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# Item-Level RFID in the Japanese Publishing Industry: A Case Study

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## Item-Level RFID in the Japanese Publishing Industry: A Case Study

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## Abstract:

Over the past decade, several industries have considered RFID technology for improving supply chain efficiency. The Japanese Ministry of Economy, Trade and Industry (METI) initiated and sponsored a number of RFID trials between 2003 and 2006. METI selected the Japanese publishing industry, one of the largest publishing industries in the world, for an early item-level RFID trial geared to increasing industry profitability. This paper uses case study methodology to examine the 2006 METI RFID trial in the Japanese publishing industry. It reports on the trial results and on their implications. The study derives some insights concerning trial composition and the feasibility and efficiency of item-level RFID from the sub-trials. Setting the 2006 METI RFID trial into a broader perspective, the paper concludes with a summary, some lessons learned, and an outlook on future research.

**Keywords:** Radio Frequency Identification (RFID), publishing, supply chain management, case study, Japan

# Item-Level RFID in the Japanese Publishing Industry: A Case Study

## I. INTRODUCTION

Over the past decade, Radio Frequency Identification (RFID) technology has appeared on the radar screens of several industries. Major publishing associations [Falk 2004; Hicks 1999] have increasingly considered RFID for supply chain efficiency improvements on a global scale. In many countries, publishers and retailers have begun to investigate how RFID technology works and have subsequently put it on their strategic agenda [Lichtenberg 2003].

As in several European countries and the U.S., Japan has actively fostered RFID, both in terms of Research and Development (R&D) and practical application since the late 1990s [Shirai and Johnson 2006]. The Japanese RFID market for tags, other system components, and software is expected to grow from €64 million in 2000 to about €850 million in 2008 and €2.75 billion in 2013 [MIC 2006].

The Japanese publishing industry, one of the largest in the world with about 4,500 publishers, 70 wholesalers, and more than 20,000 retail outlets including bookstores, second-hand bookstores, and libraries [JPO 2005], has taken a national and even global precursor role in testing RFID technology across the publishing supply chain. These tests included RFID infrastructure and applications reaching from production to individual products in the store.

This paper analyzes the RFID-related efforts undertaken by the Japanese Ministry of Economy, Trade and Industry (METI) in the Japanese publishing industry. It explores which implications the required business processes, cost, and turnover have for industry-wide RFID adoption and roll-out.

METI conducted an initial RFID trial between 2003 and 2005. In 2006, it then funded a large-scale RFID project which focused on item-level applications and involved various players in the publishing context. (For applications on logistic units, mainly in other industries, see for instance Angeles [2005], Bose [2005], Karkkainen and Holmstroem [2002], Loebbecke [2006], or Loebbecke and Palmer [2006]).

The remainder of this paper is structured as follows: It begins with a short introduction to case study methodology. After briefly describing the fundamentals of RFID technology and the Japanese publishing industry, this paper then reports on the 2006 METI RFID trial and its results, and outlines an industry-wide RFID technology roll-out scenario. Based on this case, the paper offers insights regarding the sub-trials, their composition, and the overall feasibility and efficiency of item-level RFID. It sets the 2006 METI RFID trial into perspective before concluding with a summary, some lessons learned, and an outlook on further research.

## II. CASE STUDY METHODOLOGY

We apply the exploratory case study methodology [Yin 2003] to reflect the reality of the Japanese publishing industry trial with RFID technology. Exploratory case studies are appropriate for researching a subject by applying a research question to a real-world context. They specify a unit of analysis, offer a factual description and end with a criteria-based interpretation of the case. Our research is based on the rationale that RFID is beneficial for organizations and investigates the Japanese publishing industry's initial pursuit of RFID.

We structure our research in four steps. (1) We motivate our study and establish an explorative research question based on a review of the RFID-related literature and discussions with METI representatives; (2) We study the technological and organizational context in which the 2006 METI RFID trial was embedded. This helps to interpret the case and understand potential case implications; (3) We collect data that paint a representative picture concerning setup, processes, and results of the 2006 METI RFID trial; (4) Based on the description, we interpret the case in relation to the research question.

We gathered mostly qualitative data from publicly available and organizational sources. The data collection involved repeated formal and informal interviews with senior executives and project managers between October 2005 and August 2007 as well as the investigation of meeting minutes and project reports. Especially the choice of informal interview settings encouraged respondents to talk about their personal perceptions and impressions of the project. METI officials reviewed the case paper to exclude factual errors.

## III. TECHNOLOGY AND INDUSTRY OVERVIEW

### RFID Technology

RFID technology allows for contact-free reading and saving of data via electromagnetic waves (radio frequency field). It uses RFID tags, also called *smart chips*, which are tiny computer chips with antennas. RFID tags can be integrated into a wafer-thin paper tag or a reusable plastic hard tag. RFID tags are attached to objects, individual items, or logistic units such as cartons, palettes, and containers. Such passive or semi-passive transponders "identify" themselves when they are detected by a signal from a compatible device known as an *RFID reader*. As an RFID tag passes through a radio frequency (RF) field generated by a compatible reader, it transmits its stored data to the reader. Thereby, it gives details about the item or logistic unit to which it is attached. No line-of-sight is needed between tag and reader. The radio signal goes through most materials. With RFID technology, one can read many tags at a time.

From the RFID reader, data is usually transferred to a computer which may then hand the information over to other systems such as Enterprise Resource Planning, Customer Relationship Management, or Electronic Data Interchange to coordinate intra-organizational and interorganizational supply chain processes [Loebbecke and Palmer 2006; Loebbecke et al. 2006; Shepard 2004].

