Phase 4 Population decline and physical decline

The conceptual framework applied in steps by adding the variables found from the analysis. From **Chapter three**, the decline is defined as the population and secondary industrial change to identify the relation between industrial decline and population change at the city level using the common variables to detect the declining trend of the industrial city and with the collection available data.

The multi-dimensional variables defined at the city level analysis in **Chapter Four,** which requires the multi-variables to explain the detailed process of industrial city transformation. The collected data from the case city (Kitakyushu City, Japan) which describes the urban economic, social, and environmental condition will enable to understand the change over time. Identifying the critical turning point in each dimension the city transformation process will be captured not only by population and industries, but also the impact of social and environmental factors in urban development. The process implies the balance of sustainable development dimension.

Chapter Five used transformation variables the study analyzed the current status of Korea cities. Then, select the cities in similar phases, and in-depth analysis with multi-dimensional variables found in Chapter four on the case cities (Pohang City and Yeosu City) to find the commonality and difference in its transformation phase, factors, and process. The comparison of two cities and Japan case cities as advanced case city will show the modified version of industrial city transformation paths as a result.

6.3.2 Findings of Quantitative Analysis

6.3.2.1 National Level Analysis

Chapter three showed the relative status of Japan and Korea industrial cities by comparing that of US and created typologies with the classification of each city. The impact of de-industrialization on the national level, and city decline measured by population is shown and also finding common factors for the decline in industrial type and structures. By comparing three countries, found the following findings:

a) **Industrial development and population change at city level** show the different timeline among cities in the US, Japan, and Korea. US cities experience a longer decline due to the de-industrialization of the 1950s, Japan, and Korea cities are still in growth. The direct impact of de-industrialization not shown at macro level analysis. However, decline problem is common from the national industrial development.

b) **The type of industries advanced**.

   The impact of de-industrialization is large in heavy industrial cities in case of the US; the majority included in heavy industries. Japan and Korea cities in decline group show similarity, however, the population still increasing or reaching its peak level.

c) **Population change can be due to different national and urban population trends** such as suburbanization, centralization, and aging societies. The US cities show diverse patterns of population changes within the time frame while cities in Japan and Korea shows more synchronized patterns.

6.3.2.2 City-Level Analysis

Chapter four, with a case Kitakyushu city in Japan study finds factors of decline and transition and confirms the common aspects in transformation and transition phases:

a) **Development stages are in growth, crisis, decline, and transition** from the change of industrial structure and population.

Phase 1	Growth (~ the 1960s) growth of the city with industrialization
Phase 2	Crisis (1970-1980) reach peak level of population and economic crisis
Phase 3	Decline (1980-1990) start of population decline and transition phase
Phase 4	Transition (2000-2010) new strategies for environmental model city

b) **Relevant factors** revealed by principal component analysis. Phase1 secondary industries, gender balance, environmental, industrial pollution; Phase2 area, population, density, road, unemployment, crime rate; Phase3 aging rate, the number of foreigners, consumption related pollution, number of redevelopment projects, Phase 4 tertiary industries, consumer spending, car ownership, vacant housing, waste treatment energy use, a number of environmental projects

c) **In case of Kitakyushu city, the factors for decline shifts from industrial decline to population decline and physical decline**

The economic crisis is shown in Phase 2 from external factors the oil crisis and competition from later industrial producers such as Korea and China. Internally, Industrial characteristics of the city as continuous from mining to heavy industries such as steel and chemical show the transition of industries, however, remaining dominant. Deindustrialization and unemployment started the decline of population and allied areas such as Tobata and Wakamatsu region.

d) **There are impacts from social and environmental factors for industrial city decline and transition**

Environmental pollution is not major factors for the decline since early declines at Phase 1 as the city government and industry's effort to overcome challenges. Also, indirectly the city’s social safety issue is occurring out-migration of business and woman population in the nearby Fukuoka city. Suburbanization and city center decline partly recovered by the government strategies of during 1980s-1990s. However, consumption related pollution increase in Phase 3 and population decline combined with aging problems.

e) **Kitakyushu city's transition strategies are dominant in the redevelopment of the city center, promoting tourism, and industrial infrastructure as a port**

The increase of connectivity by transportation development and transition towards new industrial development as environmental technologies are important.

6.3.3 Case Studies

6.3.3.1 Korea Industrial Cities

a) **Industrial development in Korea started with the national industrialization** and strategically location heavy industries in south-eastern part during 1970-1980s.

b) **Heavy industrial cities still in a growth stage**, especially the large metropolitan cities are still increasing with industrial dominance. Incheon and Ulsan are representatives due to its close location to capital region and type of automobile industries.

c) **Population decline detected from old industrial cities** such as Mokpo, and the small-medium sized cities populated around 100,000-200,000. Masan and Yeosu are the cities also experience population decline. Pohang city is the largest cities with a population around 500,000 at the peak stage in the development and shows a recent decline. The size of city, type of industries, and the location is an important factor in the industrial city decline in case of Korea.

d) **The transition analyzed with additional criteria** which are an economic condition of the city with an increase of total GRDP and decline in manufacturing value added. Pohang city only shows the pattern for a transition in population decline. Yeosu city is also showing singular structure, the value of manufacturing industries and GRDP is increasing. Both cities are still maintaining the highest percentage of manufacturing industries in 50-60% in singular structure.

6.3.3.2 Pohang City and Yeosu City

a) **Pohang city is at the stage of industrial peak and population peak while Yeosu City industry is still growing, but the population is in decline**

Both cities have singular structure and importance as known for its national industrial center. Pohang city population reaches 500,000 with urban-rural integration in 1995. Yeosu city also the integration of three regions in 1998 and becomes 300,000 populations. Local autonomy starts from 1998. National government industrialization and de-industrialization is in local government initiatives.

b) **The transition started recently in Pohang city in 2005**

Despite the economic crisis in IMF in 1998, POSCO economy peaked in 2007 and city decline. The Yeosu city turning point is from 2012 holding world expo in the region. Economic crisis not

expected in the case of Yeosu for its continuous industrial complex development. However, the population decline in the rural and old city center is a major challenge for the city to remain. The symptoms of economic crisis existed, but the belated reaction to transition advanced industries are remaining a major problem. Yeosu City shows reversed the process from population decline and not yet the industrial decline, however, higher chance of collapse from the industries.

c) **Common issues and challenges of industrial city transition in both cities are aging, pollution, city-center decline due to suburbanization and out-migration.**
Pohang city is expecting massive labor retirement from manufacturing industries as the migrated workers in the region. The Yeosu City aging problem is mostly due to rural areas while industrial workers remain young in their 20-30s, but high chances of leaving the area after retirement. Environmental pollution affected hard on Yeosu city with oil leak incident in 1995. Pohang city issue of city center decline is suburbanization due to new development of housings. Old city center redevelopment is ongoing with the harbor and design. Yeosu city is old-town severe out-migration lacking commercial and residential facilities, however, locating Expo aims to improve the city center and regeneration.

d) **Pohang city strategies are high-tech industrial development and tourism.** The main actors for transition are private sector (POSCO) and universities and research institute (POSTECH). The major development for transition started with 'Young-il-man Renaissance' plan as the city government efforts focus on developing social overhead capitals such as road system and transportation, industrial infrastructure with port and new industrial complexes. City center redevelopment projects also designed which mostly funded by the government and POSCO.

e) **Yeosu city strategies are to promote marine and cultural tourism** as the city is utilizing natural resources such as island post-management of Expo facilities. The major actors in transition are a collaboration of resident groups whose active participation shown from the process of city integration in 1998 and preparing Expo in 2012.

f) **Key factors for transition in two cases, cities are national government support, global and regional network, and local stakeholders' collaboration.**
Industrial cities in Korea are still a center of the national economy as the government supporting the local development. Development of industrial complexes is the major source of keeping its economy and city plans are mostly matching the national planning. The political background is

hard to ignore in case of Pohang city; that funding transition project related to the period of conservative parties is ruling. Another factor for transition is that increase connectivity through transportation development and create a network with neighboring cities. Both cities challenge to overcome the disadvantage of location, however, transportation development often led out-migration of population and result competing with neighboring cities. Therefore, Pohang city considers collaboration with Gyungju and Youngdeok area and connecting larger metropolitans such as Ulsan and Busan. Yeosu City development is also a regional problem as an industrial complex connected to the Gwangyang Bay area. Lastly, local stakeholder collaboration is positive factors for the transition. Pohang city tightly related to POSCO and POSTECH in developing transition. However, being overly dependent on POSCO not only for the economy, but also for its post-industrial development measures bringing the challenge especially during the economic crisis. Yeosu city has a positive effect on resident participation. However, the key stakeholders and leadership in transition needed.

g) **In general, the industrial cities would achieve sustainable development from overcoming the disconnection from industrialization and changing the mindset of growth.**

A city's challenge to renew the strong image of steel city and chemical city and tourism became the key focus more recently. However, the lack of cultural, historical resources and disconnection from the industrialization period make difficult for cities. Industrial pollution affected fishery industries in case of Yeosu city losing the diversity of the region. Natural resources again become a valuable asset for post-industrial development as tourism becomes the core business in both cities. Fast growth from the industrialization also led, optimistic anticipation for continuous growth and mindset of growth-oriented planning is now failing to manage the timely transition.

6.4 Implication on Transformation of Industrial Cities

Based on research findings, this chapter sets forward some general recommendations for current industrial cities with decline problems or facing upcoming challenges. Also, guide future industrial city development and sustainable urban development by extracting common issues from the specific context of industrial cities in Japan and Korea.

6.4.1 Deindustrialization and Population Changes

a) The relevant factors in decline are the industrial type, from the massive heavy industrial city decline in the US, and a few advanced cases of decline in Japan and Korea. The historical decline of industrial cities similarly rooted in the flexibility of reformation. The number of cases of decline in heavy industrial cities in the US is enormous,

b) National population trends are also a relevant component for industrial city decline, such shrinking and aging society issues in Japan and population concentration in capital metropolitan areas in Korea that gives the unfavorable condition for local industrial cities to maintain compatibility.

c) The location of cities also confirmed as the population concentration in capital metropolitan in Japan and Korea, implies the unfavorable conditions for local cities to maintain its growth in the future.

6.4.2 Industrial City Transformation based on Kitakyushu City Case

The analysis in this Chapter has its significance in capturing the complex process transformation at the city level by adapting the concept of multi-dimensional transitions. The outcome shows the complex transformation process of Kitakyushu city.

First, the transformation industrial city should be considered earlier from the stage of industrialization expecting the decline stage. Having a history of the industrial city, somehow the dominance of the major industrial cities is another reason for lacking the economic diversity and regarded as the detachment period. The decision of further advancement in manufacturing industries, in the end, brought a lack of the economic diversity. The industrial city tends to stay industrial cities as the decision made during the 1980s of keeping the major industries. The timely management of expected decline should consider beforehand.

Second, considering not only economically, but social and environmental is the key to the transition. The decline is not only due to economic dimensions, but also from social aspects to increase the diversity in human resources and natural and cultural resources. Historical recovery measures in serious environmental pollution problems reversely created a unique identity of the city. Environmental modeling city initiatives connected from the past experiences, as the global acknowledgment brought national investment in the recycling industry and now promoted the city to increase energy and environmental technology related business requiring high-skilled workers. However, social security issues combined with direct and indirect effect to reluctant in business and residents. The increase of connectivity to overcome a detached period of industrialization will be important.

Third, the new direction of physical development should come from the local context utilizing various resources. Tourism is one of the major industries, an increase of attentions of industrial heritage and preservation or increased commercial areas and amenity of city center improve positively impact for revitalization. Until the environmental industries became the major promotion theme, redevelopment measures varied in developing high- tech and tourism which wasn't recognizable. Especially measures detached from local context are not proven to be effective, such as the failed attempt of promoting tourism from amusement park (space world) and only temporal events. Therefore, utilizing the resources and experience developed during the industrial, and preservation of pre-existing cultural and the natural asset will be critical for future transition.

Fourth, planning should be made regarding smaller and compact size, especially regarding the economic and physical development of the city. The quantitative decline expected for its pre-existing industries. Therefore, the future is challenged by downsizing the city. Employment of new industries and economic status will not be equivalent. Regarding physical development, the selective decline of the area is expected. Kitakyushu city plans to concentrate the city center has been positive for its urban center.

Lastly, national government support and the regional planning and collaboration are necessary. The decline is also due to external factors. Kitakyushu city declines affected from the growth of the neighboring city of Fukuoka, service industries and information, logistic business, competed to locate in Fukuoka.

6.4.3 Implications for Future Development of Korea Industrial Cities

Of the two cases, the transition is expected to the future development of Korea industrial cities.

First, the industrial city transition cannot be prepared without a national government support and regional network and cooperation with neighboring cities. Pohang city and Yeosu city as a small-medium sized local city located far from metropolitan region are usually disconnections to the international airport and business and cultural, infrastructural deficit. A limitation for every local city in Korea considering the situation of the concentration of capital region. However, industrial cities to achieve development in long-run, government support for an increase of accessibility with transportation development and expanding regional network and cooperation with the neighboring city will be important. The national government should be supporting economic restructuring also with the industrial city in economic prosperity. Policies should support new industrial development in the area before the crisis and the actual decline of industries. The decline of cities will enlarge the national and regional government cost. Local authorization and support should be flexible in the timely management of the city. The national government should also consider such as aging issues with aging manufacturing labor workers in industrial cities. Further issue and challenge policies for an aging society and concrete plan should regard as urgent matters. Regional government should intervene competition among the cities and encourage collaborations among cities. Developing plans to keep the diversity of the region and consider collective planning is important and prevent the integration of cities after a decline.

