

博士論文（要約）

論文題目 Environmental consequences of e-book reader: implications of
changing consumption pattern and consumer satisfaction

（電子書籍端末がもたらす環境波及効果
-消費行動と消費者満足度の変化）

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ABSTRACT

Adoption of information and communication technology (ICT) has been promoted to reduce environmental impact in everyday life. Among such ICTs, digitalization of media transfer has a potential of reducing resource use when electronic media is substituted for traditional media. For example, replacing paper books with e-books read on e-book reading device (thereafter, e-book reader) anticipates resource saving because one e-book device can contain thousands of books. However, such claim is based on the assumption that the digital media is completely interchangeable with paper media in the consumption stage. In reality, ICT devices possess novel functions that can increase the volume of consumption as a result of adopting ICT. Additionally, consumer satisfaction is a determinant of technology retention, but is often ignored in the discussion of environmental impact assessment. To capture environmental consequences of ICT, this doctoral research developed and examined an integrated assessment methodology. This thesis presents the developed methodology based on e-book readers and draws implications for current and future book reading activities. Specifically, the methodology consists of three quantified components: the attributional (i.e. life cycle environmental impact of the medium), the consequential (i.e. changes in consumption pattern), and the experiential (i.e. changes in consumer satisfaction) effects of ICT. The study subject is a dedicated e-book reader, a portable electronic device mounted with an e-ink display.

Analysis of the environmental consequences of the three components confirmed that e-book readers indeed hold a promise of reducing global warming potential (GWP) related to book reading activities. Firstly, the methodology to estimate life cycle GWP of emerging display technology was found to be more representative when actual materials involved in production and observed correlation between display area and production cost in the display industry were considered. While emerging technology is generally assessed by substituting available life cycle inventory data, this research scrutinized the scale of deviation of the results when materials are itemized instead.

Secondly, adoption of e-book readers was discovered to reduce both the GWP per book and total GWP of book reading activity. In this research, the GWP of books was found to break even between paper books and e-books read with an e-book reader at five books. When e-books are read with a tablet device, the threshold is at 10 books. Consumers of e-book readers purchased more than seven e-books annually on average, which resulted in a smaller GWP per book relative to the GWP per paper book. On the other hand, the annual e-

book purchase of consumers that read e-books with tablet devices was less than 10 books; thus, tablet users' GWP per combined book outweighed that of the GWP per paper book. Furthermore, the GWP of annual combined book reading activity was smaller when e-book readers were adopted because the consumers substituted e-books for paper books. Therefore, consumers with e-book readers read the minimum threshold number of e-books, which results in recovering the GWP of their e-book readers, and substitute e-books with paper books; the overall book reading activity remains consistent with e-book reader adoption.

Thirdly, e-book readers also demonstrated higher consumer satisfaction than that of paper books among all consumer groups. The average satisfaction level for these groups of e-book readers was 30 to 40 % greater than that of paper books, which implies that e-book reader is a more desirable medium for reading. Additionally, e-book reader owners expressed higher satisfaction of their e-book reader than that of consumers who only read paper books or those who read e-books using other electronic devices such as personal computers, smartphones, and tablet devices. The use experience of e-book readers was thought to be necessary for consumers to realize satisfaction from the product. However, a social experiment with e-book readers implied that the experience of e-book readers is negligible to satisfaction. Also, consumers that read only at home were found to value the functions of e-book readers less than the consumers that read both at home and outside.

Furthermore, integrated assessment methodology based on eco-efficiency illustrated that adoption of e-book readers can increase eco-efficiency from the conventional patterns of reading only paper books. Eco-efficiency can be improved relative to conventional patterns by meeting the three preconditions: consumers must 1) show higher product satisfaction of e-book readers than that of paper books, 2) substitute more than five paper books by e-books annually, and 3) maintain the same volume of reading activity or decrease upon adoption of e-book readers. Because the experimental group of the social experiment met the three preconditions, the group member's eco-efficiency of book reading activity was enhanced relative to that of the control group that only read paper books. As eco-efficiency connotes a future outlook of the technology, e-book reader's potential to reduce GWP is highly likely to encompass from now and in the future of book reading activity.

In conclusion, the developed methodology demonstrated that adoption of e-book readers reduces the adverse environmental impact from a conventional book reading activity. While the majority of the e-book reader adopters continue to read e-books and paper books collectively, environmental impact anticipates reduction provided more than five paper books are substituted by e-books annually, and provided consumers maintain their volume of

reading activity. Additionally, enhancing functions desired by consumers that only read at home could increase e-book reader adoption further.