RFID at item level allows every individual item to be distinguished. In the case of the publishing industry, for instance, every copy of the latest Harry Potter book would have a unique RFID code, whereas all of them carry the same International Standardized Book Number (ISBN) and barcode [Lichtenberg 2003]. As tagged products pass readers, RFID technology enables real-time tracking services and thus facilitates enhanced management of product recalls and returns [Higashino 2006].

So far, the main inhibitors to large-scale RFID diffusion have been (1) the price of individual tags; (2) the development and integration of software; (3) the management and analysis of the vast amount of data gathered; (4) the frequent lack of industry-specific technical standards [Loebbecke and Palmer 2006; Loebbecke and Huyskens 2006]; and (5) user concerns regarding privacy and security [Piramuthu 2007].

### Japanese Publishing Industry

The Japanese publishing industry is about 6 percent of the size of the Japanese automotive or electronic sector with a turnover, in 2004, of about €365 billion each. It comprises three levels of players: publishers, wholesalers, and retailers, which together employ about 100,000 people.

The top five publishers account for approximately 25 percent of the total industry sales [Japan Society of Publishing Studies 2004]. Two of the 70 wholesalers, Nippan and Tohan, control 80 percent of the market [Matthews et al. 2002; Miyamoto and Whittaker 2005]. The top three retailers account for about 10 percent of the publishing retail market [Miyamoto and Whittaker 2005]. Japan counts more than 20,000 retail outlets for publishing products, i.e., twice as many as the UK and the U.S. together.

With almost €10 billion in revenues in 2005, books accounted for more than 40 percent of the Japanese publishing market. Despite the availability of several distribution channels for books, book publishers sell roughly 70 percent of all books to wholesalers, who in turn sell about 65 percent to retail bookstores [Miyamoto and Whittaker 2005]. Traditionally, the cooperation among publishers, wholesalers, and retailers in the Japanese publishing industry has been strong, including human capital exchange, cash infusion, and IT network building [Kornicki 1998].

Annually, Japanese publishers issue more than 75,000 new books and sell about 1.3 billion books with a variety of 1.2 million titles [JPO 2006a; Miyamoto and Whittaker 2005]. Japanese book retailers either buy books or make consignment deals. The latter allow them to return unsold books to publishers. More than a third of the books delivered on consignment are returned, making the book industry special in the context of item-level tagging.

In the 1990s, the Japanese publishing market faced a major decline, the first ever as far as industry representatives could remember. Main reasons for the decline were (1) decreasing personal income during a recession; (2) spreading of the Internet and mobile phones; and (3) emerging library services as well as the newly introduced secondhand book shops [Hanajiri 2003]. Especially the book sector was hit by cheaper electronic forms of distribution [METI 2002].[1] Only in the new millennium could the Japanese publishing industry stop the downtrend. In 2004, it grew for the first time in more than a decade [Miyamoto and Whittaker 2005].

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1   In Europe and North America, music and newspaper markets suffered the most from newly available electronic distribution opportunities [Rao 1999; Picard 2003].

## IV. THE 2006 METI RFID TRIAL

The 2006 METI RFID trial was part of a more comprehensive METI RFID project in the publishing industry. Table 1 illustrates the project plan and timeline of the overall project.

**Table 1: Project Plan and Timeline of METI RFID Project in the Japanese Publishing Industry**

| Time | Project Phase | Activities |
|---|---|---|
| 2003-2004 | **Basic Research** (Preliminary RFID usability trial) | • Formation of research-related organizations and units<br> - RFID tag research committee<br> - Hibiki tag development consortium<br> - RFID technical company consortium<br> - Inventory information management research committee<br>• Planning research activity<br> - Division of research to special working groups<br> - RFID field trial preparation<br>• Preliminary practical RFID business model tests<br> - ECOM publication distribution traceability project<br> - Accomplishment of preliminary, small-scale RFID field trial<br> - Problem resolution approach in working groups<br>• METI RFID performance evaluations<br>• Investigation into support systems for RFID-enabled processes:<br> - Establishment of privacy protection guideline<br> - Study into management of code issuance |
| 2005-2006 | **Applied Research** (RFID application trial toward a business model) | • Practical tests of RFID tag attachment methods<br>• Investigation of RFID-based customer services in retail stores<br>• System development for RFID-enabled processes<br> - Privacy protection system<br> - Code system<br> - Sales management system<br> - Computerization and network application system<br> - Data access management system<br>• Solution of transitional problems associated with RFID roll-out<br> - Workflow analysis for simultaneous use of RFID and barcodes<br> - Process development for simultaneous use of RFID and barcodes<br>• METI RFID trial conduct involving publishing industry players publishers (e.g., wholesalers and retailers), technology vendors (e.g. Hitachi, NEC, Fujitsu), and governmental organizations |
| Starting in 2007 | **Roll-Out Preparation** (Implementation tests with selected partners) | • Post-trial evaluation in preparation for RFID roll-out<br> - Exchange and discussion of RFID trial results in the publishing industry<br> - RFID roll-out cost analysis<br> - Assessment of status quo for distribution of publishing products<br>• Updated technology model testing involving publishers, wholesalers, and retailers<br>• Development of further RFID-based services for the publishing industry<br>• Finalization and establishment of application support systems<br> - Code system<br> - Management system for actual application<br>• Retrieval of product information of publishing products and creation of codes for each product<br>• Interface design and integration of RFID with existing EDI systems<br>• Initiation of RFID roll-out in the publishing industry<br> - Roll-out of commercialized Hibiki RFID tag<br> - Distribution of RFID-tagged comic books<br>• Cooperation with other industries with regard to systems, code, customer service, privacy, and applications |