Second, local government to draw vision and strategies in long-term involve the private sector and residents' group in local development. Industrial dominance is still dependent on the development of industries. Continuous development in manufacturing industries shown from both cities. Realization of current status will be an important challenge. Create a partnership among local stakeholder also includes in this context that participation in the transition. In the case of Pohang, POSCO has been recognized as a key factor, contribution, and partners for local development. During industrial development, Pohang city located the University POSTECH, which initially the industrial research, development and became the major partners. Yeosu city, the citizen participation is noticeable in creating event has been successful from the integration. Therefore, social integration and institutional level collaboration are expected in the future.

Third, utilizing the local natural and cultural resources in the local area became most important strategies as tourism industries are important for future development. Two cities were both located in ocean fishing industries from the pre-industrial stage and beach area. During the industrialization, despite the conflicted value of economic production and environmental preservation, both cities were

able to utilize clean ocean with beach, food, and combined with tourism in the transition later period. Also cultural and historical asset strategies, for example, Yeosu city has its history as a marine port and the development of cultural heritages. Also, the industrial production site itself is a major tourism spot for night view. The impact of pollution was more severe in Yeosu city with the decline of marine aquaculture that Pohang city the responsibility covered by financial support and environmental effort by POSCO company.

Fourth, industrial development and old-city regeneration projects will be a major challenge in a transition period. Yeosu held EXPO in 2012 as a countermeasure of city center decline. Post-event management and utilization of facilities in a local event and tourism. Pohang city also increased city center amenity. However, suburbanization is still considered in two cities.

Lastly, planning in two cities should be more future-oriented with the issues such as emission of carbon, energy consumption, and aging issues. Current strategies for development are much economic growth oriented, with the physical development of promoting tourism. The vision for the city needs consideration of local context with long-term consideration.

6.5 Direction for Future Studies

6.5.1 Significance

This research contributes to the understanding of the transformation of industrial cities by incorporating the context of Japan and Korea. While many researchers have raised the issue of the decline and transition of industrial cities, this study shows the relevance of development that occurs and managed at each stage. Moreover, the findings of this research show that transformation of industrial cities still has remaining challenges for the future, which dealing with the problems new challenges occur over time.

1) Typology

Created typology as byproducts of Chapter 3 used for future analysis of the study. Collected data from three countries enable the comparison. Also, with the industrial and urban characteristics, classified cities can be further analyzed with the additional variables.

2) Conceptual Framework

The conceptual framework of the transformation of the industrial city applied into following studies.

a) **Analyze the historical development in long-term and identified concurrent issues of decline and transition**

   The long-term trajectories of industrial city transformation will differ from changes from 19C, 20C, and 21C. The understanding of the current industrial cities in a modernized era might differ from the older-industrialization in history. Returning of manufacturing industries in the pre-existing city area is also not fitting in the case. However, the framework is expected to cover the majority of industrial cities developed in the post-war era between the time of modernization and globalization.

b) **Examine the current stage of development and predict the future scenarios**

   Addressing the issue of industrial city decline will also influence the cities in developing countries as it maintains its growth, but in the long-term the city possibly experiences a decline.

c) **Identify factors in multi-dimension perspectives and verify the major impact factors towards transition**

The decline factors are not only due to industries and population. The transition of social and environmental factors related to economic advancement also explains the transformation. The critical turning point of each transition might be different from its order and impact due to different city context. For example, the level of pollution or time order of urbanization issue can be compared with multi-dimension transition measures.

d) **Compare transformation trajectories among industrial cities** and extract commonalities and differences among different national and cultural context. Comparison and contrast are available by using the framework.

3) Case Cities

The study contains the broad context of variables to explain the complex process of the decline of industrial cities. However, in-depth study on each issue is needed in the future to come up with a plan and strategies to suggest a direction for case cities as well as other industrial cities. There are difficulties in generalizing the strategies due to the specific context of case cities. However, the study will give a comparative model to advance in the future studies. Phases of development can be different from the uncertainty of the future, for example, technological improvement of industries, social changes such as immigration policy, or unpredicted crisis such climate changes can make the difference in the future.

6.5.2 Direction for Future Studies

As an attempt to find the common trend of industrial city decline, the study redirects the issue of the severe heavy industrial city decline in the US. Also discovers the similar case of a decline in Japan and Korea, the transition expected shortly. Assessing the current status of industrial cities would be needed in the future.

Some cases show that population changes are not always the consequences of de-industrialization. The cities are recently in peak or recent decline implies. Therefore, the common industrial decline factors should also consider the population trend in national context

Also, the transformation of industrial cities regarding population changes is short to verify the direct impact of the industrial transition to population changes. Therefore, more detailed analysis at an individual city level will be needed to identify factors for decline and transition.

Cases are difficult to represent the commonalities. The comparison of a different case of cities will be needed. The framework improved with the different case study regarding the difference in time of the development. The specific issues and challenges might be different from city context and also its time of development.

APPENDIX

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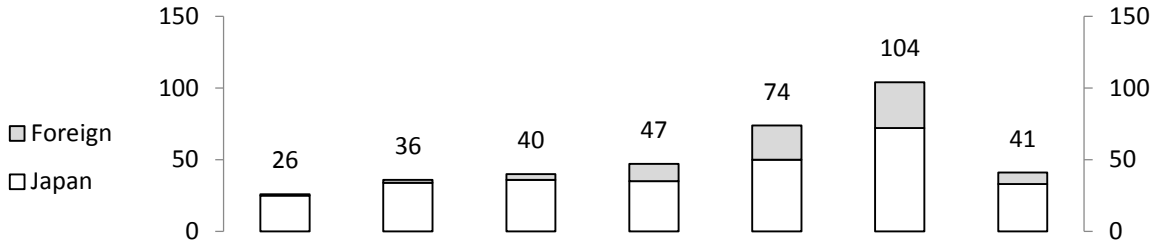
2-1 Numbers of Industrial City Research on National Database, Japan, and Korea

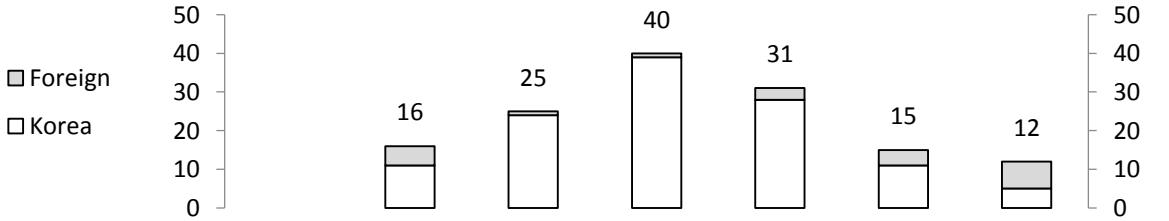
Japan



	1940-1950	1960	1970	1980	1990	2000	2010-2014	Total
Thesis & Articles	26	36	40	47	74	104	41	368*
Japanese (n)	25	34	36	35	50	72	33	285
Foreign Countries (n)	1	2	4	12	24	32	8	83
Foreign Countries (%)	0.04	0.06	0.10	0.26	0.32	0.31	0.20	-

*Excluded duplicated count of the publication by the same author with the same issue

Korea



	1950	1960	1970	1980	1990	2000	2010-2014*	Total
Thesis & Articles	-	16	25	40	31	15	12	139
Korean (n)	-	11	24	39	28	11	5	118
Foreign Countries (n)	-	5	1	1	3	4	7	21
Foreign Countries (%)	-	0.31	0.04	0.03	0.10	0.27	0.58	-

3-1 Number of Cities in Database

		1950	1960	1970	1980	1990	2000	2010	Source
US	Municipal government* (Population over 100,000)					19,279	19,429	19,519	Government Census
	Cities in Statistical Report	489	683	912	957	1,227	1,265		
	Cities Population over 100,000	106	124	152	160	196	241	297	UN Demographic Yearbook
Japan	Total Cities			569	646	655	671	786	Statistics Bureau
	Population over 100,000	64	119	156	197	208	229	268	UN Demographic Yearbook
Korea	Total		27	32	40	74	79	84	E-national statistics
	Population over 100,000	8	10	18	34	40	56		UN Demographic Yearbook

3-2 Definition of Cities

(1) US: United States Census Bureau[1]

Census.gov › Business & Industry › Federal, State, & Local Governments › Census of Governments 1992, 2002, 2012

No. of Municipal Governments

	1992	2002	2012
Total	19,279	19,429	19,519
> 300,000	58	58	106 (> 500,000)
> 200,000	25	30	124 (> 250,000)
> 100,000	119	153	297 (> 100,000)
Over 100,000	195	241	527

(2) Japan: Statistics Bureau[2]

Statistics Bureau > Official statistics of Japan > Number of cities, district, town

	Designated City	City	Total
1970	6	563	569
1980	10	636	646
1990	11	644	655
2000	12	659	671
2010	19	767	786
(2016)	20	770	790

(3) Korea: Ministry of security and public administration[3]

E-national Statistics > Administrative Division and Population Status

	Metropolitan City	City	Total
1960	1	26	27
1970	1	30	32
1980	21	38	40
1990	6	67	74
2000	7	72	79
2010	7	74*	84

*Including 1 Special Autonomic City (Sejong), Special Self-Governing Province 2 Administrative cities (Jeju, Seoguipo)

[1] http://www.census.gov/govs/cog2012/

[2] http://www.e-stat.go.jp/SG1/hyoujun/initMunicipalityCount.do

[3] http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1041

3-3 Correlation

		HL	SD	PC	MAXPOP	MAXMAN	COUNTRY	GPC	GIND
HL	Pearson Correlation	1	.354**	-.027	-.039	.193**	.239**	-.116*	.955**
	Sig. (2-tailed)		.000	.639	.508	.001	.000	.046	.000
	N	297	297	297	297	297	297	297	297
SD	Pearson Correlation	.354**	1	-.037	.040	.002	.065	-.007	.567**
	Sig. (2-tailed)	.000		.529	.497	.966	.261	.909	.000
	N	297	297	297	297	297	297	297	297
PC	Pearson Correlation	-.027	-.037	1	.015	.013	.038	.649**	-.061
	Sig. (2-tailed)	.639	.529		.801	.822	.517	.000	.292
	N	297	297	297	297	297	297	297	297
MAXPOP	Pearson Correlation	-.039	.040	.015	1	-.071	.070	-.025	-.027
	Sig. (2-tailed)	.508	.497	.801		.219	.229	.662	.648
	N	297	297	297	297	297	297	297	297
MAXMAN	Pearson Correlation	.193**	.002	.013	-.071	1	.597**	-.023	.199**
	Sig. (2-tailed)	.001	.966	.822	.219		.000	.699	.001
	N	297	297	297	297	297	297	297	297
COUNTRY	Pearson Correlation	.239**	.065	.038	.070	.597**	1	-.102	.225**
	Sig. (2-tailed)	.000	.261	.517	.229	.000		.080	.000
	N	297	297	297	297	297	297	297	297
GPC	Pearson Correlation	-.116*	-.007	.649**	-.025	-.023	-.102	1	-.114*
	Sig. (2-tailed)	.046	.909	.000	.662	.699	.080		.049
	N	297	297	297	297	297	297	297	297
GIND	Pearson Correlation	.955**	.567**	-.061	-.027	.199**	.225**	-.114*	1
	Sig. (2-tailed)	.000	.000	.292	.648	.001	.000	.049	
	N	297	297	297	297	297	297	297	297

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

3-4 Industrial type

1. Statistics

	USA		Japan		Korea	
Type	n	%	n	%	n	%
Light	51	32.3	70	37.2	8	11.3
Heavy	34	20.7	50	26.6	27	38.0
Mixed	25	15.2	48	25.5	27	38.0
Hightech	2*	-	12	6.4	3	4.2
Total	112	68.3	180	95.7	65	91.5
Missing	52	31.7	8	4.3	6	8.5
All Data	164	100.0	188	100.0	71	100.0

(1) Light industrial cities

- **USA** 26 cities out of 53 (48.6%) in increasing, 14 cities (26.6%) in steady, 13 cities (24.8%) in decline
- **Japan** 28 cities (39.9%) in increase, 22 cities (31.5%) continuous decline, 20 cities (28.7%) recent decline
- **Korea** 4 cities (47.4%) decline, 3 cities (36.8%) recent decline, and 1 cities (15.8%) growing

(2) Heavy industrial cities

- **USA** 18 cities out of 34 (52.1%) are declining
- **Japan** 32 cities out of 50 (63.1%) are in increase
- **Korea** 17 cities out of 27 (61.4%) are recent decline

(3) Mixed industrial cities

- **USA** 10 cities out of 24 (41.2%) are steady but varies with increase and decline for both 7 (29.4%)
- **Japan** 28 cities out of 48 (57.6%) are in increase
- **Korea** 17 cities out of 27 (61.4%) are in recent decline

(4) High-tech

- **USA** (US 1940 data don’t include relevant classification type)
- **Japan** 6 cities out of 12 (48.1%) decline, 5 cities out of 12 (40.7%) increase
- **Korea** all 3 cities are increasing

2. Classification

(1) US: Data 1940

Criteria: (PL>60%) (PH> 60%) (PH40-PL40) Diverse (DS>3) Specialize (DS<2)

