Use of Information Technologies in Shipping Logistics: A Case Study of Singapore

Zheng Yanchao
School of Civil and Environmental Engineering, NTU

A/P Wong Yiik Diew
School of Civil and Environmental Engineering, NTU

Abstract—This project endeavours to investigate the current status of IT adoption in Singapore’s shipping logistics and seafreight forwarding industry. It is found that the level of adoption of IT applications in Singapore’s shipping logistics industry is considerably comprehensive. The observed perceived usefulness and perceived ease of use of IT applications are high across the industry, particularly for web-based IT applications. The most significant perceived benefits brought by IT implementation are found to be faster information response and access, improvement of efficiency and streamlining of logistics processes, whereas the most significant perceived barrier to IT adoption is the high cost of implementation. Lastly, it is revealed that more R&D efforts focusing on the provision of real-time information are warmly anticipated by the industry.

Keywords—information technology, shipping logistics

1. INTRODUCTION AND BACKGROUND

Shipping being an integral part of the global logistics activities has seen tremendous growth in the past few decades. It is become more common for shipping companies to operate logistics arm so as to offer total solutions to customers via door-to-door shipment services. As technology advances rapidly, the emphasis on the use of information technologies in logistics and/or supply chain management of maritime companies is increasing at the same pace.

Singapore has ambitiously set the goal for the country to be the world’s top logistics hub, while information technology (IT) industry and shipping industry are among the most essential sectors in Singapore’s economy. The use of IT is common in the logistics industry in Singapore. However, little study has focused on the shipping arm of logistics industry in particular. How the state of IT adoption in shipping logistics in Singapore affects the industry performance falls under the focus of this study.

Through a systematic framework, IT applications are empirically studied with the focus on revealing industry’s perception of the level of adoption and usefulness of IT applications, as well as facilitators and barriers to their adoption. By investigating the essential factors that influence the industry players’ decision to adopt IT applications in their business and identifying the perceived gaps between the expectation of a well-established shipping logistics hub and the current status of IT capability of shipping logistics industry, this study suggests possible directions of future research in the shipping logistics industry on IT development and deployment from the perspectives of the authority/government augmented with industry’s perception and researchers’ propositions.

2. OBJECTIVES AND METHODOLOGY

The objectives for the study are double fold: 1. to report on the state of use of IT in shipping logistics industry, evaluate the perceived usefulness (PU) and perceived ease of use (PEOU) of main IT applications and analyse the facilitators and barriers to IT applications adoption; 2. to explore the possible trend of use of IT and to propose recommendations for IT Research and Development (R&D) in shipping logistics industry in Singapore. Six interview sessions were conducted with industry players and researchers.

A total number of 354 survey questionnaires were sent out, addressed to Singapore Logistics Association (SLA) registered members’ representatives who are usually the chief executive officer, managing director or president/vice president of the company. The questionnaire is required to be completed by a manager or personnel whose job scope and work experiences are related to logistics and transportation. The questions tap on the perceived usefulness and perceived ease of use of the categories of IT applications investigated, utilising the technology acceptance model (TAM) developed by Davis (1993).

The questionnaire was initially pilot-tested (in third quarter of 2009) on two industry experts and revisions and amendments were made. The first round of survey questionnaire distribution was sent to 24 companies, and the second round of distribution was conducted one month later to 190 companies, while the final round of distribution was administered to 140 companies two months following the second round. A total number of 28 valid responses were collected yielding a response rate of 7.9% and they were analysed in this study.
3. LITERATURE REVIEW

3.1 TAXONOMY FOR USE OF IT

According to Romano (2003), e-integration in the supply chain management can support business processes at two different levels: 1. intra-company integration, to alleviate the boundaries between functional departments of the organisation and facilitate intra-organisation information exchange and management; and, 2. inter-company integration, to alleviate the boundaries between individual companies and facilitate inter-companies dyadic integration or overall supply network integration.

This study adopts similar a taxonomy of IT applications. The proposed taxonomy is expected to facilitate the study on how companies perceive the facilitators and barriers of adopting IT applications in the shipping logistics industry.

The intra-company IT applications mostly serve two purposes – to produce or facilitate the services and daily operations of the company (service/operation related), and to support the company’s general administration, management and decision-making (information management related). Inter-company IT applications handle the company’s exchange of information with external parties, of which the most common parties are suppliers and customers. As a result, inter-company IT applications are categorised into customer-related and supplier-related applications. Web-based IT applications are frequently discussed in many literatures recently, and this type of IT applications can serve both intra- and inter-company purposes. Hence, this study looks into web-based IT applications as well, in addition to the two conventional categories.

3.2 IMPACT FACTORS INFLUENCING THE USE OF IT APPLICATIONS

3.2.1 Firm Size

The size of a company can be differentiated in terms of a few criteria in most of the studies: 1. the scale of its business operation – whether the company operates its business in multi-national markets or runs locally; 2. the financial strength – the company’s value of total assets, annual turnover, etc; and, 3. the number of employees of the company.