## Motivation

In 2003/2004, the Japanese publishing industry undertook METI-funded performance evaluations. The evaluations included all supply chain processes, paying special attention to (1) store operations and redesign; (2) spotting and preventing book theft; and (3) illegal book trade in second-hand bookstores and libraries [Hada et al. 2004]. The evaluations indicated ongoing challenges regarding the use of RFID technology leading the Japanese publishing industry to further investigate [Fujita 2007b]:

1. Distribution inefficiency, not only because the Internet offered distribution costs far lower than the traditional multi-tier channel involving publishers, wholesalers, and local retail bookstores;
2. Increasing book returns on consignment deals; and
3. Large amounts of paper waste contaminated with plastic and silicon from RFID transponders.

METI, together with the Japan Publishing Organization for Information Infrastructure Development (JPO) that aims at improving book distribution using innovative technologies, took up the issues and at the same time reacted to economic difficulties when they set out to identify and test faster and better interorganizational coordination of all business processes across the publishing supply chain.

METI and the JPO calculated an RFID business case for the Japanese publishing industry. Altogether, they projected the impact of RFID on the Japanese publishing sector to reach about €2.5 billion in combined sales increases and cost reductions [JPO 2006a]. Specifically, they anticipated sales of new books to increase by about €1.2 billion per year resulting from better management of release dates and improved customer relationship management. Costs from returned books were expected to be reduced by about €200 million per year and book theft was expected to decrease by about €290 million per year [JPO 2006a]. Further, they expected book inspection time to be reduced by 90 percent with RFID applications [JPO 2004] and anticipated a general improvement in business processes, distribution and tracing systems [JPO 2006a].

Based on those numbers, the Japanese publishing industry opted for an RFID implementation trial and prepared to organize the first real-life test of supply chain wide item-level RFID implementation [Higashino 2006]. Soon after, it proceeded with a large consortium consisting of industry associations and players, governmental institutions, and technology vendors, even though RFID regulation was still rudimental and RFID technology under continuous development.

## Consortium Composition and Objectives

The JPO took a leading role in organizing the consortium for the 2006 METI RFID trial [Fujita 2007a]. Several JPO member companies, paper manufacturers, printing companies, book manufacturers, publishers—including the three major players Kodansha[2], Shogakukan[3], and Shueisha[4]—and bookstores participated. METI also invited technology vendor, Hitachi, in charge of the RFID developments in Japan, to supervise the technological aspects of the trial.

The consortium members formulated a catalogue of trial objectives focusing on seamless sharing of information through RFID. Setting international standardization trends, the three main goals were to promote (1) fundamental R&D for interorganizational coordination and information exchange on a global scale; (2) common cross-sector problem solving regarding the social acceptability of RFID technology; and (3) the acceleration of RFID adoption and diffusion across the publishing supply chain as a role model for other industries [Higashino 2006]. Further, the consortium aimed at creating new RFID-based business models and at exploiting newly available information for publishers' marketing purposes.

## Technological Context

### RFID Infrastructure in Japan

Implementing RFID in the publishing industry required a commonly accepted product numbering scheme and an allocated frequency range for RFID systems.

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2 Kodansha is one of Japan's largest publishing companies. In 2006, it achieved revenues of more than €1.3 billion. It has a major joint venture with Walt Disney Company.
3 Shogakukan has a market share of about 8 percent in the Japanese publishing market, specializing in schoolbooks, books for children, and encyclopedia. With about 69 magazines, 7,500 book titles, 10,900 comic book titles, 900 magazine books, and 3,000 DVD and video titles, it achieved a turnover of about €1.25 billion in 2006.
4 Shueisha specializes in Manga comics and other magazines.

*Product numbering scheme:* The development of a common product numbering scheme began long before considerations to implement RFID technology. In 1977, the Japanese Distribution Systems Research Institute, which was founded in 1972 to investigate the potential of supply chain enhancements in many industries, launched the Distribution Code Centre—Japan (DCC-Japan) as national authority for product number coding. In 1978, envisioning the global scope of product numbering, the DCC-Japan joined the European Article Numbering (EAN) Association. In January 2004, the former European Article Numbering Association migrated to GS1.

As successor to the EAN Association, GS1 considered mature and standardized product number coding inevitable for the identification of products at item level across the entire supply chain. With a special focus on RFID applications and together with international research institutions, GS1 founded EPCglobal in 2003. In January 2004, EPCglobal set up a Japanese unit, EPCglobal Japan, which promoted specific product numbering codes for use with RFID technology in Japan [Shirai and Johnson 2006].

*Frequency range:* Available frequency ranges were scarce when commercial RFID use came into play during the 1990s. In Japan, Ultra High Frequency (UHF) was mainly allocated to cell phone services. Only the frequencies 13.56 MHz (HF) and 2.45 GHz (UHF) were available for RFID. In April 2005, understanding the need for a globally harmonized RFID frequency allocation, the Japanese Ministry of Internal Affairs and Communications (MIC) released the 950 MHz to 956 MHz frequency range in the UHF band for RFID use [JPO 2006b]. As the frequency range lay within 860 MHz to 960 MHz specified by EPCglobal as standard for international collaboration, Japanese RFID implementations were compatible with other industrial nations.

