

Improving Supply Chain Traceability with the Integration of Logistics Information System and RFID Technology

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Abstract. Logistics information system (LIS) is becoming important as it provides efficient and effective logistics management that aims to reduce cost and cycle time for its customers on the supply chain. In view of the stringent competition, it is necessary for these systems to facilitate not only the processes of the logistics service providers but also the operations of the supply chain participants in order to support the outbound logistics effectively. In this study, a logistics information hub, Integrated Logistics Information Management System (ILIMS), is presented to suit this need. It not only provides the third party logistics (3PL) service providers a uniform way to do business with trading partners, but also improve the traceability through the integration of Radio Frequency Identification (RFID) technology. A case study is discussed in applying ILIMS to a medium-sized 3PL company in the Pearl River Delta (PRD) region resulting in a big improvement on the outbound logistics performance in the supply chain.

Introduction

Logistics management typically deals with various inbound and outbound logistics activities that involve all levels of planning and execution [1]. However, many small and medium-sized third party logistics (3PL) providers in Hong Kong still focus on internal operation performance but lack the vision of collaborating with other supply chain participants on improving overall supply chain performance [2]. Moreover, these 3PL providers are unable to synchronize information with trading partners in real-time for making timely decision or providing responsive services. It is unresponsive in today's digital era. New method is needed to support the business growth of 3PL providers in the coming future.

In this paper, an Integrated Logistics Information Management System (ILIMS) is designed for local small and medium-sized 3PL providers with advanced information technology to suite this need. It is a web-based logistics information hub connecting with different supply chain members to provide faster and reliable logistics information sharing. ILIMS also unifies the way of doing business among trading partners with standardized logistics process and common business data. Moreover, remote logistical items are equipped with embedded intelligence that allows them to communicate with supply chain members in real-time through integrating Auto-Identification (Auto-ID) technology into ILIMS and supply chain operations. This paper presents the supportive literature followed by the establishment of a generic model of an integrated logistics information system. ILIMS is used in integrating outbound logistics processes, resulting in the improvement of supply chain visibility. Afterwards, a case study is presented to illustrate how the ILIMS improves the supply chain performance of a local third party logistics company.

Third Party Logistics and Outbound Logistics Management

Third party logistics involves the use of external companies to perform logistics functions that have been traditionally performed within a company [3]. It is an external logistics service provider who manages, coordinates and delivers logistics activities on behalf of a shipper [4]. In the highly competitive marketplace, many companies sub-contract the non-core processes such as logistics to outside expertise. As a result, there has been a trend for 3PL providers to participate in their fulfillment process in providing cost-effective logistics management. According to [5], many small and medium-sized 3PL companies in the PRD region specialize in providing flexible logistics services at very competitive price by forming strategic partnership with manufacturers, distributors and logistics service providers in the region. To do this successfully, it is important for them to (i) create added-value activities by exploiting IT solutions, (ii) offer integrative service, and, (iii) maintain good partnerships or form joint venture with logistics companies in China.

Outbound logistics are essentially part of the primary activities of a firm's value chain that associate with collecting, storing and physically distributing the product to buyers. These activities include finished goods warehousing, material handling, delivery vehicle operation, order processing and scheduling [6]. Order fulfillment is one of the key activities in the outbound-to-customer logistics process. Successfully manage this activity can enhance the competitive advantage of the firm and hence create values to its customers. As the execution of supply chain process involves coordination of the flow of information, product/services and finance among these participants [7], therefore, it is important to effectively manage the product flow among these supply chain parties during the order fulfillment process in order to satisfy the delivery performance at a reasonable cost.

As the existing method adopted by the 3PLs causes various communication problems in the supply chain, which impact the fulfillment process badly, hence, there is a need of a certain kind of logistics information system (LIS) to improve supply chain visibility.

Improving Supply Chain Visibility by RFID-Based Logistics Information System

Radio frequency Identification (RFID) is an Auto-ID technology developed by Auto-ID Center at Massachusetts Institute of Technology [8]. It works in combination with electronic product codes (EPCs), which aims at enhancing supply chain visibility through improving inventory management, reducing shrink, making recalls more efficient and providing the means to authenticate products. As a result, physical objects on the supply chain such as logistics items are embedded with identification tags that will allow them to communicate with each other and with various supply chain members. In brief, RFID technology provides three benefits to supply chain management, namely, (i) the ability to recognize each item uniquely, (ii) high accuracy in tracking and tracing items moving through the supply chain effectively, and, (iii) exchange of information with trading partners seamlessly to collaborate in activities such as vendor managed inventory (VMI), planning, forecasting and replenishment. Moreover, in managing supply chain logistics, the electronic product code (EPC) is able to address everything from products to packages, containers, and pallets that aims to automate the supply chain. Hence, the movement of logistics items on the supply chain can be traced and the status is synchronized with 3PL providers and its supply chain counterparts through integrating RFID technology with LIS. As a result, the operations performance of 3PL companies and other supply chain members are improved with better supply chain traceability.

Integration of RFID technology to LIS represents the feasibility of making real-time decision in distribution management. With the presence of a RFID-based LIS, logistics information can be obtained in a real-time base so that the efficiency of product delivery process carried out by 3PLs can be greatly enhanced through providing an intelligent way of managing supply chain traceability. Fig.1 presents a 4-Tier framework of strategic goals development in enhancing supply chain traceability underpinned by RFID-based LIS. In Tier 1, the strategic goals are to achieve business objectives optimization and to offer performance management through adopting the RFID-based

LIS. The achievement is controlled and monitored by a collection of measurements as defined in Tier 2. The underlying performance data is essentially extracted from various data sources on the enterprise information systems through integrating the data to the LIS in Tier 3. In Tier 4, the required performance data is essentially captured from day-to-day business activities in different business and logistics functions. In brief, the 4-Tier strategic framework provides a solid foundation for developing the supply chain operation model to achieve better supply chain traceability.

