

RFID ADOPTION MODEL FOR TAIWAM'S LOGISTICS SERVICE PROVIDERS

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Abstract: This research proposed a conceptual model of RFID adoption based on multiple case study to explore the related factors of RFID application. The major factors of the RFID adoption includes technology, organization, and environment characteristics. This multiple case study explores the RFID adoption model for Taiwan's Logistics Service Providers. Six cases were interviews and data collected with distributors of Taiwan logistic industry. To use the analysis bases on cases study to perform and verify the research structure proposed. Different types of RFID adoption have influence on developing related activities and business performance, technologies, knowledge, and building network relationships.

Keywords: radio frequency identification, adoption model, logistics service provider

INTRODUCTION

Logistic management is one of the key success factors of a supply chain system. The number of logistics service providers (LSPs) has been growing constantly. Reducing costs, and improving efficiency and service quality in a competitive business environment are the main concerns of many LSPs. Logistics companies could increase their performance by employing RFID technologies. Many logistics companies have invested extensively in information and logistics technologies. However, Organizations that have failed RFID implementations have been plastered all over the press because of lack of technology, deficient IT knowledge, budgetary constraints, unqualified business partners and misunderstanding of the overall effectiveness of the technology and how it relates to its business (Persaud, 2007). Therefore, to understand RFID technology, organizations must grasp the concepts of operation and the components of the system.

Since, service innovations can enhance supply chain performance and increase customer value. The RFID system is a critical innovation factor for sustainable development. This research discusses how to enhance business performance by applying the RFID adoption to improve LSPs service performance.

Taiwan's logistics service providers should pay attention to adopt more efficient logistics technologies to provide better services for their customers. This article studies the factors influencing the RFID adoption of technological innovations by Taiwan's LSPs. We will investigate the influences of adopting new technologies on supply chain performance. A multiple case study survey is conducted to study the adoption of technological innovations by Taiwan's logistics industry.

The next section will presents the summary of RFID adoption in logistics industry. Section three introduces the research framework of RFID adoption. Section four gives a description of the multiple case study. We will focus on the analysis results of cases comparison and the findings. The final section gives conclusions.

LITERATURE REVIEW

RFID Adoption for Logistic Industry

To deliver products quickly to customers, many companies seek to outsource their logistics activities to logistics service providers. This reflects the trend of using logistics service providers to satisfy the increasing need for logistics services (Lieb and Miller, 2002). New modern facilities such as logistics parks, distribution centers and warehouses are being built at a record setting pace. To fully satisfy the diversifying requirements of customers, many logistics service providers improve their service efficiency by continuous adoption of information or automation technologies (Sauvage, 2003). RFIDs represent a specific type of information technology that can potentially impact a firm's competitive environment by enabling the tracking of location information of personnel, goods, or equipment anywhere within a firm's value chain.

Nixon (2001) suggests that logistics service providers should employ new information technologies to raise their service capability in the e-commerce age. Chapman, Soosay and Kandampully (2003) suggest that the logistics industry should pay more attention to innovation in logistics service, and the innovation in logistics can be implemented through technology, knowledge and relationship networks. Adopting RFID technologies might enable logistics service providers to enhance their service abilities.

The majority of RFID applications have centered on firms increasing efficiencies in the supplier management process, which ultimately results in lowered costs. However, RFID is also currently being used by logistic service companies in order to enhance the service effectiveness to the customer, thus enhancing the overall value perception. Instead of focusing on efficiencies of supplier relationships for manufacturers, these service firms seek to employ the technology to generate additional value for the customer (Leea, Fiedlera, and Smithb, 2008). Through the value-chain concept, managers are able to target strategic uses of technologies at these primary activities that add the most value to the firm’s products or services.