### Hibiki RFID Tag

To tackle RFID technology challenges, in 2004, Hitachi took a central role to form the Hibiki Tag Development Consortium, cooperating with Dai Nippon Printing, Toppan Printing, NEC, and Fujitsu. Funded with about €92 million from METI between 2004 and 2006, the so-called Hibiki project aimed at developing and testing innovative RFID tags. Hibiki RFID tags had to be low-cost, high-quality, multi-standard, rewritable, and designed for item-level use [Ishikawa et al. 2003].

The coding scheme of the resulting Hibiki RFID tag complies with ISO and EPCglobal standards, even though it only serves one data encoding and transmission type (instead of two specified by EPCglobal). The Hibiki RFID tag offers a 512 bit memory. It is compatible with EPCglobal Gen II devices [Hara, 2003]. Assuming an output volume of 100 million tags, production cost per Hibiki tag are €0.05 compared to €0.10 to €0.15 for European or American tags.

Overall, METI was satisfied with the Hibiki project results, and therefore solely promoted Hibiki tags for a further RFID trial in the publishing industry.

### Customer Privacy Context

When RFID became a mainstream topic at the beginning of the millennium, customer privacy organizations and civil rights activists emphasized the danger of customer data being gathered, processed, and exploited without the customer even being aware. They raised concerns that personally relevant data was stored on RFID tags and then transferred from the tag without customer permission. They claimed that customer data stored on an RFID tag containing an ISBN code would allow drawing conclusions on customers' shopping behavior and possibly on political and philosophical attitudes.

In June 2004, as the privacy topic gained public attention, METI and the Ministry of Internal Affairs and Communications (MIC) jointly established and released *Guidelines for Privacy Protection with regard to RFID Tags facing the consumer*. The policy regulated to make attached RFID tags transparent to the user. It set restrictions for gathering and using personal customer information and gave consumers the rights to nullify or remove RFID tags. Finally the policy ruled the accountability of RFID tag issuers [Shirai and Johnson 2006].

In the 2006 METI RFID trial, project participants specified and even extended the overall privacy policy concerning two aspects. They required that information stored on RFID tags only include the arbitrary numbers and letters needed for the distribution process to the exclusion of any personal customer data. Also, they required that any information stored on the RFID tags be deleted and that the tags be destroyed before product delivery to the customer.

## METI RFID Sub-Trials

The 2006 METI RFID trial in the publishing industry consisted of five sub-trials: (1) the *Customer Order Tracking* sub-trial; (2) the *Sales Management System* sub-trial; (3) the *Store Operation and Customer Service* sub-trial; (4) the *Code System and Privacy Protection* sub-trial; and the (5) *Paper Recycling* sub-trial.

The *Customer Order Tracking* sub-trial (see Figure 1) involved printing and book binding companies, publishers, wholesalers, bookstores, and consumers. It focused on the tracking of customer orders of comic books. Hibiki RFID tags were attached to 100,000 comic books during the manufacturing process. Following ID issuance and code writing on the tag, publisher personnel inspected the comic books and sorted them into the distribution system. To fix and maintain delivery dates based on RFID across supply chain members, the printing and book binding company set a delivery date for the book to reach the wholesaler. The wholesaler then set a date when the book would reach the retailer; and finally, the retailer fixed a date for the book to be available to customers. Along the entire process, from printing to customer purchase, the Customer Order Tracking sub-trial investigated the cost per customer order, the cost per retail service, and the cost for design and store layout of next generation bookstores.
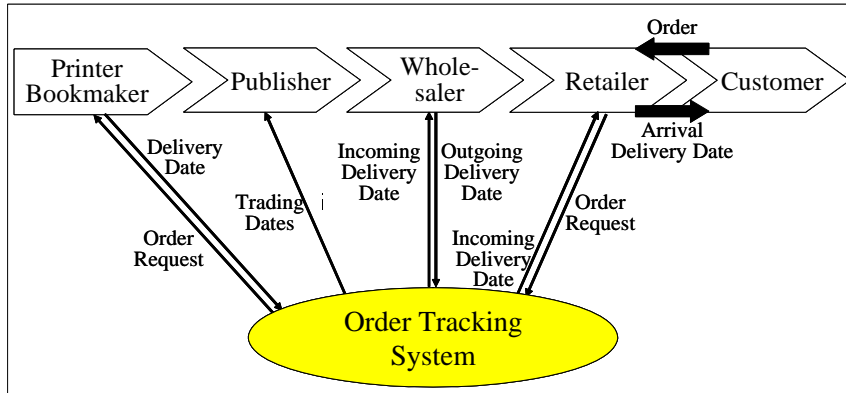


**Figure 1: Customer Order Tracking [After JPO2006b].**

The *Sales Management System* sub-trial aimed at reducing stocks and book returns, and at shorter reaction times to customer orders. It also encouraged management to reintegrate returned books into the supply chain at the earliest possible stage. For the sub-trial, 10,000 copies of the *Encyclopedia of Health and Medicine* published by Kodansha Ltd. were printed, tagged, and distributed across the supply chain. Information gathered from Hibiki RFID tags affixed to the Encyclopedia was passed to and processed by the sales management system. The information let publishers, wholesalers, and bookstores track returnable and non-returnable books and their respective status. To provide advantages for printing companies, the Sales Management System offered fast and precise sales feedback and thus fostered a reduction of book overproduction.