	Heavy		**Light**		**Mixed**
	Specialized	Diversified	Specialized	Diversified	Diversified
N	**21**	**12**	**23**	**30**	**24**
%					
	Gary	Cleveland	Akron	Los Angeles	New Haven
	Canton	Pittsburgh	Lexington	Grand Rapids	Springfield
	Pueblo	Stamford	Manchester	Kansas city 5	Joliet
	Youngstown	Syracuse	Winston-Salem	Columbus	Milwaukee
	Waterbury	Buffalo	New Bedford	St Louis	Oakland
	Flint	Inglewood	Greensboro	Trenton	Baltimore
	Detroit	Rockford	Columbus 5	Salt lake city	Worcester
	Lansing	Toledo	Durham 5	Minneapolis	Jersey City
	Portsmouth	Bridgeport		Providence	Quincy
	Dearborn	Hammond	Savannah	Louisville	Indianapolis
	Baton rouge	Elizabeth	Cedar rapids	Boston	Cincinnati
		Long beach	Tacoma	Memphis	Camden
	Birmingham		Green bay	Cambridge	Wichita
	Erie		San Jose	Santa Ana	Newark
	Davenport		Omaha	Kansas city	Chicago
	Dayton		Tampa	Dallas	Seattle
	Evansville		Springfield	St Paul	Aurora
	South bend		Waco	Phoenix	University city
	Burbank		Paterson	Fort worth	Peoria
	Fort Wayne		Knoxville	Des Moines	Glendale
	Hartford		Augusta	Nashville-Davidson	Houston
	Beaumont		Macon	Rochester	Niagara falls
			Lowell	Richmond	
			Scranton	Philadelphia	San Diego
				Chattanooga	Duluth
				Allentown	
				Yonkers	
				Utica	
				New York city	
				Charlotte	

(2) Japan: Data 1970

	Heavy		Light		Mixed
	Specialized	**Diversified**	**Specialized**	**Diversified**	
N	40	**42**	**16**	**31**	**43**
%					
	Seto City, Aichi	Mitaka City, Tokyo	Mito, Ibaraki	Sapporo, Hokkaido	Osaka Habikino
	Nobeoka , Miyazaki	Kawagoe City, Saitama	Osaka Kishiwada	Asahikawa, Hokkaido	Hachioji, Tokyo
		Hirakata, Osaka	Hakodate, Hokkaido	Aomori , Aomori	Tsu City, Mie
		Sayama , Saitama	Hachinohe, Aomori	Toyohashi, Aichi	Okazaki City, Aichi
	Takatsuki, Osaka	Tokorozawa, Saitama	Otaru, Hokkaido	Morioka, Iwate	Kisarazu, Chiba
	Yokosuka, Kanagawa	Chigasaki	Ashikaga, Tochigi	Kushiro, Hokkaido	Yamaguchi Iwakuni
	Musashino-shi, Tokyo	Amagasaki, Hyogo	Chiba Nagareyama	Saitama Kasukabe	Shizuoka Fujinomiya
	Fuchu-shi, Tokyo	Narashino, Chiba	Ishinomaki City, Miyagi	Hirosaki, Aomori	Anjo City, Aichi
	Ikeda, Osaka	Toyokawa, Aichi	Kiryu City, Gunma	Yonago, Tottori	Hyogo Kakogawa
	Ube City, Yamaguchi	Yokohama City, Kanagawa	Osaka Izumi	Tomakomai, Hokkaido	Fuji, Shizuoka
	Chofu, Tokyo	Fujisawa City, Kanagawa	Kyoto Uji	Obihiro, Hokkaido	Wakayama Wakayama
	Muroran, Hokkaido	Ichikawa City, Chiba	Hamamatsu City, Shizuoka	Hokkaido Kitami	Iruma-shi, Saitama
	Kanagawa Hadano	Saitama Ageo	Ichinomiya, Aichi	Shizuoka	Tottori Tottori
	Moriguchi, Osaka	Daito, Osaka	Imabari, Ehime	Gifu City	Kurashiki, Okayama
	Machida, Tokyo	Kitakyushu, Fukuoka	Komatsu , Ishikawa	Nara Kashihara	Shimonoseki, Yamaguchi
	Takarazuka, Hyogo	Osaka Yao	Shizuoka Yaizu	Kumamoto	Nagano City, Nagano
	Numazu, Shizuoka	Kashiwa City, Chiba		Fukui City	Mie Matsusaka
	Kurume, Fukuoka	Neyagawa, Osaka		Miyazaki , Miyazaki	Matsue City, Shimane
	Yokkaichi, Mie	Chiba City, Chiba		Nara, Nara	Yamaguchi Hofu
	Tokyo Higashimurayama	Ibaraki, Osaka		Yatsushiro City, Kumamoto	Nagaoka City, Niigata
	Fukuoka Omuta	Nagoya, Aichi		Shizuoka Fujieda	Onomichi, Hiroshima
	Takasaki,	Kawaguchi City,		Aizuwakamatsu,	Gifu

Gunma	Saitama	Fukushima	Kakamigahara
Otsu, Shiga	Tachikawa, Tokyo	Yamaguchi City	Ise City, Mie
Koganei-shi, Tokyo	Ichihara, Chiba	Kagoshima, Kagoshima	Ogaki, Gifu
Kariya City, Aichi	Funabashi, Chiba	Okayama	
Gunma City Isesaki	Himeji, Hyogo	Hitachi Omiya, Ibaraki	Hiroshima
Osaka Minoo	Toyonaka, Osaka	Tokushima , Tokushima	Kasugai City, Aichi
Kadoma, Osaka	Komaki City, Aichi	Kofu, Yamanashi	Suita, Osaka
Kodaira, Tokyo	Yamato-shi, Kanagawa	Beppu, Oita	Osaka-shi, Osaka
Chiba Yachiyo	Fukushima	Miyazaki Miyakonojo	Odawara, Kanagawa
Niihama City	Hitachi City, Ibaraki	Kyoto , Kyoto	Fukuyama City, Hiroshima
Kobe City, Hyogo	Hino City, Tokyo		Soka, Saitama
Toyota City, Aichi	Sakai City, Osaka		Osaka Matsubara
Ota City, Gunma	Iwaki City, Fukushima		Matsuyama, Ehime
Nagasaki, Nagasaki	Hiratsuka, Kanagawa		Utsunomiya, Tochigi
Tsuchiura City, Ibaraki	Higashi-Osaka		Nishinomiya, Hyogo
Ueda, Nagano	Kure City, Hiroshima		Akita
Toyama	Kobe City, Hyogo		Kumagaya, Saitama
Kawanishi , Hyogo	Kamakura, Kanagawa		Saitama
Sasebo, Nagasaki	Itami City, Hyogo		Koshigaya
Suzuka, Mie	Oyama, Tochigi		Sendai, Miyagi
Chiba Sakura	Atsugi City, Kanagawa		Matsudo City, Chiba
			Fukuoka
			Takamatsu, Kagawa
			Maebashi, Gunma
Specialized	**Diversified**	**Specialized**	**Diversified**
Heavy		**Light**	**Mixed**

(3) Korea: Data 1997, C. Manufacturing 23 Categories

	Heavy	Heavy	Light	Light	Heavy-Light Mixed	NA
	Specialized	**Diversified**	**Specialized**	**Diversified**		
N	**13**	**25**	**3**	**5**	**19**	**6**
%						
	Ulsan	Incheon	Jeonju	Seoul	Busan	Anseong
	Suwon	Gwanju	Kyungsan	Gongju	Daegu	Gimpo
	Gwangmyung	Anyang	Tongyeong	Nonsan	Daejun	Hwasung
	Icheon	Bucheon		Namwon	Seongnam	Gwangju, Kyunggi
	Donghae	Pyungtak		Eujeongbu	Guri	Yangju
	Samchuk	Ansan			Namyangju	Pocheon
	Seosan	Osan			Hanam	
	Yeosu	Shiheung			Paju	
	Gwangyang	Gunpo			Chuncheon	
	Pohang	Euwang			Wonju	
	Gumi	Yongin			Iksan	
	Changwon	Cheongju			Gimje	
	Geoje	Choongju			Mokpo	
		Cheonan			Naju	
		Asan			Youngju	
		Gunsan			Youngcheon	
		Jeongeup			Sangju	
		Gyungju			Moonkyung	
		Gimcheon			Milyang	
		Masan				
		Jinju				
		Jinhae				
		Sacheon				
		Gimhae				
		Yangsan				

3-5 Population change

1. Statistics

	USA		Japan		Korea	
Group	n	%	n	%	n	%
1mil	9	5.5	11	5.9	9	12.7
1-0.5	19	11.6	18	9.6	10	14.1
0.5-0.2	37	22.6	88	46.8	33	46.5
0.2-0.1	99	60.4	71	37.8	19	26.8
Total	164	100.0	188	100.0	71	100.0
Missing						
All Data	164		188		71	

(1) Metropolitan Areas (over 1mil)

USA 6 cities out of 9 (61.9%) increasing

Japan 8 cities out of 11 (68%) increasing

Korea all 9 cities in recent decline

(2) Large cities (1mil-0.5)

USA 7 cities (38.5%) out of 19 in both increase and decline

Japan 13 cities out of 18 (69.2%) increasing

Korea all 10 cities in recent decline

(3) Small-Medium sized cities (0.5-0.1)

USA 0.2 group 20 cities out of 37 (53.2%), 0.1 group 56 cities out of 99 (56.2%) increasing

Japan 0.2 group 43 out of 88 (48.6%) 0.1 group 34 out of 71 (47.6%) increasing

Korea 0.2 group 16 out of 33 (47.8%), 0.1 group 10 out of 19 (51.2%) increasing

2. Classification

US

	1950-1960	1960-1970	1970-1980	1980-1990	1990-2000	Total 59
Decline	(-)	(-)	(-)	(-)	(-)	4
	(-)	(+)	(-)	(-)	(-)	12
	(+)	(+)	(-)	(-)	(-)	11
Recent Decline	(+)	(-)	(+)	(-)	(-)	7
	(+)	(+)	(+)	(+)	(-)	2
Increase	(+)	(-)	(+)	(+)	(+)	8
	(+)	(+)	(-)	(+)	(+)	6
	(-)	(+)	(-)	(+)	(+)	1
Recent Increase	(-)	(-)	(-)	(-)	(+)	3
	(-)	(-)	(-)	(+)	(+)	5

Japan

	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	Total 188
Continued Decline	(-)	(-)	(-)	(-)	(-)	3
	(+)	(-)	(-)	(-)	(-)	4
	(+)	(+)	(-)	(-)	(-)	21
Fluctuate	(+)	(+)	(-)	(+)	(-)	3
Recent Decline	(+)	(+)	(+)	(-)	(-)	25
Decline 2010	(+)	(+)	(+)	(+)	(-)	34
Continued Increase	(+)	(+)	(+)	(+)	(+)	98

Korea

Korea	1970-1980	1980-1990	1990-2000	2000-2010	Total 60
Continuous Decrease	(-)	(-)	(-)	(-)	14
Increase	(-)	(+)	(+)	(+)	8
	(+)	(+)	(+)	(+)	27
Fluctuate	(+)	(-)	(+)	(-)	8
	(-)	(+)	(-)	(+)	3

Among 71 cities, 50 valid and 11 missing values.

3-6 Industry to Population

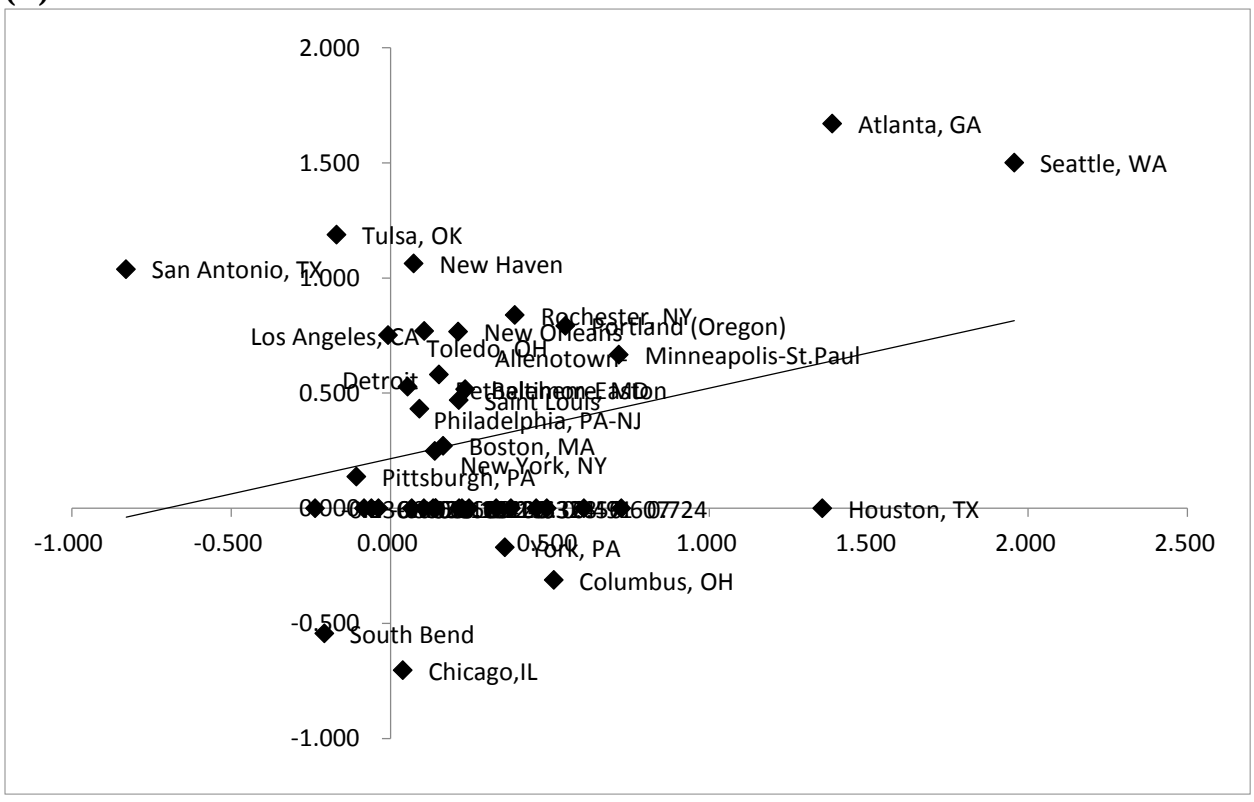
Following the graph of Chapter 3 Figure 3 5 Trends of Industry-Population Dynamic in National Level, 20 Years Span. Cities in (X, Y) X: Industrial Change, Y: Population Change, which changes from previous years to current years.