The Potential Benefits and Encountered Problems

It has been claimed that RFID offers the potential to greatly improve supply chain efficiency and effectiveness because it enables companies to track product information and allows greater control and flexibility in managing goods as they move through the supply chain (Jabjiniak and Gilbert 2004). Ideally, when RFID becomes fully implemented in distribution centers, it may eliminate the need for bar code scanning and manual counting at receiving docks. The RFID system can facilitate the exchange of necessary information in real time and then resolve the lack of communication problems among the supply chain members. RFID location tracking-based delivery planning to improve traditional logistic operations in the shipping yards of automotive assembly plants, which provides visibility and appropriate operational decisions for vehicle deployment and load makeup (Kim et al., 2008). According to Vijayaraman and Barbara’s study (2006), RFID can help companies provide operational efficiencies and improve stock level transparency in short shelf-life product distrib perspectives— exploiting customer-facing orientati business practices, definit

RESEARCH FRAMEWORK

RFID Adoption Mode

Based on a review of characteristics — (1) tech consider those characteris of distributors and the e: intention of RFID adoptic logistics industry.

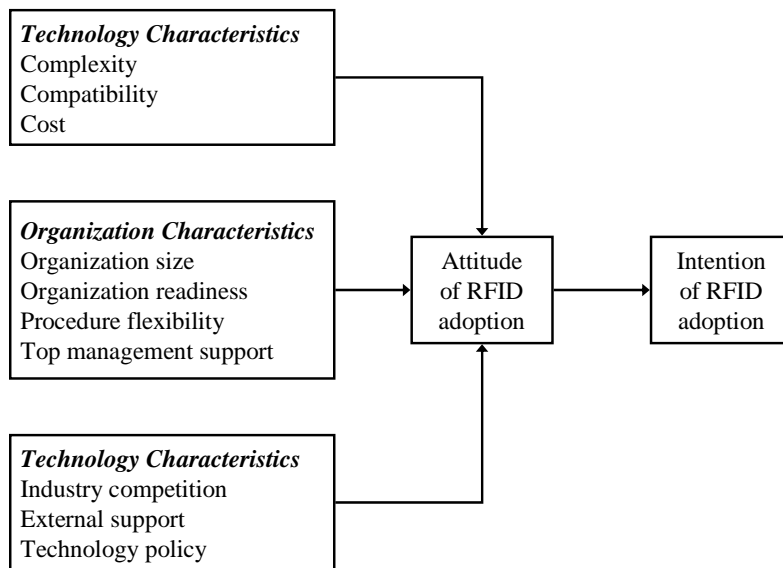


Figure 1: Research framework

Methodology

This research applies a case study methodology for data collection and analysis. This multiple case study explores the reaction strategies suppliers use to respond to short-term dynamics of schedule changes in supply chains. We examine the relationship and supply chain processes between a notebook computer manufacturer and five component suppliers.

Six LSPs were selected from a benchmark list in Taiwan’s logistics industry as potential case study candidates. High-level managers (vice presidents, or other high-level managers) were interviewed to provide related data and experience for the study. Case data were collected primarily through structured face-to-face interviews with managers of these distributors. However, when necessary, telephone interviews with other executives in the firms were conducted to supplement the information gathered during the personal interviews. To enhance answer validity, participants verified the summaries of major findings of each interview after the end of each

interview session. Furthermore, to ensure consistency and reliability, structured interview guidelines were used for all interviews.

CASE COMPARISON

Background of Multiple Cases

Using the designed questionnaire, six firms were interviewed for business strategy/service innovation data gathering and comparison. The background of six LSPs are shown in Table 1. The interview guidelines include ten open-formatted questions.

Table 1: Background of six LSPs

Company	A	B	C	D	E	F
Capital in NTD\$ millions	130	15	100	29,159	495	2,400
Number of employees	666	2000(global) 560(Taiwan)	60	1,104	80	3,350
Distribution area	Local	Global	Local	Global	Local	Local
Test field of RFID	Pallet	Container and cargo tracing	Pallet	Container monitoring	Pallet	Vehicle and container
Logistics system	Open	Open	Closed	Open	Open	Closed
<i>Environment</i>						
Customers	Large retailers chains; large and small firms; end users	Large and small firms; mostly corporations	Large and small firms; restaurants; supermarket chains	Large and medium firms; mostly corporations	Hospitals; large and small firms	Mostly large firms
Suppliers	Large food and beverage manufactory	Mostly multinational corporations	Some food and beverage manufactory; corporations	Mostly multinational corporations	Pharmaceutical companies	Large and small firms; corporations
RFID adoption stage	Completed the pilot test and will not implement RFID.	Completed the pilot test and will not implement RFID.	RFID pilot test is undergoing now.	Completed the pilot test and will implement RFID.	RFID pilot test is undergoing now.	Completed the pilot test and will implement RFID.
RFID adoption category	Ready adopter	Ready adopter	Unprepared adopter	RFID initiator	Unprepared adopter	RFID initiator