The main objective of the *Store Operation and Customer Service* sub-trial was to generate more detailed and objectified, even if qualitative, assessments of customer demand and to transform them into quantitative information for better customer services. The sub-trial focused on retail bookstores and the interaction between retail personnel and customers (see Figure 2).
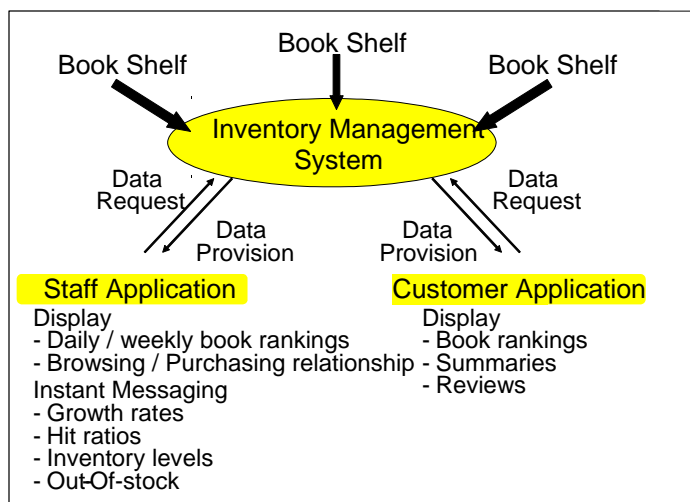


**Figure 2: Store Operations and Customer Service [After JPO 2006b].**

The sub-trial examined the introduction of flatbed smart shelves, which displayed information to consumers and retail personnel. Offering an inventory management system for RFID-tagged books on the shelves, the sub-trial

gave retail personnel the opportunity to observe daily and weekly book rankings in real time and to analyze the relationship between customers' book browsing and buying. It enabled retail personnel to send instant messages concerning growth rates, hit ratios, inventory levels, and out-of-stock items to the employees in charge of inventory management. Finally, it also provided customers with book rankings, summaries, and reviews as an additional service.

The *Code System and Privacy Protection* sub-trial involved all supply chain participants. It was built on a newly developed common coding system for publishing products. The sub-trial required printing and book binding companies to attach the Hibiki RFID tags to books and assigned publishers, wholesalers, and retailers to implement software for reading and interpreting the information stored on the tag. The Code System and Privacy Protection sub-trial analyzed the trade-off between providing appropriate and reliable information on the one hand and securing customers' private data on the other hand. By setting up flatbed smart shelves, the sub-trial offered information on customer behavior in the retail store prior to purchase. For instance, it provided information that allowed tracking a customer route through the store after a book had been picked from a shelf. However, the sub-trial requested retail stores to preserve customer anonymity by neither storing customer data on the tags nor matching purchase data to customer information upon checkout.

The *Paper Recycling* sub-trial concentrated on paper manufacturers, printing companies, and book binding companies. Based on a full-scale RFID roll-out in one paper manufacturing plant, it experimented with various ways of attaching RFID tags to books in consideration of environmental concerns. The sub-trial examined the efforts needed to detach RFID tags automatically, when separating pieces for recycling.

## V. TRIAL RESULTS

The 2006 METI RFID trial delivered results that enabled further profitability calculations for a planned roll-out.

Of the almost 1.3 billion books distributed industry-wide in 2006, more than 0.5 billion (38.5 percent) were returned on consignment deals. The returned books account for 163,167 tons of paper causing logistic costs by traveling from the publisher to the bookstore and later back to the publisher. With RFID technology and the sales management system, for the first time in the era of consignment deals, the return rate of books with RFID tags was reduced from 38.5 percent to less than 10 percent in the 2006 METI RFID trial.

The 2006 METI RFID trial facilitated an assessment of the quantity and configuration of RFID equipment necessary to enhance the publishing supply chain. For an average publisher, it used 20 sets of RFID readers and writers, whereas for an average wholesaler it took as many as 50 and for an average bookstore as little as five sets. Further, the trial indicated that the capital requirements and the cost of the equipment could be covered with an initial investment of €6,468 for each set plus 20 percent additional maintenance cost per year.

The trial proved that state-of-the-art RFID technology was able to attach an inlet-embedded label to the front cover of a book without disturbing customers using the book. It further showed that binding RFID-tagged books without changing the existing production line was possible—a requirement to keep total costs under control. The 2006 METI RFID trial achieved tagging 5,400 books per hour in a bookbinding facility with additional improvement potential based on endless RFID tag carrier tapes.

The 2006 METI RFID trial revealed that attaching RFID tags to books cost €0.08 per book. Due to increased efficiency from RFID, it reported bookbinding costs to be reduced by €67,590 for an average publisher involved in the trial. To achieve an end-to-end RFID infrastructure, the trial required wholesalers to install an RFID sorter system for about €1.29 million. With regard to retail stores, the 2006 METI RFID trial found theft numbers to be reduced by about 90 percent.

In the course of the 2006 METI RFID trial, RFID technology saved human resources by reducing person-hours in several areas. It improved the efficiency of inspection efforts upon arrival of books at the store. Whereas inspection without RFID took a worker 48 seconds, RFID technology reduced the inspection time to seven seconds. RFID technology lowered the efforts for the reception of 5,000 books at a store covering around 500 to 650 square meters by approximately one person-hour. Similarly, RFID technology improved inventory taking workload from 670 seconds to just 48 seconds. In total, it saved average stores of 500 to 650 square meters holding about 100,000 books close to 287 person-hours for inventory taking per year.

Besides the positive results, the 2006 METI trial also revealed several additional issues. It showed that RFID equipment costs could be greatly reduced through large-scale production and commercialization. Due to the still limited size of the RFID market, the 2006 METI RFID trial found that services such as equipment maintenance were still rare, complex to coordinate, and expensive. Further, it signaled that the cost of attaching RFID tags and the

speed and accuracy of tag reading and writing needed further improvement. It particularly identified bulk-reading of multiple items at a time, required for cartons of books, for instance, as an issue for further improvement. The 2006 METI RFID trial suffered from writing errors in the process of binding comic books that could be avoided through enhanced writer software with faster data encoding capabilities.