Integrated Logistics Information Management System

The proposed Integrated Logistics Information Management System (ILIMS) is a web-based LIS that integrates core logistics processes seamlessly so that logistics services can be provided effectively. It is a common platform that allows different parties to transmit, capture, share and collect the required data via the Internet. LIS facilitates logistics management and allows users to acquire desired logistics services over the Internet. To realize significant value using RFID requires a collaborative environment with trading partners to exchange relevant information. An Integrated Logistics Information Management System (ILIMS) is proposed in Fig.2 to systematically integrate LIS into the 3PL's supply chain with RFID capability so that real time product traceability is allowed in the distribution process.

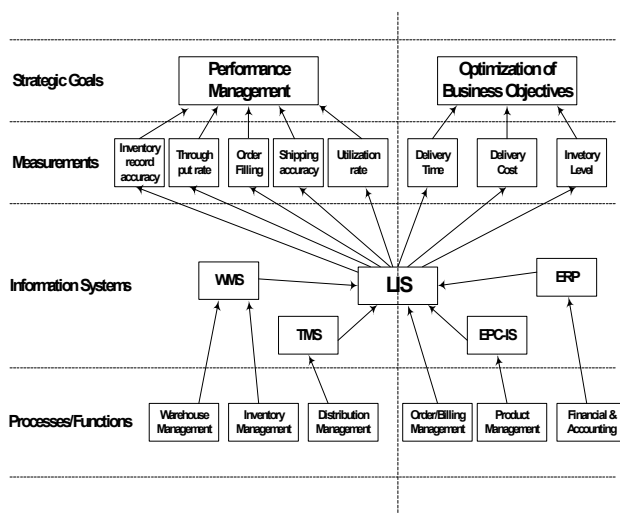


Fig.1 Strategic Goals of RFID-based LIS

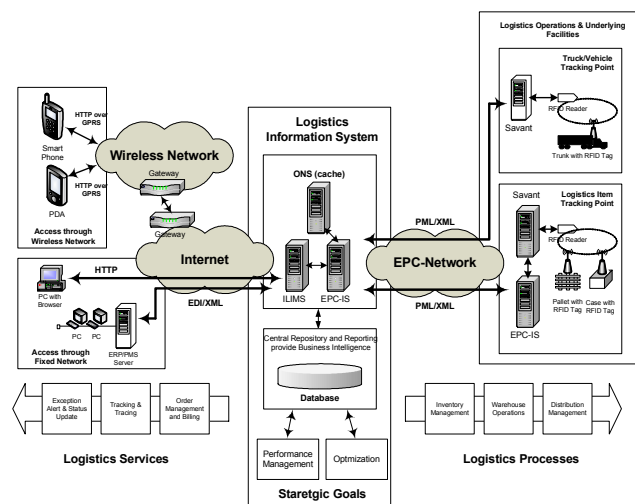


Fig.2 ILIMS

Case Study

With the intention of improving supply chain traceability for various product distribution activities in outbound logistics management, ILIMS was tested in Asian Logistics Solutions Limited (ALSL), a medium-sized 3PL company that offers integrated logistics solutions in the PRD region. The targeted customers of ALSL are primarily overseas manufacturers, which demand 3PL integrated logistics service in China. Most existing customers are Asian electronic component manufacturers that do not maintain logistics operations in the region. The manufacturing plants and warehouses of these companies are located in China where their customers are mainly trading companies or retailers in Hong Kong and the PRD region.

Results and Discussion

By adopting ILIMS in ALSL, the data generated in the daily operations such as transaction data and logistics documents are captured on the database. Since ILIMS provides a single point of control on information, the capability of information sharing among the supply chain parties is enhanced. As a

result, the fulfillment process of the outbound logistics operation in the supply chain is improved. The improvement does not only beneficial to ALSL, but also to its business counterparts in the supply chain. Moreover, all the logistics documents are now prepared by ILIMS. Business data generated in the transactions are stored electronically in the ILIMS database, which can be shared with trading partners simultaneously. As a result, the operation efficiency is improved which enables ALSL to handle higher transaction volume. ALSL measures the performance at the logistics control points being evaluated. It is noted that the performances on various logistics functions are improved significantly. The average throughput rate is increased by 25%, the order filling by 10%, the average shipping accuracy by 52%, and the inventory record accuracy by 47%. Besides, the utilization rate is increased by 65% on average. In the aspect of business performance improvement, ILIMS facilitates the business process flow and resources utilization of ALSL. In summary, ILIMS provides ALSL and its trading partners an efficient and uniform way of doing business through a comprehensive approval of reviewing organizational performance for continuous business improvement.

Conclusions and Future Work

In this study, advance IT applications and RFID technology are used in designing integrated logistics information system (ILIMS) for improving the business performance of small and medium-sized 3PL providers and their trading partners with focus on speeding up of logistics process, enhancement of information sharing and improvement of supply chain integration. To do this, a system architecture of ILIMS and EPC-network are designed and integrated. ILIMS was implemented in ALSL and in the companies of its customers and their supply chain members. The analysis shows that the adoption of ILIMS has resulted in a significant improvement in supply chain performance in (i) throughput rate, (ii) order filling, (iii) shipping accuracy, (iv) inventory record accuracy, and (v) utilization rate. With the aid of EPC and RFID technology, small and medium-sized 3PL providers is capable to further in-source some of the logistics functions to provide more value-added services such as Vendor Managed Inventory (VMI).

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