RFID system can utilize IT to help enterprises in process integration or operation simplification and store the data in the system in time. RFID is not only a set of ready-made information systems, it helps the enterprise in adjusting the whole operation methods via optimized operation model. Because the issues of RFID characteristic, technology and management aspects, and high construction cost, etc., RFID system is different from other information systems such as Electronic Data Interchange (EDI) or Enterprise Resource Planning (ERP) that can be implemented at early stage after evaluation. The input and construction of RFID will replace or simplify original working process. Since there are some technological and environmental issues need to be overcome, a company must assess and confirm through different stages such as evaluation, corporate position that examined internal and external environmental issues, system testing and final support stage before RFID formally pre-implemented.

Comparison Result of RFID Adopter

RFID adoption can be divided into different stages (Brown and Russell, 2007). According to the characteristic at stage and enterprise's attributes, this study classifies the RFID adopters into three categories: unprepared adopter, ready adopter, and initiator adopter. Table 2 summarizes their readiness on different attributes into high, medium, and low levels.

Table 2: Attributes of RFID adopter

Adopter Attribute	Unprepared Adopter	Ready Adopter	Initiator Adopter
Adoption attitude	Low	Medium	High
Financial allocation	Low	High	Medium
IT complexity	Low	Medium	High
Organization support	Low	Medium	High
Government support	High	Medium	Low
Partner support	High	Medium	Medium

According to the framework of RFID adoption, we evaluate the assent degree for three major characteristics. We interviewed with six logistics firms which have RFID adoption experience (ie. unprepared, ready, initiator). The respondents score on the adopting factors under this framework. The score is according to Likert five-level scale from 5 (strongly agree) to 1 (strongly disagree) as showed in Table 3.

Table 3: The assent degree for various variables

RFID adopter category		Unprepared Adopter		Ready Adopter		Initiator Adopter	
Company		C	E	A	B	D	F
Environmental characteristic	Industry competition	4	2	3	5	5	5
	Partner network	5	4	4	4	4	4
	Government policy	5	5	5	4	3	4
Technological characteristic	Technology complexity	4	3	5	4	3	3
	Technology compatibility	3	3	4	3	5	5
	Cost	3	3	5	5	3	3
Organizational characteristic	Power structure	4	5	3	3	4	4
	Organization readiness	4	4	3	4	5	5
	Procedure flexibility	2	4	4	5	3	4

The assent degrees on the factors of adoption are variant among different category of adopters. As summarized in Table 4, partner network, government policy, and power structure are major factors that affects the adoption among unprepared adopters. The ready adopters emphasize on technology complexity, cost, and procedure flexibility. The initiator adopters fell that industry competition, technology compatibility, and organization readiness are the major affecting factors.

Table 4: The assent degree on adopting factor among adopters

Factor		Adopter	Unprepared Adopter	Ready Adopter	Initiator Adopter
Environmental characteristic	Industry competition				★
	Partner network	★			
	Government policy	★			
Technological characteristic	Technology complexity			★	
	Technology compatibility				★
	Cost			★	
Organizational characteristic	Power structure	★			
	Organization readiness				★
	Procedure flexibility			★	

Discussion and Findings

Through the interviews of the cases, we found that the companies will follow five stages: planning, corporate position, pilot test, professional support, and supply chain partner, to assess and adopt RFID system before formal overall implementation. Different key issues will appear at different stage. In addition, both government and companies must consider the application market of RFID, the setup of standards, or the protocols of data/information exchange while adopting mainly at present. If local IC designer/manufacture can be integrated and closely cooperate with big foreign companies, it is possible that RFID application will drive domestic and international economic development in the future.

Based on the above discussions and the research framework as shown in Figure 1, we propose the propositions as follows:

Proposition 1:

The more explicit the technology, the more the likelihood that Taiwan's logistics service providers will adopt innovation in logistics technology.

Proposition 2:

The more the organizational encouragement, the more the likelihood that Taiwan's logistics service providers will adopt innovation in logistics technology.