Hence, overall the METI trial in the Japanese publishing industry gave METI an agenda of critical issues to be solved prior to an industry-wide RFID roll-out. It delivered both a preliminary financial assessment of RFID at item level in the Japanese publishing industry and a list of remaining issues. However, it could not offer generalizable and quantified profitability statements concerning a roll-out in the entire publishing industry.

## VI. PAINTING A ROLL-OUT SCENARIO

Based on the experience from the 2006 METI RFID trial, the Japanese publishing industry painted a roll-out scenario forecasting several positive effects. Overall, it expected book returns to decrease and book-binding costs and distribution costs of shipping and revoking books to be reduced as a consequence of the RFID implementation. Further, it expected inspection times and inventory taking efforts to be reducible for every entity across the supply chain. At the retail end, the publishing industry considered a decrease of theft and additional sales due to RFID-enabled services.

Several assumptions were made in order to calculate the investments, recurring costs, and cost/benefit effects of an RFID roll-out: The diffusion of RFID technology among publishers is restricted to larger publishers due to the investment and the technology competency required. RFID diffusion reaches only to the largest 1,000 out of about 4,200 Japanese publishers. Consequently, only books published by those 1,000 publishers—about 90 percent of newly published books—are tagged.[5] All 35 wholesalers and all 17,000 bookstores are expected to participate. Sales are expected to increase by about 5 percent due to enhanced services, also impacting profit margins which, historically, have ranged around 15 percent for publishers and bookstores and around 8 percent for wholesalers.

The assumptions and the trial results led to the following profitability scenario for an RFID roll-out in the publishing industry (see Figure 3).

> Reducing book returns by 10 percent could save a total of 32,632 tons of wasted logistics. Whereas the majority of returned books are commonly redistributed to bookstores, more than 8 percent of returned books are wasted. A 10 percent reduction of that figure could reduce book waste by 1,336 tons.
>
> Distributing 52.80 million books less at an average book price of €7.72 with 20 percent of the retail book price being distribution cost, could cut the distribution costs of the publishing industry by €73.62 million. As the average production cost of a book accounts for about 33 percent of the listed retail price, a 10 percent reduction could reduce production costs in the entire publishing industry by €135.92 million.
>
> In 2006, the 1,000 largest publishers each sold an average of 633,520 new books. Based on this sales volume and the attachment cost of €0.08 discovered in the trial, RFID tag attachment would cost €50,768 per publisher.
>
> With total 2006 sales of €14,206,315, an average bookstore could increase its annual sales through RFID-enabled services such as smart shelves [Loebbecke 2004], customer recommendations, and suggested reading by €41,718. Bookstores could turn this sales increase into additional profits of €6,273. Considering the market concentration and the profit margins, an average wholesaler could thus increase its profits by €1,621,075 and an average publisher by €106,398. Given the average €14,028 of theft damages in 2006, bookstores could reduce the annual losses from theft through RFID-based theft protection by up to €12,224.

**Figure 3: Toward an RFID Profitability Scenario in the Japanese Publishing Industry**

Table 2 summarizes the scenario concerning the investment and recurring costs for the RFID system across the publishing supply chain. It further reports on the quantified effects RFID technology has on each stage of the supply chain. With regard to the transfer of results to countries with less public contribution, additional investments may be needed and the amortization time may be stretched.

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5   However, to assure practicability, implications of combining tagged and untagged books are not individually accounted for in the calculation.

| | Investment (€ per entity) | | Recurring System Cost (€ per year and entity) | | Cost / Benefit Effects (€ per year and entity) | | Amortization (years) |
|---|---|---|---|---|---|---|---|
| **Publisher** | 20 RFID R/W sets | 129,360 | Tag attachment | 50,768 | Red. cost of bookbinding | 67,590 | 2 |
| | | | System maintenance | 25,872 | Add. profit (sales) | 106,398 | |
| **Wholesaler** | 50 RFID R/W sets | 323,400 | System maintenance | 64,680 | Add. profit (sales) | 1,621,075 | 2 |
| | RFID sorter | 1,293,600 | | | | | |
| **Bookstore** | 5 RFID R/W sets | 32,340 | System maintenance | 6,468 | Add. profit (sales) | 6,273 | 3 |
| | | | | | Red. theft | 12,224 | |

**Table 2: Financial Estimates of RFID Roll-Out across the Publishing Supply Chain**

## VII. INSIGHTS

This section offers insights regarding (1) the sub-trials; (2) trial configuration (trial context, trial composition, and trial competencies and resources); and (3) RFID feasibility and efficiency in the Japanese publishing industry.

### Sub-Trials

The Customer Order Tracking sub-trial illustrates the shortening of the product delivery process. It points to the necessity of precise information input and the appropriate protection of private customer data as main problems. It successfully identifies the main challenges of large-scale RFID adoption at item level and offers sufficient cost and profitability information to prepare for the industry-wide roll-out.

The Sales Management System sub-trial shows that available real-time information on retail inventories and book returns allows publishers and book printers to enhance the quality of future demand estimates and thus to better allocate production capacities.

The Store Operation and Customer Service sub-trial indicates that customers readily adopt the customer service applications. It illustrates that customers are willing to give away information to be passed upstream across the publishing supply chain in exchange for better service. Further, it outlines how retail personnel can survey future demand and future trends based on objictified customer data.