(1) Range of Data

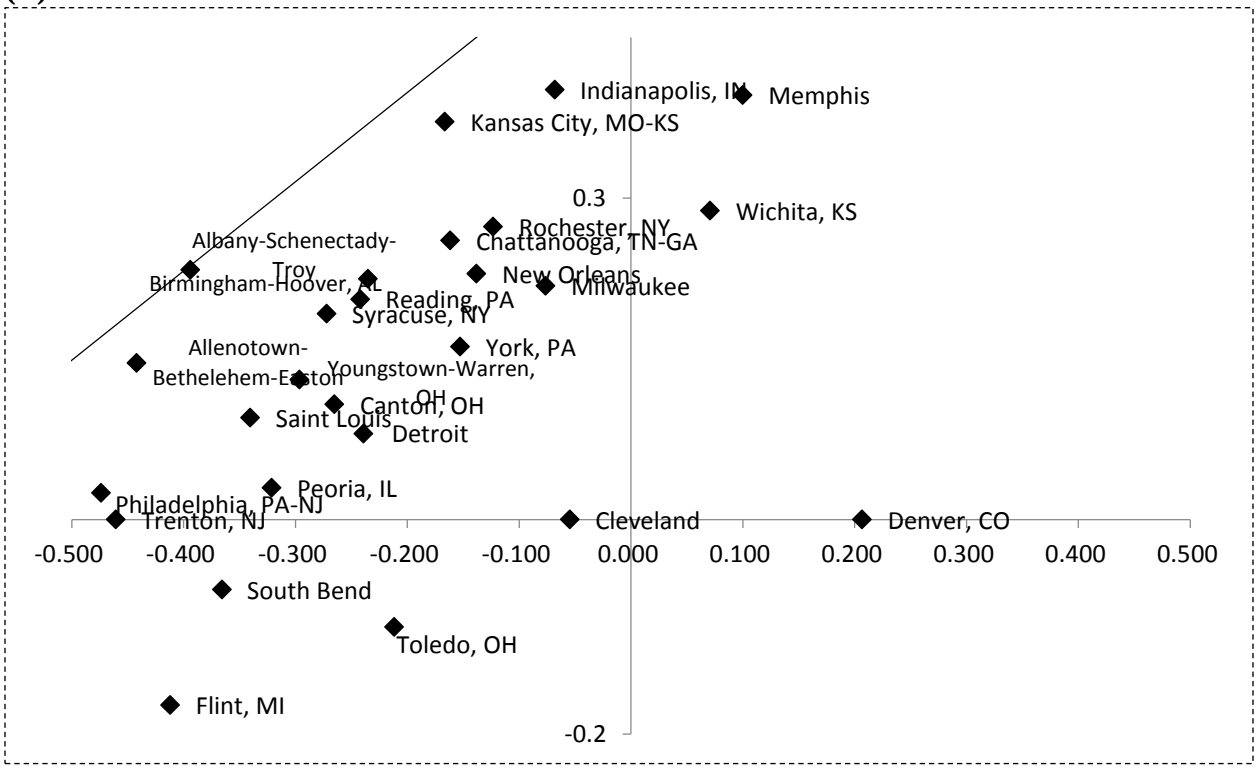
	1950-1970	1970-1990	1990-2010
US	o	o	o
Japan	x	o	o
Korea	x	o	o