Various studies have found that firm size is one of the major factors that are positively and significantly associated with the adoption of IT applications in its business endeavour. Teo et al. (2009) identified that firm size is positively related to the adoption of e-procurement in Singapore. Ngai et al. (2008) indicated in their findings that companies with international business coverage are more likely to adopt logistics information system than those whose business operations are confined to local business operation.

It is investigated in this research whether the firm size in terms of the above stated criteria affects significantly the adoption of IT applications in the shipping logistics industry.

3.2.2 Perceived usefulness (PU) of IT applications

A commonly-refered research conducted by Davis (1993) suggested that the PU of IT functions exerts more than twice as much direct influence on use than does attitude towards using, which underscores the importance of the usefulness variable. The finding by Davis then described as “surprising” is now commonly concluded in various technology acceptance behaviour studies; many recent studies indicated similar results that PU is one of the most significant determinant of using certain IT services or products (Hsu et al., 2009).

However, few studies have reviewed local perception of perceived usefulness of IT applications in the shipping logistics industry in Singapore, as a result of which this research shall investigate on this issue based on the data acquired through surveys and interviews.

3.2.3 Perceived ease of use (PEOU) of IT applications

The PEOU is referred in technology acceptance model as “attitude towards using”, and it has been commonly-investigated by researchers to understand to what extent users perceive certain technology as being easy to use. It is also one of the factors investigated in this research, in the aim of revealing whether industry practitioners view specialised IT applications as a potential technical difficulty in achieving higher efficiency in the production and service process.

3.2.4 Perceived benefits of use of IT

The perceived benefits of use of IT are different from that of PU of IT applications in the sense that the PU reflects the perception and sentiments of the industry towards the IT adoptions, while perceived benefits of use of IT include identification and investigation of a set of pre-defined factors that are potentially possible to influence the adoption of IT applications to determine whether these factors in particular play significant role in affecting the adoption of IT. The factors are determined through various reviews of literatures, interview with industry players and pilot testing of the questionnaire with industry practitioners (Lai et al., 2005; Ngai et al., 2008; Teo et al., 2009). In this research, the factors (perceived benefits) identified are: faster information response and access; improves customer services; improves efficiency; improves cost performance; enhances competitiveness; streamlines logistics processes; and others.

Many literatures indicate that the perceived benefits of adopting IT are significant in terms of improving efficiency of accessing and processing information. Lai et al. (2005) and Teo et al. (2009) suggested that the perceived indirect benefits are more significant than perceived direct benefits of IT adoption, such as improved customer service and improved relationship with business partners.

Interestingly, when Ngai et al. (2008) studied the logistics information system (LIS) adoption under similar context recently, a surprising finding was concluded that perceived benefits do not seem to be an important factor that influences companies’ decisions to adopt LIS. The conclusion was not clearly explained but it was suggested that logistics companies’ full
awareness to the benefits might be the reason why the perceived benefits are no longer as significant as that concluded in 2005.

It is also an aim of this study to find out whether perceived benefits of IT applications play an important role in facilitating companies’ decision of adopting IT, under the context of Singapore’s shipping logistics industry.

3.2.5 Perceived barriers to use of IT

Similar to the perceived benefits of use of IT, the perceived barriers are a set of problems identified through literature reviews (Lai et al., 2005; Ngai et al., 2008; Teo et al., 2009), interviews and questionnaire to investigate whether certain factors are significantly influencing the adoption of IT. The factors (perceived barriers) identified in this research are: lack of expertise in IT; high cost of implementation; lack of support from top management; impact on traditional practices; resistance from organisational culture; lack of adequately customised IT applications; and others

3.2 STUDIES ON IT ADOPTION IN LOGISTICS

Lai et al. (2005) reported on the current state of IT adoption in Hong Kong’s logistics industry, identified the benefits of and barriers to adopting IT, and provided recommendations for the adoption of IT in the industry. Their study categorised the types of IT into intra-firm and inter-firm information systems. Through a survey sample size of 195 respondents, the researchers investigated the use of the following IT applications: Electronic Data Interchange (EDI); Internet; Intranet; Bar-coding; Email; Activity-based costing; ERP; and Electronic funds transfer.

Lai et al. (2005) revealed that top perceived benefits included quick response and access to information, improved customer service and enhanced competitiveness, whereas top perceived barriers were lack of expertise(s) in IT, inadequate knowledge in implementing the system by employees and insufficient financial support.

Hsu et al. (2009) discussed shipper (customers of shipping logistics industry) behaviour to use electronic commerce (EC) services in the liner shipping industry in Taiwan. The results indicated that “the partnership is the most significant factor affecting the transaction use intention, while the PU of the shipper is the most significant determinant of inquiry use intention”, while “EC promotions only significantly affect transaction use intention”.