The Code System and Privacy Protection sub-trial indicates that bookstores need appropriate installations to void the tags before passing books to customers in order to fully comply with the privacy protection guidelines. It thereby identifies an important cost component with regard to large scale RFID adoption.

The Paper Recycling sub-trial demonstrates that RFID tags can easily be attached to and also removed from various types of book covers so as not to disturb the recycling process.

### Trial Configuration

The internal and the external context encouraged METI as governmental institution to initiate and support the RFID trial. From an intra-industry perspective, the economic situation of the Japanese publishing industry fueled the industry's willingness and readiness to engage in the 2006 METI RFID trial and thereby strengthen its competitive position. The technological progress made by foreign companies from various industries, e.g., pharmaceuticals, fashion, and automotives, and by foreign technology vendors, called for a Japanese response to preserve the country's status as a technology powerhouse and hence provided the necessary motivation and technological competition.

Government involvement has stimulated participation from private companies that are perceived to be part of the regulation and lawmaking process. By involving companies from the entire publishing supply chain, METI enabled a trial covering supply-chain-spanning systems. Incorporating technology vendors in the trial fostered new technological development to fit the specific needs of the publishing industry.

The heterogeneous trial consortium assured a variety of competencies and resources contributed by the participants. METI and MIC, as state agencies, could adapt the regulatory context. They could reallocate frequency bands and define a binding privacy policy that made the trial technically feasible and enhanced the social acceptability of RFID. Public project funding also eased companies' willingness to participate. The large publishers and wholesalers selected for the 2006 METI RFID trial contributed their expertise concerning the relevant business process reconfigurations in global publishing. Technology vendors' engineering skills played an important role in developing the high-tech RFID systems and their large scale production facilities allowed for producing low-cost RFID tags.

## Feasibility and Efficiency

Overall, the 2006 METI RFID trial in the Japanese publishing industry attests to the technical feasibility of RFID item-level tagging to enhance order fulfillment and tracking of books on their way to customers. It demonstrated that RFID technology contributes to accelerating numerous supply chain processes, such as bookbinding, delivery, order tracking, and inventory taking. Thus it delivered arguments for accelerated RFID adoption and diffusion by industry players. The 2006 METI RFID trial pointed to the required business process adaptations, identified cost components, and allowed for early profitability assessments. It illustrated the opportunity of conducting innovative marketing campaigns and raised overall RFID awareness. Ultimately, the positive results of the 2006 METI RFID trial in the Japanese publishing industry have encouraged other industries to consider deployment of item-level RFID.

## VIII. 2006 METI RFID TRIAL IN PERSPECTIVE

Whereas other industries and institutions approached RFID in stages, starting with logistic units and stepwise moving towards item level [e.g., Angeles 2005; Bose, 2005; Karkkainen and Holmstroem 2002; Loebbecke and Huyskens 2006], METI chose an integrated approach. In the same trial, it tagged books on item level and assessed the value of RFID technology for logistic processes.

When tagging on item level, industries such as fashion or fast moving consumer goods (FMCG) have to deal with different product shapes and properties which make the actual tagging comparatively difficult [e.g., Loebbecke and Palmer 2006; Sydanheimo et al. 2006]. For extremely low-price goods, tagging is expensive compared to the product price. As the 2006 METI RFID trial focused on books and magazines—all rather similar in shape and properties—tagging is less problematic. Further, with hardly any books or magazines being extremely low-price, tagging is generally affordable.

In comparison to trials initiated and driven by industry leaders such as the retailer, Wal-Mart, with a powerful position in the supply chain, the 2006 METI RFID trial emerged from a governmental initiative. The governmental input eased regulatory hurdles and mitigated resistance within the supply chain. It also overlaid some RFID-related cost issues.

## IX. SUMMARY, LESSONS LEARNT, AND OUTLOOK ON FUTURE RESEARCH

The paper described RFID technology and the Japanese publishing industry as a foundation for presenting the case of the 2006 METI RFID trial in the Japanese publishing industry. It provided insights regarding individual sub-trials, trial configuration, and the feasibility and efficiency of item-level RFID in the Japanese publishing supply chain.

The three main lessons learned are:

- RFID improves future demand estimates if employees and customers—when assured basic privacy—accept the technology.
- When governmental institutions initiate and conduct technology trials—often under macro-economic pressure—they provide sufficient resources and competencies and often trigger active participation by private companies.
- Item-level RFID supports innovative marketing tools and accelerated business processes.

Building on this research, we plan to investigate RFID technology trials at item level in other media industries to validate our findings across products and, possibly, countries. We also suggest analyzing whether industry-wide trials without state funding lead to similar results in order to better understand RFID opportunities in the publishing industry.

## REFERENCES

Angeles, R. (2005). "RFID Technologies: Supply-Chain Applications and Implementation Issues," *Information Systems Management* 22(1), Winter, pp. 51-65.

Bose, I., and R. Pal. (2005). "Auto-ID: Managing Anything, Anywhere, Anytime in the Supply Chain," *Communications of the ACM* 48(8), pp.100-106.

Falk, H. (2004). "Technology Corner: Privacy in Libraries," *The Electronic Library* 22(3), pp. 281-284.

Fujita, M. (2007a). Telephone interview conducted on January 10.

Fujita, M. (2007b). Telephone interview conducted on September 17.

Hada, H., Y. Yumoto, M. Ogawa, and J. Kokuryo. (2004). "Toward an Auto ID Network That Really Changes the World," www.m-lab.ch/autoid/SwissReWorkshop/papers/TowardAnAutoIDNetworkThatReally ChangesTheWorld.pdf, downloaded January 20, 2007.