(2) Graphs

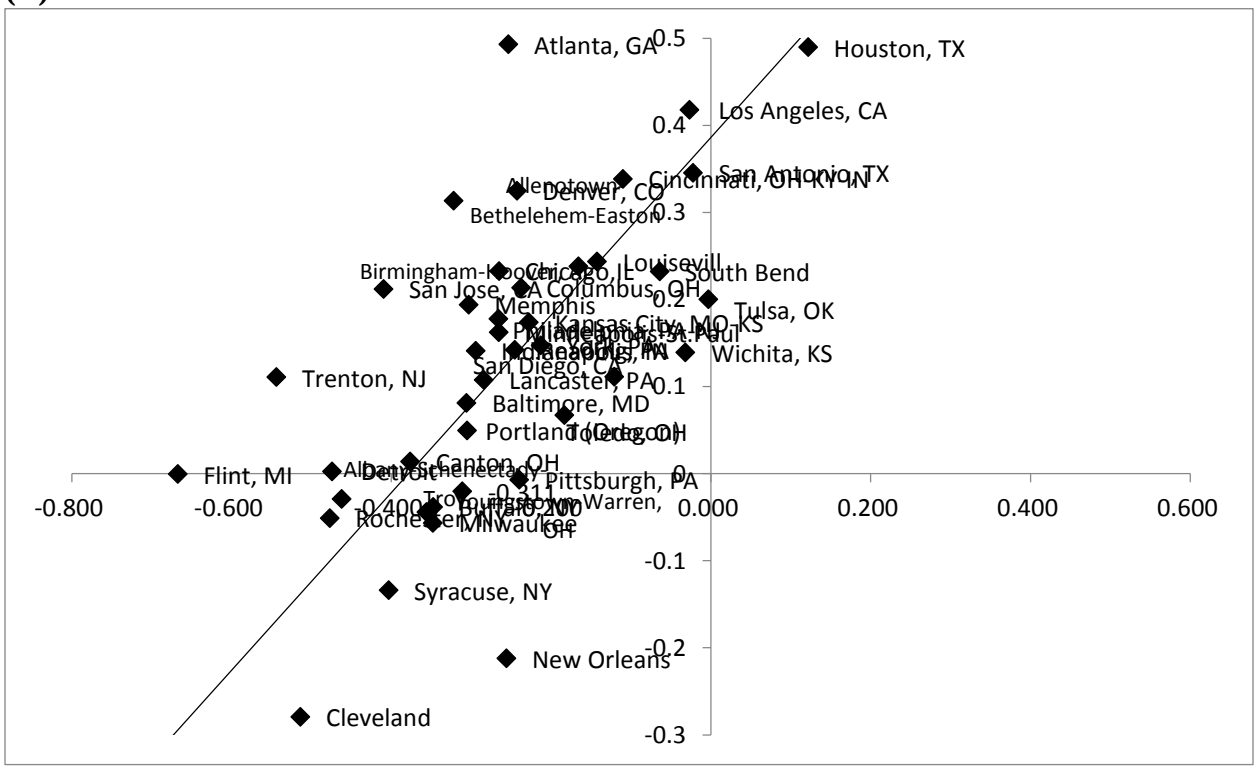
(A) US 1950-1970



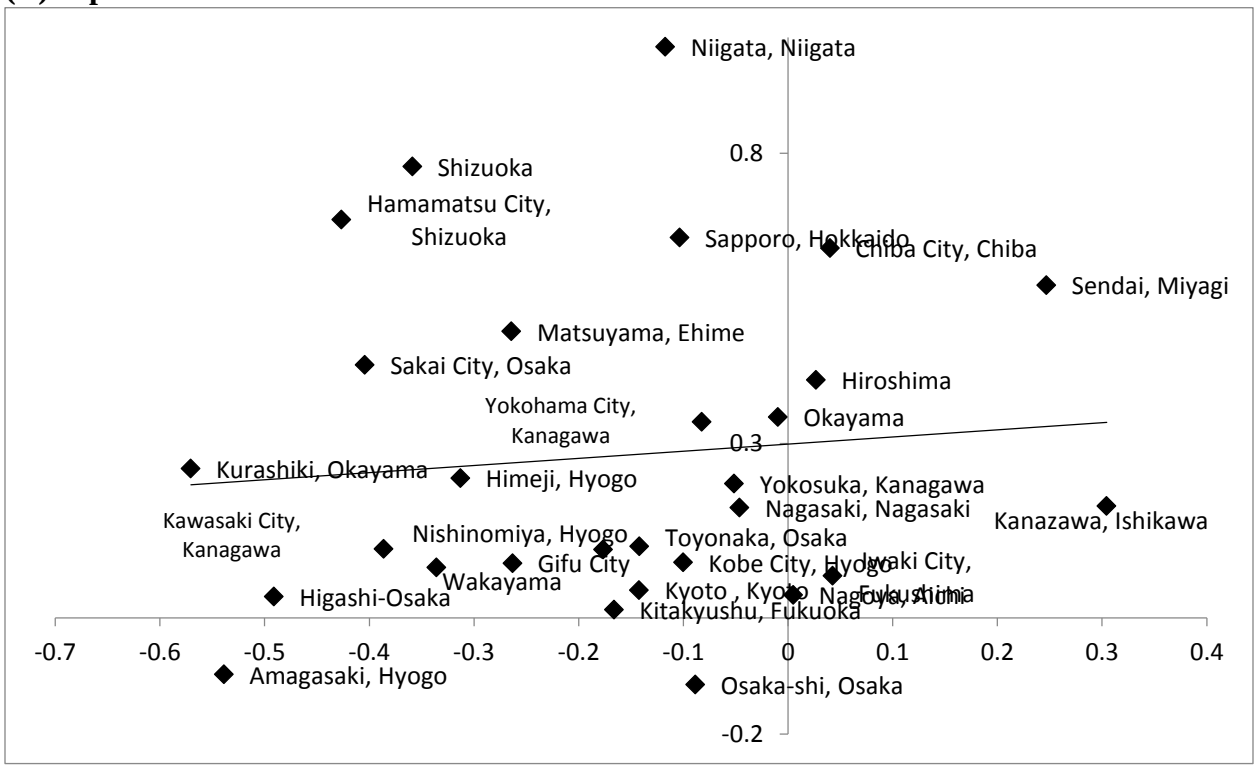
(B) US 1970-1990



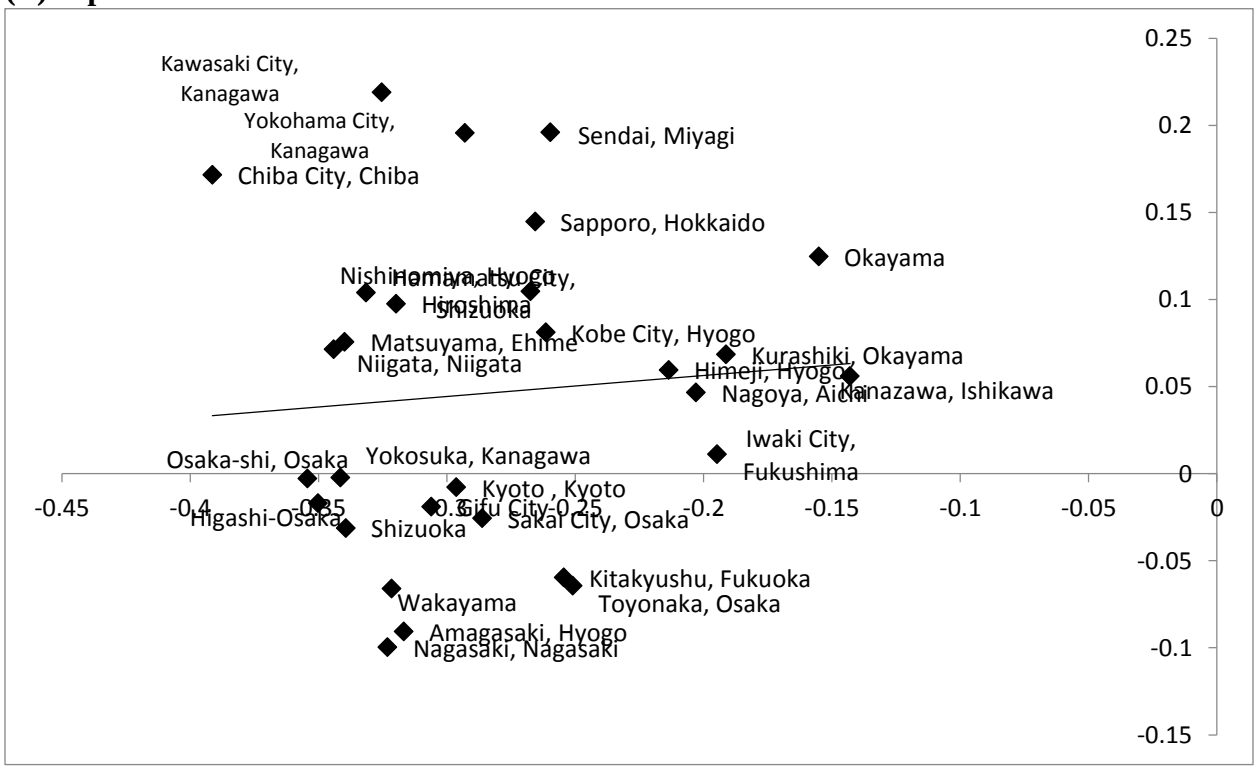
(C) US 1990-2010



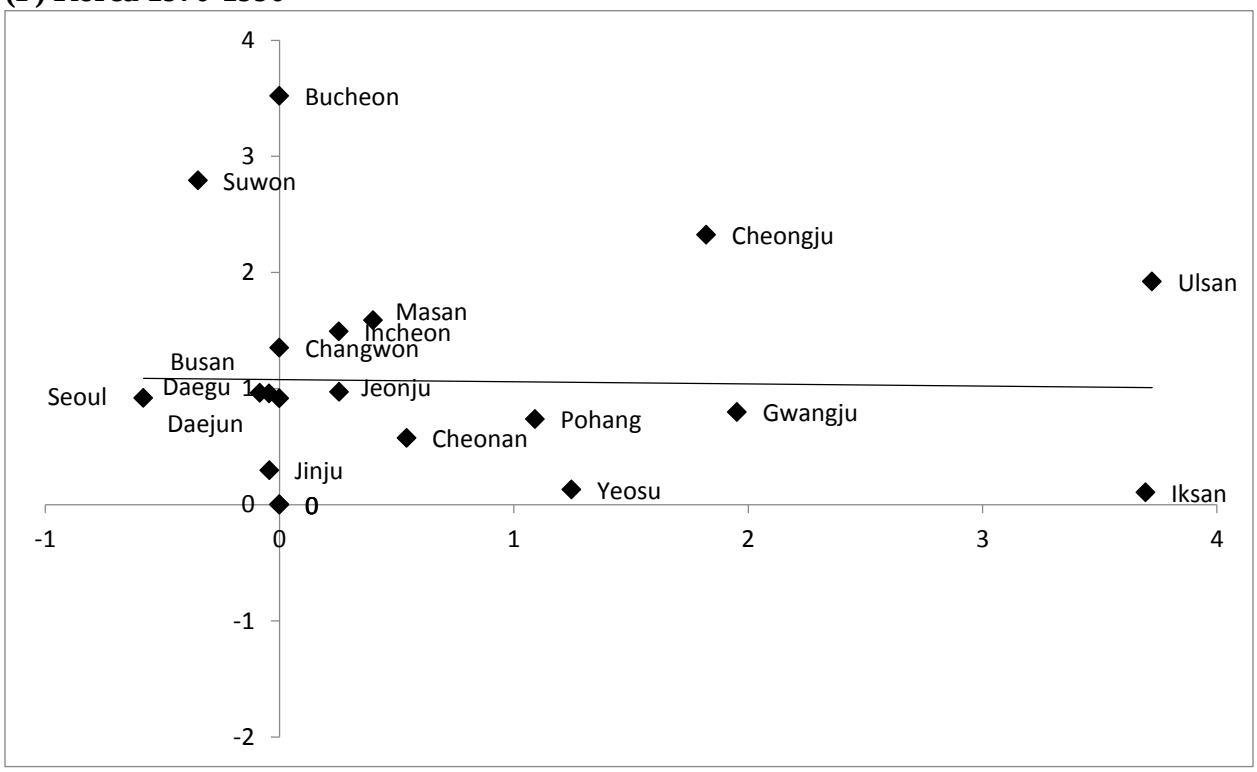
(D) Japan 1970-1990



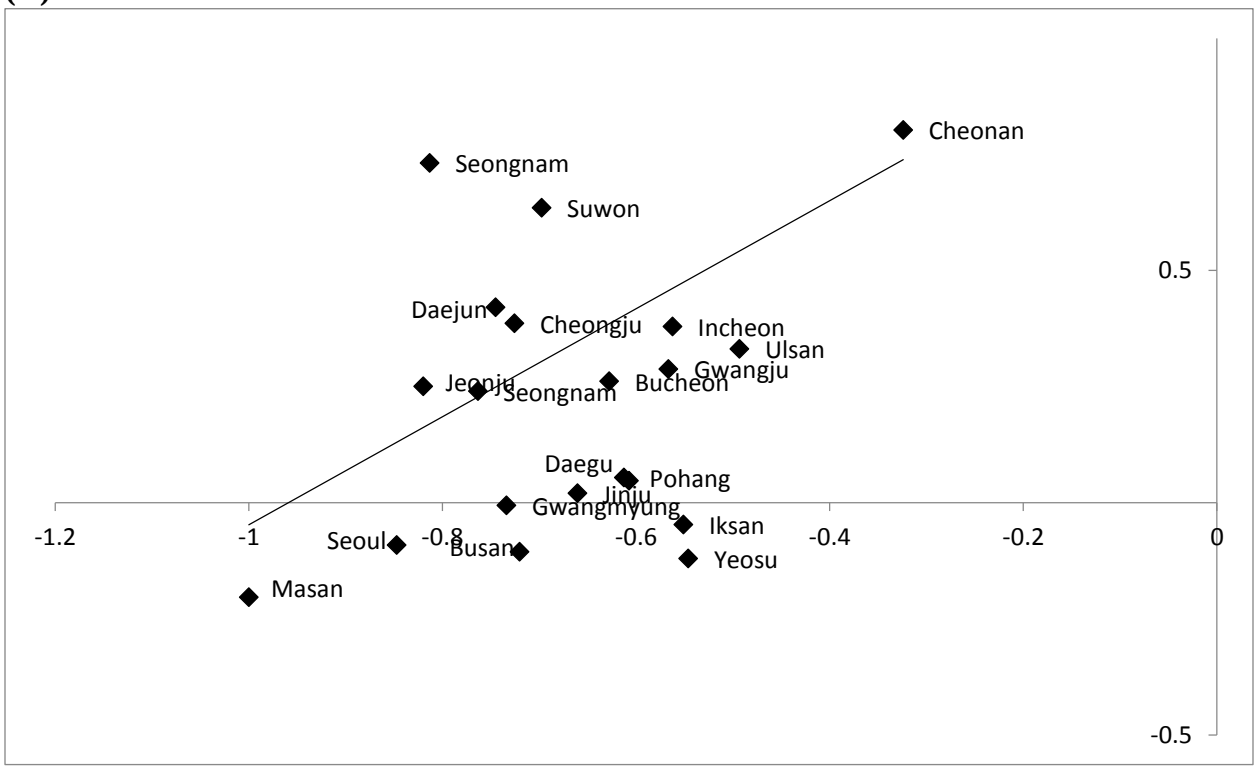
(E) Japan 1990-2010



(F) Korea 1970-1990



(G) Korea 1990-2010



4-1 Principal Component Analysis

Principal component analysis used to describe and synthesize the phase of Kitakyushu city development, principal. Among 291 variables collected, 43 variables are input in the statistical analysis due to data availability which only continuous variables from 1960-2010 (by 5 years) selected. The result shows cities will develop with certain growth and decline in economic, social, environmental, physical development.

Table A. Multidimensional transition and phases of development, Kitakyushu City

Phase 1	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**
1960-1970	1970-1980	1980-1990	1990-2000	2000-2010
Industrial	*Growth*	*Transition*		*New Phase*
Industry (Agriculture) (Mining)	Area, Density	Population Foreigner		Industry – (Tertiary) – **(**Service)
Industry (Secondary) (Manufacturing)	Population**,** Population in concentrated area	Population Change (-)		Education (College rate)
Industry (Transportation Communication)	Age less than 15	Age 65 or more (-)		Unemployment
	Crime (-)	Education (Employment rate)		Consumer Spending
	Pollution – N		Pollution – Photochemical, CO	
		Waste Landfill - incinerated ash	Waste – Land fills others	Waste incineration Waste recycle
Gas- Residential Use		Gas consumption total	Gas – Commercial Use	Gas- Industrial Use, Other Use
	Land use – pavement road rate		Electricity Power Use (-)	Electricity Light Use
				Travel Vehicle – Passenger cars
				Land use – actual road length

Table B. Rotated Component Matrix

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
POP	-.891	.233	-.137	.358	-.030
AGE15	-.965	.003	-.183	.097	-.159
AGE65	.981	.069	.154	-.075	-.042
EDU1	.950	.261	.018	-.021	-.111
EDU2	-.940	-.309	-.045	-.017	-.092
IND2	-.928	-.138	-.335	-.049	.044
IND3	.903	.205	.359	.099	-.010
INDAGR	-.943	-.137	-.133	-.019	-.252
INDMIN	-.769	-.434	-.384	.063	-.205
INDMAN	-.946	-.248	-.194	.014	-.050
INDSER	.965	.028	.129	-.100	-.170
INDTNC	-.924	.030	-.063	.074	.235
UNEMP	.854	.257	.299	.132	-.087
POLLAIR5	-.681	-.618	-.307	-.197	-.129
GASR	-.967	-.102	-.120	.164	-.039
GASI	.953	-.038	.092	-.205	.156
GASETC	.820	.212	.177	-.149	-.469
ELECLT	.955	.155	.212	-.054	.123
WTINC	.835	.370	.263	.054	.261
WTRCL	.955	-.062	-.258	.019	.111
TRV	.927	.193	.251	.035	.193
TRVP	.906	.265	.236	.095	.210
LUR_M	.611	.474	.255	.514	-.264
LUPR	.737	.472	.392	.128	.253
ARE	.808	.456	.359	.074	.061
DENS	-.913	.179	-.181	.312	-.011
POPCONSA	.783	.433	.356	.117	.237
POPFOR	.403	.869	.208	.149	.127
CONSUM	-.201	-.962	-.100	-.126	-.048
CRIME	.445	-.801	-.123	-.113	.000
POLLAIR	-.546	-.777	-.274	-.071	-.126
POLLAIR3	.422	.866	.214	-.056	.008
POLLAIR4	-.068	.961	-.229	.049	-.118
GASC	-.566	.654	.010	.376	-.191
ELECPW	-.342	-.840	-.246	-.274	-.201
CHPOP	-.474	.213	-.810	.177	-.200
POLLAIR2	-.161	-.221	-.886	-.320	.173
GAS	.150	.452	.867	-.042	.026
WTLIA	.599	.203	.624	.321	.316
WTLO	-.269	.557	.025	.773	.042
WI	-.294	.099	.097	.927	.138
POPCONS	.242	.403	.165	.535	.656

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

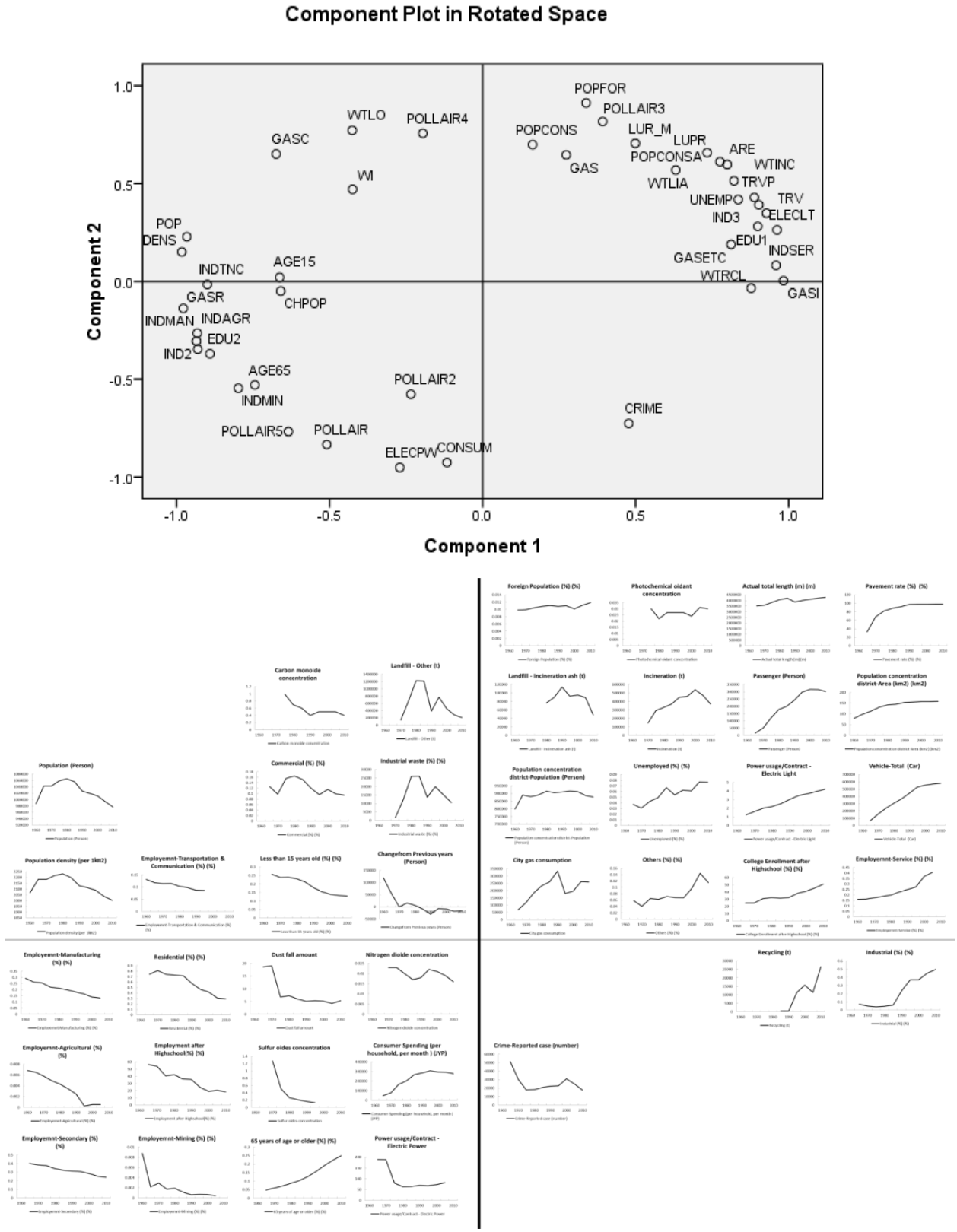


Figure C. Component Plot in Rotated Spaces

4-2 Kitakyushu Timeline (1-A)