Proposition 3

The more the environmental uncertainty, the more likely that Taiwan's logistics service providers will adopt innovation in logistics technology.

Proposition 4:

The more the provision of government support, the more the likelihood that Taiwan's logistics service providers will adopt innovation in logistics technology.

This research analyzed the collected qualitative data, given the exploratory nature of the study and the limited prior empirical research on the topic. The research outcome shows that service innovations contributed positively to efficient LSP operations. After organizing and analyzing the multiple cases, this study categorized RFID adoption into three types: unprepared adopter, ready adopter, and initiator adopter. Findings show that LSPs adopted either a service-provider or a niche-market provider.

CONCLUSION

We interviewed with six logistics firms which have RFID adoption experience (ie. unprepared, ready, initiator). The study discuss the positive relationship between type's competence and service value. According to the framework of RFID adoption, we evaluate the assent degree for three major characteristics. Different types of RFID adoption have influence on developing related activities and

business performance, technologies, knowledge, and building network relationships.

To satisfy the increasing requirements of customers for one-stop services, many LSPs have adopted initiatives to broaden the scope of their services. They own their features and know-how knowledge in operation processes, such as distribution centers. In order to be more competitive, logistics companies must use knowledge more efficiently to become innovation-based logistics service providers. Innovation is a process of turning opportunity into new ideas and of putting these ideas into widely used practices. To improve the logistic performance, Taiwan's logistics service providers can differentiate their products and/or services through service innovation. Logistics service providers can expand their new business through service innovation.

The empirical result shows that introducing innovative service actually improves business operation efficiency and returns in benefit. Finally, this paper develops four propositions and four types of service innovation for LSPs. The current study stresses that service innovation brings many benefits and improves LSP performance. If LSPs intend to promote their competitiveness, they can adopt RFID to emphasize service innovation. These research findings offer LSPs some implications of how to gain benefits and business performance, and make suggestions for internal operating management. Based on the results, this study develops a theoretical framework and several managerial implications, as well as recommendations for future research directions.

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REFERENCE

- Chapman, R.L., Soosay, C. and Kandampully, J. (2003), "Innovation in Logistic Services and the New Business Model: A Conceptual Framework", *International Journal of Logistics Management*, 14(1), pp. 29-31.
- Jabjiniak, B. and Gilbert, G. (2004), "RFID warrants a strategic approach", *Business Integration Journal*, 6(1), pp. 29-31.
- Journal of Physical Distribution & Logistics Management*, 33: 7, pp. 630-650.
- Leea, L.S., Fiedlera, K.D. and Smithb, J.S. (2008), "Radio frequency identification (RFID) implementation in the service sector: A customer-facing diffusion model", *Int. J. Production Economics*, 112, 587-600.
- Lieb, R. and Miller, J. (2002), "The Use of Third-Party Logistics Services by Large US Manufacturers: The 2000 Survey", *International Journal of Logistics: Research and Applications*, 5: 1, pp. 1-12.
- Lin, C.Y. (2008), "Determinants of the adoption of technological innovations by logistics service providers in China", *International Journal of Technology Management and Sustainable Development*, 7: 1, pp. 19-38.
- McGinnis, M.A. and Kohn, J.W. (2002), "Logistics Strategy-Revised", *Journal of Business Logistics*, 23: 2, pp. 1-17.
- Nixon, M. (2001), "Innovations in logistics technology: generating top-line value and bottom-line ROI", *World Trade*, 14, pp. 62-64.
- Persaud, D. (2007), "A How-to Guide for RFID Implementations: Are You Tuned Into RFID?" *RFID Journal*, Aug 2007.
- Sauvage, T. (2003), "The relationship between technology and logistics third-party providers", *International Journal of Physical Distribution & Logistics Management*, 33: 3, pp. 236-253.
- Speakman, J.P. (2002), "Innovation Leads to New Efficiencies", *Logistics Management*, 41, p. 71.
- Tang, L. L. and Tsai, W. C. (2008), "The Conceptual Model of RFID Adoption for Taiwan Logistic Industry", *The Second International Conference on Operations and Supply Chain Management*, Taipei.
- Vijayaraman, B. S and Barbara, A. O. (2006), "An empirical study of RFID implementation in the warehousing industry", *The International Journal of Logistics Management*, 17(1), pp. 6-20.