Hanajiri, M. (2003). "The Challenge of a Saturated Book Market in Japan," *Publishing Research Quarterly* 19(3), pp. 51-59.

Hara, Y. (2003). "Consortium Forms in Japan for RFID Tags," *EE Times*, www.eetimes.com/story/OEG20031117S0020, downloaded 20 January, 2007.

Hicks, P. (1999). "RFID in the Book Trade: Standardization Bodies in Publishing," *Publishing Research Quarterly* 15(2), pp. 21-23.

Higashino, M. (2006). "Special Committee on RFID Tag/Traceability," *ECOM Journal*, www.ecom.jp/journal/2006e/electron/electron1.html, downloaded January 20, 2007.

Ishikawa, T., Y. Yumoto, M. Kurata,, M. Endo, S. Kinoshita, F. Hoshino, S. Yagi, and M. Nomachi. (2003). "Applying Auto-ID to the Japanese Publication Business to Deliver Advanced Supply Chain Management," *Innovative Retail Applications, and Convenient and Safe Reader Services*, Auto-ID Center, Keio University.

JPO. (2004). Japan Publishing Organization for Information Infrastructure Development.

JPO. (2005). Japan Publishing Organization for Information Infrastructure Development.

JPO. (2006a). *Annual RFID Report 2005*, Tokyo, JP.

JPO. (2006b). "The Outline of RFID Tag Field Trials in the Publishing Industry," FY06 Consigned Project by METI, Slide presentation held at Tokyo, JP, December 19.

Japan Society of Publishing Studies. (2004). "Hakusho shuppan sangyo- data to chart de yomu nihon no shuppan" (White Paper of the Publishing Industry – Data and Charts), Bunka Tsushinsha, Tokyo, JP.

Karkkainen, M., and J. Holmstroem. (2002). "Wireless Product Identification: Enabler for Handling Efficiency, Customisation and Information Sharing," *Supply Chain Management* 7(4), pp. 242-252.

Kornicki, P. (1998). The Book in Japan: A Cultural History from the Beginnings of the Nineteenth Century, Honolulu, HI: University of Hawaii Press.

Lichtenberg, J. (2003). "New Technology: RFID: Are These New Tracking Tags the Next Big Thing?" www.pma-online.org/scripts/shownews.cfm?id=889, downloaded 20 January, 2007.

Lichtenberg, J. (2006). "A Miracle in Almere," *Publishing Trends*, www.publishingtrends.com/copy/06/0612/0612MiracleInAlmere.html, downloaded 20 January, 2007.

Loebbecke, C. (2004). "Modernizing Retailing Worldwide at the Point of Sale," *Management Information Systems Quarterly Executive* 3(4), pp. 177-187.

Loebbecke, C. (2006). "RFID in the Retail Supply Chain," in M. Khosrow-Pour (ed.), *Encyclopedia of E-Commerce, E-Government and Mobile Commerce*, Hershey, PA: Idea Group Publishing, pp. 948-953.

Loebbecke, C., and J. Palmer. (2006). "Recognizing RFID's Potential in the Fashion Industry: The Case of Kaufhof and Gerry Weber," *Management Information Systems Quarterly Executive* 5(2), pp. 15-25.

Loebbecke, C., J. Palmer, and C. Huyskens. (2006). "RFID's Potential in the Fashion Industry: A Case Analysis," International Bled eConference, Bled, Slovenia, pp. 1-11.

Loebbecke, C., and C. Huyskens. (2006). "Weaving the RFID Yarn in the Fashion Industry: The Kaufhof Case," *Management Information Systems Quarterly Executive* 5(4), pp. 169-179.

Matthews, H., E. Williams, T. Tagami, and C. Hendrickson. (2002). "Energy Implications of Online Book Retailing in the United States and Japan," *Environmental Impact Assessment Review* 22(5), pp. 493-507.

Ministry of Economy, Trade and Industry (METI). (2002). *Shuppan sangyo no genjo to kadai (Current Situation in the Publishing Industry)*, Tokyo, JP.

Ministry of Internal Affairs and Communications (MIC). (2006). *Japanese RFID Technology Market Estimates,* Tokyo, JP.

Miyamoto, D., and D. Whittaker. (2005). "The Book Publishing Industry in Japan and the UK: Corporate Philosophy/Objectives, Behaviour and Market Structure," CBR – ITEC Research Paper Series 05-10, pp. 1-25.

Picard, R. (2003). "Cash Cow or Entrecote: Publishing Companies and Disruptive Technologies," *Trends in Communication* 11(2), pp. 127-136.

Piramuthu, S. (2007). "Protocols for RFID Tag/Reader Authentication," *Decision Support Systems* 43(3), pp. 897-914.

Rao, B. (1999). "The Internet and the Revolution in Distribution: A Cross-Industry Examination," *Technology in Society* 21(3), pp. 287-306.

Shepard, S. (2004). *RFID – Radio Frequency Identification*, New York, NY: McGraw-Hill Professional.

Shirai, T., and P. Johnson. (2007). "Radio Frequency Identification in Japan," 2006,www.oti.globalwatchonline.com/online_pdfs/36541X.pdf, downloaded on 26 January, 2007.

Sydanheimo, L., L. Ukkonen, and M. Kivikoski. (2006) "Effect of Size and Shape of Metallic Objects on Performance of Passive Radio Frequency Identification," *International Journal of Advanced Manufacturing Technology* 30(9/10), pp. 897-905.

Yin, R. (2003). *Case Study Research: Design and Methods.* 5th edition, Thousand Oaks, CA: Sage Publications.

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