Year	International National Regional Event City Historical Event		Economic		Social
1910-1930			Mining Industry Steel Industry	1901Yawata Works to start operations Government run Yawata steel works (Developed as an industrial city, industrial waste water, exhaust emission)	Post-war Gambling & Crime Natural Disaster
1940-44					1944 1st Air Bombing
1945-49	1945 End of World War2	1949 Mejisho Emperor Yawata Steel visit during Kyushu travel			1948 Kokura Horse Racing (Japan 1st)
1950-54	Post-war Restoration				1950 Korean War (US army troops assemble in Kitakyushu)
1955-59				1959 Yawata Steel Tobata Works (Asia largest) complete	
1960	Fast Economic Growth				
1963		Kitakyushu city 5 cities Merger (0210) - Designated City (0401)			
1964		1963 The Chamber of Commerce and Industry			
1965			De-Industrialization Mining and Metal Chemical Industries	(-) Nippon Steel move out (Kimitzu, Chiba)	
1966					Heavy Crime
1967		City Mayor (Tani Gohei - 20years)			Homicide Theft - Jewelry
1968				(-) Mitsubishi Metals move out (Kashima, Ishikawa)	Mexico Marathon (gold medal), Yawata Sports peak
1969					

(1-B)

Environmental			**Physical**				**Year**
Industrial Pollution	Environmental pollution experience (till 1928)		Industrial Development Mining Industry Rail Road Development				1910-1930
				1942 Kanmon Rail Tunnel open, passenger train			1940-44
				1948 Moji Marine Safety Agency		1946 Kokura foreign affairs school (Kyushu City University)	1945-49
Aggravation of Pollution Problems			1953 Great Flood (183 lost 83000 damaged)		1951 Kokura city (fish market, Japan 1st arcade shopping street)		1950-54
Start of Women's Action on Environmental Problems	1957 Woman (housewives) participation in environmental protest			1958 Kanmon National Road Tunnel, JR Kokura station relocation (from Nishi Kokura area)			1955-59
	Pollution Control Policy Organizational Arrangement, Pollution Control Agreement (with companies)			Wakato Bridge			1960
	Cleaner Production, Process Improvement, Treatment of Pollutants, Tree Planting						
Citizen Action (Woman)							1963
	1964 Woman Alliance action on pollution (1.research and investigation 2. institutional/non-institutional communication-ex.media)	1964 Kitakyushu Pollution Prevention Council		Kitakyushu Port (Integration - Kanmon, Kokura, Dokai)			1964
	1965 Kitakyushu pollution mitigation council					Kyushu Public University open	1965
				Double track railway (Kokura-Orio, Kokura-Shindebaru)			1966
							1967
	Kanemi oil intoxication (patient)	1968 Air Pollution Prevention Law					1968
	1969 Sread action for citizens	1969 Noise Abatement Law		Hama-Kokura station (Cargo station, National)	Tobata Public Thermal Power Generation Unit 1		
		1969 Tobata Public Thermal Power Generation Unit 1 (Pollution Prevention Coopertation)					1969

4-2 Kitakyushu Timeline – Continued (2-A)

Year	Historical Event		Economic			Social
1970	Osaka Expo The basics of comprehensive science and technology policy in the 1970s (Science and technology alternative to heavy and chemical industrialization)			Mitsui Mining coke (Blast furnace coke plant, Wakamatsu) 1970 Nippon-Steel (from Yahata Works), Dantanisangyo (Wakamatsu plant) complete Shinitetsu integration (Yawata)	Nippon Steel Yawata Works Unit 4, Sumitomo Metal Industries Unit 2 - Pause	
1971	4th order capital liberalization (machine tools 50%) - internationalization				Japan Mining Wakamatsu closed (1500 job loss); Nippon Steel decide downsize 5000	Fish boat missing (14 people)
1972	Crude steel production 100 million tons breakthrough. Okinawa administrative rights return	New City Hall Kitakyushu New City Hall Bldg (Kokura District Castle)		Hitachi Metals (Tobata), Kao (Kyushu factory, Shin-Moji industrial district till 1999)	Yawata Works (No.1 No. 6 blast furnace in 1901) - pause Nippon Steel (Higashida) - paused	
1973	Oil Crisis (1st) - 4th Middle East War			Nippon Steel, Yawata Works new laboratory building (Higashida, Institute of Industrial Science)	Mitsubishi Chemical Industries (Kurosaki factory) - stop production	Hospital fire, Gunshot killing (50 victim, 20s killer)
1974	Capital liberalization (IC, Computer)	7 Districts (Kokura, Yawata devision)			Japanese National Railways (the last repair in Kokura plant - 84years history) - closed	
1975	Impact of oil shock, IIssue deficit bonds, Shipbuilding largest construction volume (18 million tons) and recession (Mitsubishi Heavy Industries - workforce reduction plan)Nagasaki Airport completed(-) Fukushima power plant 2nd Installation (residents oppose administrative litigation - rejected)		Advanced Industries: Automobile, Electronics	Nissan Motor Co., Ltd., Kyushu factory completed in Kanda (Kyushu 1st)	(-) Sunatsu Port Rail, City Cargo Rail (Wakamatsu-Kita Minato)- closed	
1976	Car ownership 30 million units topped (1965-2005) PVC Prohibition in Europe and the US			Yawata Works, Wakamatsu sintering plant (world's largest)	Recession and demand sluggish (voluntary retirement - Kurosakyogyo 180, Yaskawa Electric Mfg 700 people, Kaijima (Chikuho last major coal mine) - closure,	

(2-B)

Environmental			Physical				Year
Institutionalized Management and Recovery	Kitakyushu pollution prevention regulations promulgated Air pollution central monitoring station (-) 1970 Smog occurrence, pollution watch	1970 Kitakyushu Pollution Prevention Act 1970 Centeral Air Pollution Monitoring Station		Shin-Nakahara station (National JR)	National Road 199 (Kanmon-Kokura)	1970-1971 Takatoyama (ropeway closed)	1970
Environmental Pollution Prevention awareness arise, Environment Agency launched (Ministry of Health and Welfare, the Ministry of International Trade and Industry, the Economic Planning Agency, each department of the Forestry Agency - till Ministry of the Environment with 2001) Tokyo Gas (Regional Heating in Shinjuku),1972 Heating Supply Service Law, Kitakyushu additional specified in the pollution prevention planning region Installation Kitakyushu pollution control stations 1. Airpollution mitigation council (Public-Private cooperation) 2. Pollution prevention agreement (1967-1971, Yawata in 1969) 3. Pollution reduction technology development 4. Dokai bay improvement Companies pollution prevention agreements		(+) Kitakyushu Environmental Pollution Prevention Ordinance 1971 Designated area of pollution prevention plan (National) 1971 Environmental Cooperation (private sectors)		Tanoura container terminal (Moji)		JICST (Science Technology Information Center for Kyushu, Yawata)	1971
				Yamada Ammo Depot Return (Japan No.1 size the US)		JICST (Yawata) Science and Technology Information Center (JICST) Kyushu Branch	1972
1972 'Green Kitakyushu' Plan (Urban greening-ex.park) Environmental awareness, - PCB of disabled, Ministry of International Trade and Industry prohibit PCB (polychlorinated biphenyl) - Litigation environmental rights occur in the construction of Hokkaido Electric Power-Date firepower - Yokkaichi pollution lawsuit -Morinaga Milk arsenic poisoning victims (country) Exhaust gas emmision regulations implementation (CO, HC, Nox -photochemical smog occurs) Indicated 30% SO2 reduction city's main factory (-) Idemitsu Petrochemical, explosion accident at Tokuyama complex		Kitakyushu Sox 30% reduction		Kanmon Bridge Kanmon Bridge open (Asia 1st longest)	Hibiki Nada reclamation (Wakamatsu Kukita coast) Hibikinada development (Wakamatsu) - Reclamation construction start		1973
	(-) 'Dead Sea' Dokai Bay - Sludge dredge operation	Environment Agency, notice 50 regulation of automobile exhaust gas introduced the total regulatory system of Sox		Shin-Kanmon Tunnel (Shinkansen)	Masu Fuchi dam, New Kanmon Tunnel (Shinkansen)		1974
		Osaka Gas (LNG conversion)	Growth DevelopmentShinkansen Development	Shinkansen (Kokura Station)Sanyo Shinkansen (Fukuyama-Hakata) - Shinkansen Kokura station(+) Sanyo Shinkansen, Okayama, and Hakata - open	Sand Tianjin port (Wakamatsu ~ North Minato) abolished	New central wholesale market opened, fruit and vegetable market integration of Moji	1975
		Environment Agency, 1978 emission regulations of passenger cars (Air Pollution Control Act, Nox)	Car Use Express Road Construction	Kitakyushu Express Rail Co.Ltd. Established			1976

4-2 Kitakyushu Timeline – Continued (3-A)

Year	Historical Event		Economic			Social
1977				Kyushu Electric Power Co., Inc. New Kokura power plant (LNG), KOWA SEIKO CO., LTD. (industrial waste treatment business expand), Western Gas (Kitakyushu plant equipment to Wakamatsu Hibikina landfill, refinery gas)	Structural recession, Unemployment increase, Emergency loan-recession measures consultation business, Nippon Sheet Glass Wakamatsu plant (since 1959)-closure	Fire, Fireman death 4
1978	Nippon Steel, Shanghai Baoshan (2006 world largest) and signed a steel plant construction Protocol New Tokyo International Airport (Narita) opened				Sumitomo Metal Industries (1blast regime - steel demand decline), Yawata Works (Horaoka 4th, 3rd blast furnace) - pause, iron source aggregated to Tobata	
1979	Oil Crisis (2nd) Economic Crisis Fukuoka Population Overtake			Hisanaga Electric (Yahatanishi)		Body found - hospital chief
1980	Automobile production world # 1(1,104 ten thousand 2,884 units) Fukuoka Population Overtake			Hisanaga Electric KITA (International Research Study Association)		Homicide (21 male) 2 dead 1 injured
1981		Kitakyushu Citizen's Charter		Sumitomo Metal Industries, Mitsubishi Chemical Industries		Body found - insurance fraud killing, suicide
1982				Nissan Kyushu factory ('Sylvia') - Kyushu automobile center		
1983			Continued Industrial Development	Yawata Works (seamless pipe) factory "Techno Mix Kitakyushu" (cross-industry technology exchange study organization)	Tokyo Shibaura Electric (Light Bulb Industry - Moved, Semiconductor)	
1984			Economic Revitalization	Tokyoseitetsu (H-shape) complete - Wakamatsu		
1985	Fisheries, ability Development Center "Regional economic revitalization measures promoting region" "Specific regional SME measures Temporary Measures Act	1985Local Revitalization discourse 1985-1989 KPEC (Kitakyushu Prosperity Enrichment Council)	Regional economic revitalization area (National)	Katayama (Food manufacturing) - Wakamatsu, Shinryo Chemical (Cleaning Business- semiconductor)		

(3-B)

Environmental			Physical			Year
	(-) Elementary School (Yawata-finish) close - Pollution	Ministry of Health and Welfare, published a law Charter on Health Damage Relief pharmaceuticals (Yushō disease is opportunity for PCB that was used in the cans for edible oil has caused cause substance), three-year extension of the 1978 emission regulations apply to imported cars			West Japan Convention Center (Tanga Centeral Retail Market) West comprehensive exhibition hall opened (old Central Wholesale Market site of Kokura Station North Exit, China exhibition)	1977
					Industrial Medical University (Yawata) The university of Occupational and Environmental Health (Hiraki-gaku to Yahatanishi-ku), Western Suo (computer engineering after, Yahatanishi-ku)	1978
Overcoming Environmental Pollution			Kyushu Motorway (Yawata-Wakamatsu), Kitakyushu Rectangular Road (Kurosaki-Yawata)	Kyushu Expressway (Yawata IC-Wakayama IC), Kitakyushu Rectangular Road (Kurosaki-Yawata)	Meito Kurosaki (redevelopment) open Meitokurosaki (Kurosaki Station east district first kind urban redevelopment building) open	1979
Local Diplomacy Policy, Resource-Circulating Society Policy		1980 Establishment of KITA Reduction of Domestic Waste (New system and citizen participation)	Ongagawa River Mouth Kitakyushu City Highway (1,2,3)	Nishi-Nippon Railroad, Northern line abolished. (-) West Japan Railway (North Line) -stop	1st West Japan International Stationery Food Sample Market (West Japan Exhibition Hall)	1980
			National Road No.10	Tachinoura Container Terminal open (West Japan largest)	Fukuoka Industrial Experimental site (Yawata)	1981
1982 Green City award			Kitakyushu City Hall 2nd bldg open	Child Culture and Science Museum (-) ANA (Kitakyushu-Osaka) stop	Kitakyushu Industrial Research Institute	1982
						1983
			Wakato Bridge (4 lines, no pedestrian) - Start, Kyushu Motorway (Moji-Kokura)	Kyushu Expressway (Moji IC-Kokura East IC)		1984
1985 OECD 'Green City' Introduction			Kitakyushu Monorail (Kokura, Nation 1st)	Kitakyushu city monorail Kokura line (Japan 1st)	Wakamatsu thermal power plant unit 2- Abolish	
Residents group from 1985, Characteristics: 1. administrative role 2. local revitalization						1985