Chuan (2005) evaluated the PU of a wide range of adopted and yet-to-be-implemented technologies, and revealed that implementation of technology in the logistics industry was slow, but companies were positive in implementing new technologies. A narrower approach to the shipping logistics industry to recalibrate attributes similar to Chuan’s study could be useful in reporting on the current state of IT adoption in Singapore’s shipping logistics industry.

4. FINDINGS AND CONCLUSIONS

4.1 LEVEL OF ADOPTION

As one of the most important logistics and maritime hub in the world, the overall level of using IT applications in Singapore’s shipping logistics industry was found to be considerable. More than 60% of the surveyed companies had all three categories of IT applications adopted with medium level or above, among which web-based IT applications were deemed to be the most widely used in the current industry with 80% of the surveyed companies indicating the level of adoption being medium, high or very high.

It was also found that companies with multi-national business activities had a significantly higher level of adoption than companies that focus on local business engagement across all three categories of IT applications.

Small local operating companies occupied a fairly large portion of the market in Singapore, and the lower level of adoption in IT in this cluster of companies certainly diluted the overall level of IT usage in Singapore. However, the growth pattern of companies were at various stages and inevitably there were firms that did not adopt IT applications for varying reasons—less financially strong, smaller pool of customers, less economy of scale or different style of approaching customers.

4.2 PERCEIVED USEFULNESS AND PERCEIVED EASE OF USE

It was found that overall PU and PEOU for the three categories of IT applications were considerably high, and web-based IT applications were deemed to be the most useful and easy to use among the three.

Local operating companies had significantly lower PU in inter-company IT applications, probably due to lesser demand for them when liaising and communicating with external parties. It can also be concluded that companies did not view IT implementation as a major technical challenge, since the PEOU for all three categories were considerably and consistently high.

It was found that PU and PEOU had close correlation in intra-company IT applications category. It is believed that, when only internal use is concerned, companies have the freedom to implement IT applications based on the PU and are not constrained by technical difficulty. However, inter-company and web-based IT applications may require compliance with demands of external stakeholders even if it is technically challenging or deemed less useful for other purposes.

Another conclusion drawn is that most of the IT applications have been deemed user-friendly, but local operating companies did not recognise the usefulness of IT applications as much as MNCs; local operating companies inevitably face more technical difficulty in using IT as compared to MNCs.
4.3 PERCEIVED BENEFITS AND BARRIERS

The most significant perceived benefits brought by IT implementation were faster information response and access, improves efficiency and streamlines logistics processes, whereas the most significant perceived barrier to IT adoption was the high cost of implementation.

It was found that local operating companies valued improvement of customer services brought by IT while MNCs welcomed the improvement in overall efficiency of the IT adoption. It is believed that the marginal utility of IT adoption and varying level of IT adoption status resulted in the difference.

If companies are not adopting IT due to financial constraints, SPRING Singapore, a local governmental organisation, does provide scheme to financially support companies with intention to upgrade their infrastructures but only at a certain percentage of the investment. Nevertheless, the financial support may not drastically change the company’s decision whether to make the investment at the end of the day. It is concluded that IT implementation is usually perceived to bring intangible benefits such as improving efficiency and customer services instead of improving cost performance, which is the least perceived benefit among all factors investigated. It means that financially constrained companies would not consider investing in IT as it is not expected to bring financial return in short term, and level of financial support may not greatly influence the final IT investment decision-making. Therefore, it is suggested that the government should not only focus on directly supporting companies in financial terms but rather through others means, such as favourable policies, training and education, etc.

4.4 TREND OF FUTURE IT R&D

Among the investigated areas of future R&D, real-time information is judged as the being most important and urgent for development. Numerous current literatures also indicate this common concern in the research field.

It is noted that all the areas are well above the median level in both importance and urgency, with importance slightly higher than urgency due to the fact that the study was focused on existing technologies.

5. LIMITATIONS AND RECOMMENDATIONS

This research has identified taxonomy of different types of IT applications into two tiers. However, due to the time constraint, only the first broader tier, i.e. the intra-company and inter-company IT applications in addition to web-based IT applications have been investigated. Further research should study the impact of the second tier of each category so as to obtain more insights on the state of use of IT applications in Singapore.

Despite the efforts to gather as much information from various sources, the amount of data collected for this research has been limited. This prevents the research to achieve higher reliability and generalisation. The pitfall is also in part due to the time bar for the research activity, as the seafreight forwarding market is tightly scheduled in Singapore and feedbacks from companies take time. Future research should devote more time and efforts to generate more data for analysis so as to produce results with higher validity.

The study is focused only on maritime-related logistics sector because this study is dedicated for final year project in maritime studies. Further studies with vertical comparison to other sectors of the logistics industry should be conducted so as to further make use of the results from the current study.

Similar studies in the logistics industry have been conducted in many other places with strategic interest in logistics and shipping, yet no focus on shipping and maritime related sectors have been carried out. As this research merely focuses on Singapore’s case, it could be revealing to study similar area in other locations with similar context, so as to compare horizontally and endeavour to provide more generalisable conclusions in the broader framework.

REFERENCES