4-2 Kitakyushu Timeline – Continued (4-A)

Year	Historical Event		Economic			Social
1986	Chernovil		Special zone SME temporary action measures law	Saibu gas Kitakyushu Factory (Natural Gas)		
1987		City Mayor (Sueyoshi Kouichi) - 20year 1987 'Kitakyushu Renaisance.' International Symposium of Steel Craft		JR privatization (JR Kyushu 2HQ, Fukuoka) Japanese National Railways Privatization	Hitachi Metal (Tobata) - Closed	11 Aircraft crash South Africa (38 out of 47 Japanese casualties, Tobata fishery employees)
1989	Consumption tax introduced	1st 5year Implementation Plan (1989-1993) - Kitakyushu port 100-year festival		JICA Kitakyushu International Cooperation (Kyushu center)	Wakamatsu thermal power plant unit 1- Abolish	
1990	the collapse of the bubble economy	45th National Athletic Competition		Yaskawa Electric Mfg. (Industrial robot manufacturing) opened		03 Theft Homicide Break-in (Moji)
1991						
1992	Toyota Motor Kyushu, automobile assembly plant (Miyata, Fukuoka)	Color Renaissance (1992-)'	Advanced Technology	Kitakyushu Techno Park (Zenrin R&D) International Youth Council APC Kitakyushu Conference (ASPEC 92 Kitakyushu)	Nissan 2nd plant (largest in Japan)	
1993				Kitakyushu Techno Center National FAZ (import promotion region) Nippondenso (DENSO after, automobile parts) opened	FAZ (International Logistic, Revitalization Economy), Kitakyushu Techno Center (3rd center for supporting new technology and product for local companies)	
1994		2nd 5year Implementation Plan (1994-1998)		Asahi Glass (automobile parts)		

(4-B)

Environmental			Physical				Year
1986 Kitakyushu Environmental Planning					(-) Nishi Yawata Station - closed		1986
1990 Motor Pollution Planning				Tachinoura 2nd terminal, Container Shipment Route (Dairen, China)		Kitakyushu Career Training College	
Environmental preservation regulation (ex.environmental education)							1987
Environmental International Cooperation				Kyushu Expressway (Kokura East IC ~ Yawata IC)			1988
			Physical Renovation	Kitakyushu Prince Hotel - Mitsubishi Kasei (Mitsubishi Chemical after) and Seibu International Center for the Study of East Asian Development (ICSEAD)	Yawata Redevelopment zone completion - Prince Hotel Construction	International East Asia Research Center (ICSEAD)	1989
UNEP Global 500		Global warming prevention action plan (ministerial conference on conservation of the global environment)	Brownfield RenovationYawata Area	Wakato Bridge (4 lines)	"Space World" open (Yahatahigashi-ku)Kitakyushu International Conference Center		1990
8th National Green City Kitakyushu Fair (Green Renaissance Kitakyushu '91)				Kitakyushu Airport regular flights resume (Tokyo flights the 1st 2 round trip)			1991
1992 United Nations local government honored at the United Nations Conference on Environment and Development (Earth Summit)		KITA Environmental Cooperation Center (former KITA, international environmental cooperation of Kitakyushu) KITA rename (environmental)			Nishi-Nippon Railroad Tram (Sunatsu-Kurosaki) - Abolish (-) Nishi Nippon Rail (Sunatsu-Kurosaki) tram stop - clear Kokura center one way		1992
		Can-Bottle separate garbage collection		Kokura Soko (Kokuraekimae east district first kind urban redevelopment building) open	Kokura Sogo open, Kokura Regal Royal Hotel open		1993
					Yawata Royal Hotel open		1994

4-2 Kitakyushu Timeline – Continued (5-A)

Year	Historical Event		Economic			Social
1995				Japan Taiyo Submarine Cables (later OCC, Wakamatsu Hibikinada)	Nippon Flour Mills (Moji)- closed	
1996					(-) Sapporo Beer (Moji) closed	
1997	Kyoto Protocol (Protocol on Framework Convention on Climate Change)		Environmental Industry &Technology	Nishi Nippon PET Bottle Recycling company - Eco-town	Mitsubishi Chemical (Kurosaki)- full stop	
1998						
1999				Nishi Nippon Auto Recycling company - Eco-town		
2000				Kitakyushu Meister system (Certified awards for advanced manufacturing technicians) Sumitomo Metals Kokura (special steel) - independent		
2001	Japan PC annual shipments of more than 10 million units	Japan Expo Kitakyushu Expo Festival 2001		Tokai color (Tokaikogyo Wakamatsu plant) Kitakyushu Meister (Monozukuri)	(-) Kitakyushu JR HQ closed (-) Yawata Works (100 years, seamless steel) - pause	
2002	Promotion of "industrial cluster plan" Ministry of Economy, Trade and Industry			Asahi beer (Moji) - open		03 Kidnap Homicide (98-99, 7people serial killer) rescue 17-year-old girl
2003			Special Zone for International Cargo (1st structural reform), Robot Development and Experimental zone International logistics zones certified Special Zones for Structural Reform, Robot development and demonstration experiment zones	Toshiba (Semiconductor), Yaskawa Electric (1915-, Motoman cumulative shipments of 100,000 units. Articulated robot 10 million units)		08 Club 'Bordo' suicide explosion (Kudokai Yakuza), 9 injured

(5-B)

Environmental			Physical				Year
1995 United Nations Environment Programme (UNEP) "Global 500"			Moji Area	Moji Retro open		1995-1996 New Business Development (Facility Engineering, Kyushu gas Center, Kyushu techno research business, power & environmental business)	1995
Agenda 21 Kitakyushu		1996 Yawata works: Environmental policy revision			The Mall Kokura open		1996
"Kitakyushu Eco-Town Plan"					Space World Station'		1997
1998 Kitakyushu Eco-Town	Agency for Natural Resources and Energy Secretary Award (Kitakyushu Kogasaki garbage treatment plant)			Kitakyushu media dome, AIM, Mojiko Hotel open	Asia Pacific Ocean Import Mart (AIM), Kitakyushu media dome opened	Kitakyushu Monorail (JR Kokura Station Renovation) open	1998
			City Center Redevelopment Kokura Area	Water Environment Museum	Higashida first blasts furnace (1996 historic cultural property) - opened to public	Blast Furnace (Higashi 1st, 1996 cultural property) open to public	1999
	2000 UN Conference on Environmental Development	4th International ESCAP Environmental Convention		(-) Nishitetsu Tram (Kurosaki-Orio) last operation - stopped 89years history	(-) Nishi Nippon Railway (Kurosaki-Orio) stop	ChaChaTown Kokura open, (-) Kokura Sogo, Kurosaki Sogo closed	2000
			New Development Wakamatsu	New outer harbor (Nissan, Kyushu factory North) Chikuho Honsen (East Orio-Orio-Heiankawa)	Kitakyushu Science and Research Park (1st zone) development	Establishing PCB Treatment Facility (2001) Kitakyushu Eco-town center	2001
Sustainable Society Policy	2002 World Summit on Sustainable Development Awards Environment Museum, Natural History, Museum of History opened	Kitakyushu Initiative for a Clean Environment (Johannesburg Summit)		Nature Human History Museum open	Kitakyushu Science and Research Park		2002
				Riverwalk Kitakyushu (Muromachi home district first kind urban redevelopment building) open	Kyushu Railway Memorial, Kitakyushu Art Center, RiverWalk Kitakyushu open	The NS Wind Power Hibiki (Wind power generation, Wakamatsu-ku Hibikinada district, 10 windmills)	2003

4-2 Kitakyushu Timeline – Continued (6-A)

Year	Historical Event		Economic		Social
2004	Ministry of Economy, Trade and Industry "New Industry Creation Strategy" (world No.1 technology maintenance, "information appliances" with the goal of regional revitalization of domestic "fuel cell", "Environment and Energy", etc. 7 explicit fields and action plan.			PCB processing facility, The new Toyota Group (logistic function to New Moji Port), Nissan Motor Co., Ltd., vehicle production total in Kyushu plant 10 million units achieved	
2005	Toyota Motor Kyushu (Miyata) - new line				
2006					
2007		New City mayor (1st Kenji Kitahashi)			
2008		2008 Environmental Model City			
2009					10 Ship collision (Kanmon, Korean container ship)
2010					
2011	Future City & Integrated Special District for International Strategy selected by National Government (2011)	City mayor (2nd Kenji Kitahashi) 2011 'Environmental Future City' Initiative			11 Safety (gun death - construction company executive officer)
2012					
2013		City 50 years			
2014					

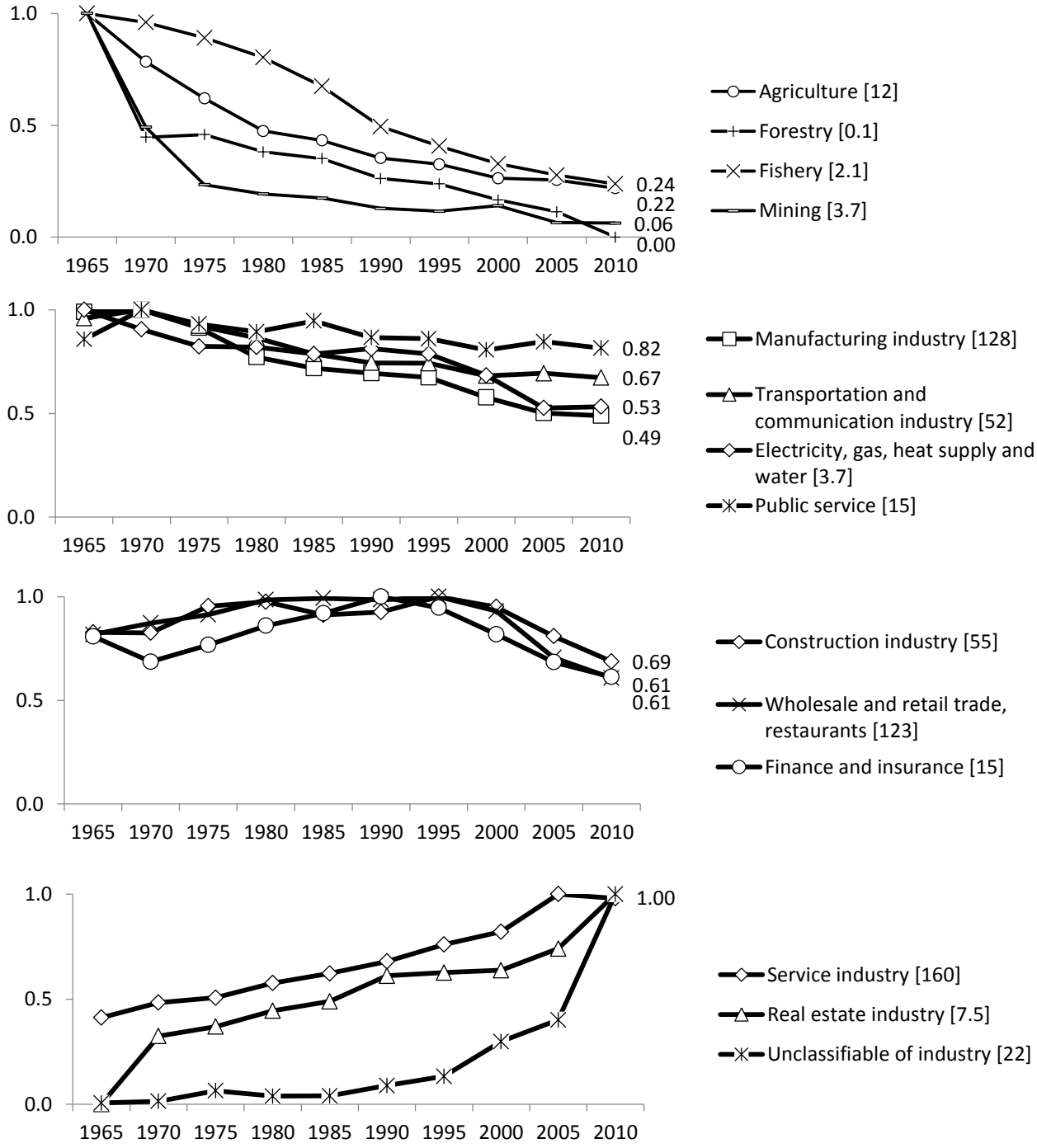
(6-B)

Environmental			Physical				Year
	Implementation and Evaluation of Practical Activities PCB treatment facility (Wakamatsu)	World Capital of Sustainable Development (2004)	Suburbanization Kokura Minami Wakamatsu	Kokura Isetan open (old Kokura Sogo building) Kokura Isetan (old Kokura sogo bldg) open, Yawata Station Redevelopment open	Kyushu Shinkansen (Yashiro - Kagoshima, 2010 Hakata - Yashiro Kagoshima)		2004
06 OECD Green Growth Model City					Hibiki Container Terminal-service (Recycle Port) Higashi Kyushu Expressway (Kitakyushu JCT- Kanda Kitakyushu Airport IC)		2005 2006
	Photochemical smog alarm (in 10years)			New Kitakyushu Airport, (24hour, reclamation)		Kitakyushu Innovation Gallery (Industrial Technology Preservation Succession center)	2007
Low Carbon Society Policy & Green City Environmental Model City	Eco-Model City & Green Frontier Plan (2009)		Environmental Industrial Facilities Yawata Area	Hydrogen Station complete	Next Generational Energy Park		2008 2009
	2010 Green Asia International Strategy Speical District (Fukuoka Prefecture) International Water Business	2010 Non-Nuclear peace city declare 2010 Asian-Green Camp: Asian Center for Low Carbon Society (Yahata-Higashi ku)			Asia Center for Low Carbon Society Smart Grid Experimental Zone (4 in nation)		2010
	Environmental Future City (Green Asia International Strategic Comprehensive Special Zone)	OECD Green Cities Programme Model City (2011)			Kitakyushu Hydrogen Town		2011
		12 Environmental Future City 'International Strategic Special District' (Prefecture, Fukuoka city)		Shin-Wakato Road Shin-Wakamatsu Road (WakaTo Tunnel)	Kitakyushu Manga Museum	Environmental Museum ('Earth Road' Program)	2012
Creation of Local and Global Sustainable Society							2013 2014

4-3 Kitakyushu City: Graphics with Original Value

(1) Employment by Industry, Kitakyushu City (1965-2010)[4]

Y: Number of employees (person) (Maximum value =1) *Category of Industries [Maximum Number of Employees/1000]*

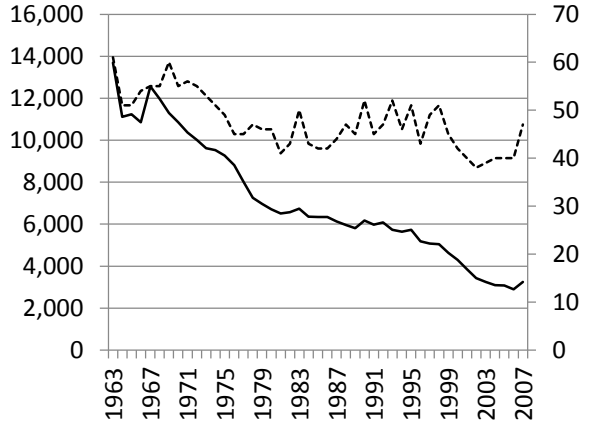


[4] The maximum number of employees are regard as peak (value=1) and actual number are enlisted as "Industry Name (Number of employees/1000)"

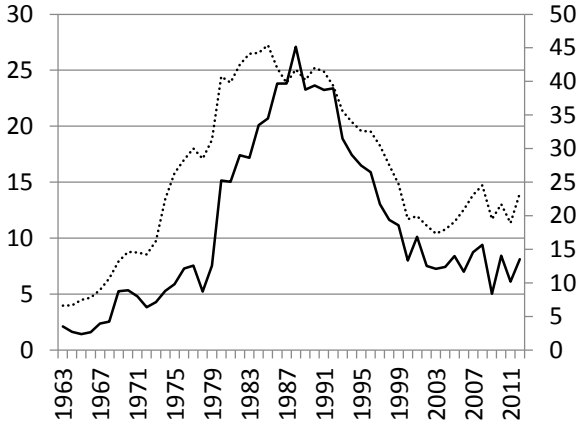
(2) Number of Enterprise and Employment, Value added and Export Value by Manufacturing Industry Sub-Category, Kitakyushu City (1965-2010)

Chemical

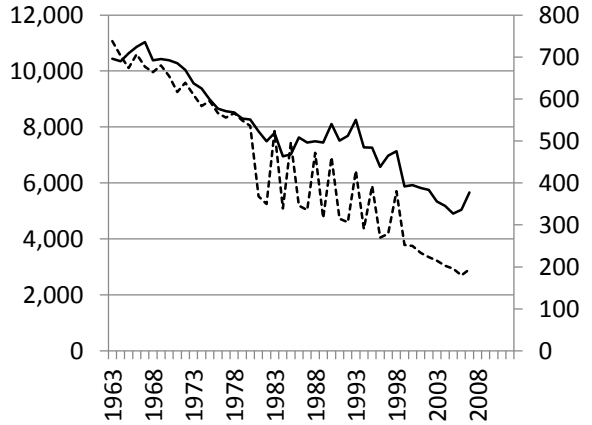
Y1: Number of employees (person) Y2: Number of companies (number)

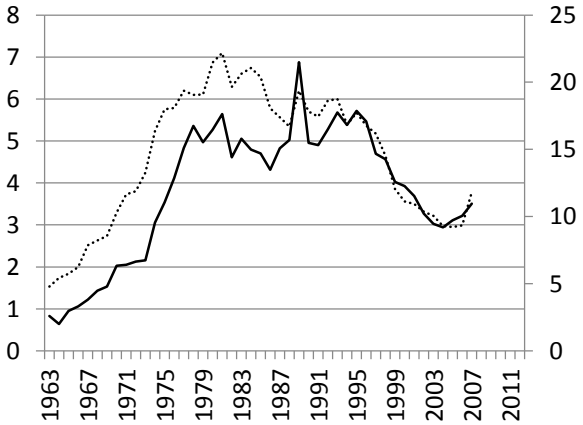


Y2: Value Added (million KRW) Y4: Export Value (million KRW)

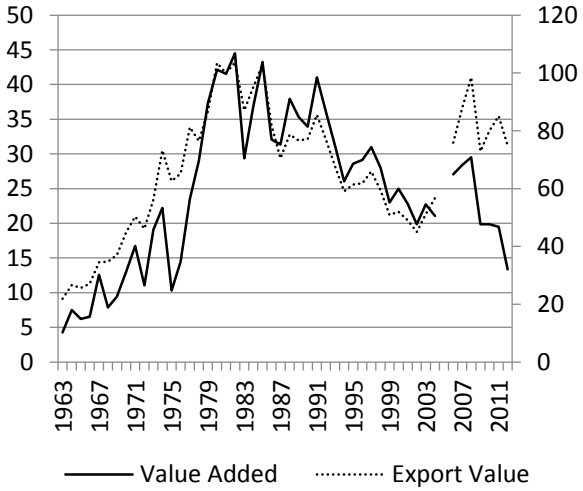


Foods



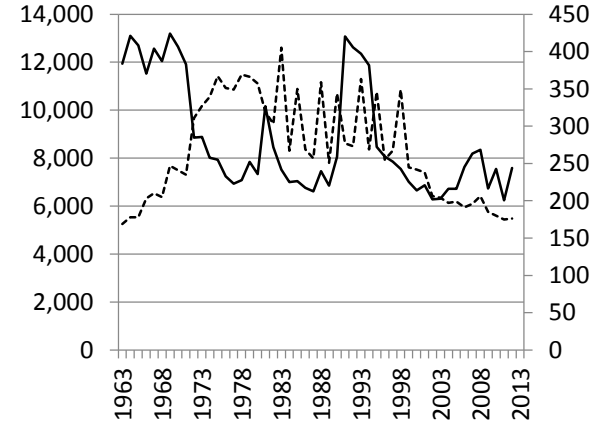


Steel

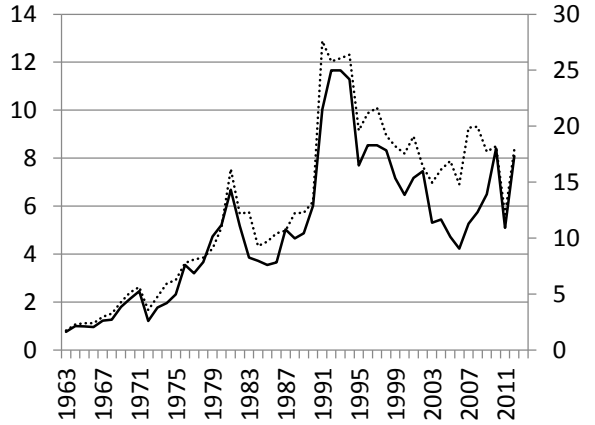


Metal Products

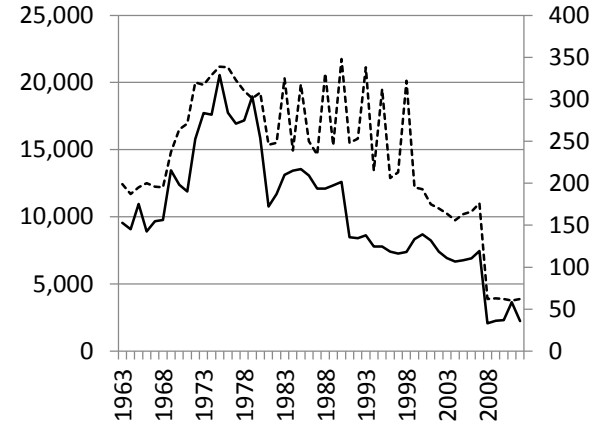
Y1: Number of employees (person) Y2: Number of companies (number)

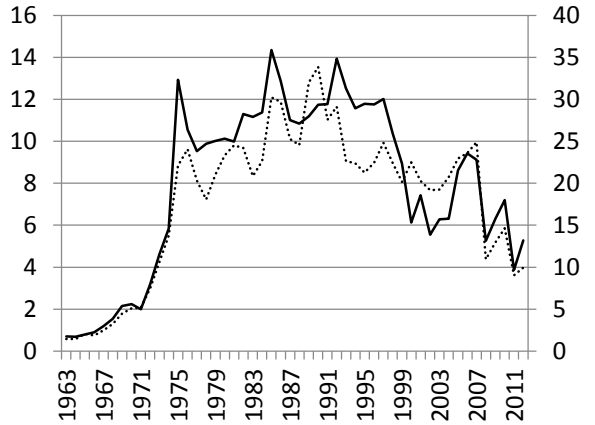


Y2: Value Added (million KRW) Y4: Export Value (million KRW)

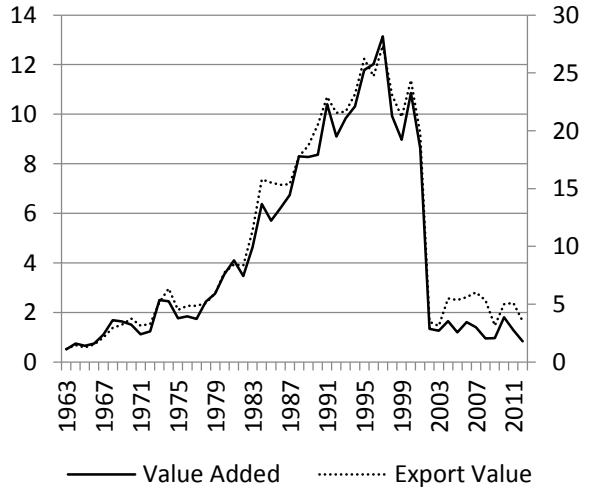


General Machinery

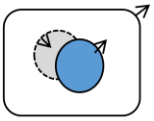
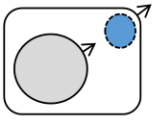
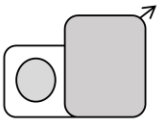
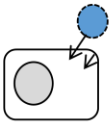
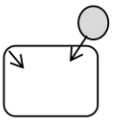
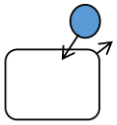




Electronics



5-1 Typology of Korea Industrial Cities by Industrial Transition and Population Changes

Category	(a) Mixed	(b) Hidden	(c) Binary	(d) Decline	(e) Reverse	(f) New
City boundary Old industry New industry Change						
Industrial Transition	o	x	x	x	new	
Population	+	+	+	-	-	-
Classification	Light to high-tech industry Large cities (pop >1mil)	Heavy industrial (Manuf.-GRDP 50%) Large cities (pop >1mil)	Metropolitan area (bed town) Administrative Integration	Heavy industrial (Manuf.-GRDP 50%) Small-medium cities	Industrial development as response to regional decline (late comers)	New development of industry (high-tech) – growth
Example Cities	Daejun Gwangju	Ulsan Incheon	Ansan Anyang Hwaseong	Gwangyang Pohang Yeosu	Gimhae Gyungju Seosan	Cheongju Paju

(a)*Mixed:* Large cities (over 1million population) with industrial transition (light to high-tech mixed) are in growing stage; Daejun, Gwangju

(b)*Hidden:* Large cities with dominant heavy industries are growing with manufacturing value added over 50% among total GRDP; Ulsan, Incheon

(c)*Binary:* Cities becoming bed-town near metropolitan area or cities with new administrative integration have population growth as the city expand boundary; Ansan, Anyang, Hwaseong

(d)*Decline:* Heavy industrial cities located in local area, usually small-medium sized, are mostly experience in population declining; Gwangyang, Pohang, Yeosu

(e)*Reverse:* Industrial development follows the regional decline which shows new investment in the area; Gimahae, Gyungju, Seosan

(f)*New:* Cities with new industrial development, usually high-tech, in growth: Cheongju, Paju

TRANSFORMATION OF INDUSTRIAL CITIES AND

SUSTAINABLE URBAN DEVELOPMENT