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Towards A Reference Framework For RFID-Enabled Garment SC Visibility

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ABSTRACT

In the current environment organizations can no longer compete on price alone. Supply chains are becoming important, where efficiency and effectiveness play the pivotal role. RFID is a highly heralded technology in the supply chain field, which can synchronize the information flow with the material flow. However, organizations are still not widely adopting it, as the industry is missing compelling business cases to illustrate how to implement the technology and how it actually can bring benefits to the business. In this study we develop and demonstrate an innovative information infrastructure to facilitate a smooth supply chain operation. The infrastructure is designed based on an in-depth case study of a typical complete garment supply chain. SCOR model is used to ensure that the design is applicable in various supply chain set ups.

Keywords: RFID, Supply Chain Visibility.

Introduction

The competition in the garment industry is keen. Brand owners are continuously facing with the inevitable rising labor costs in China. No doubt, competitive advantage in the industry is shifting further into the leverage of supply chain efficiency and effectiveness [1]. Towards that end, the design-to-market cycle must be significantly shortened requiring tighter collaboration and information sharing among supply chain partners [2]. RFID-based technology is the key IT enabler to advance supply chain performance and real-time visibility.

However, the industry is still facing a low RFID adoption after the Wal-Mart mandate [3]. The RFID adoption has been slow due to organizations are missing a compelling business case to illustrate the actual benefits of RFID [4]. The few published business cases are specifically designed for a certain situation, which makes it difficult to apply to other environments. Besides, there are little systems available which readily enable RFID information sharing across supply chains.

The objective of this study is to:

- Design a RFID-enabled infrastructure to enable seamless supply chain operations
- Develop a RFID reference framework for the garment industry
- Illustrate the RFID benefits on a supply chain level

Literature review

The RFID discussion started in 2004, when major retailers mandated their top suppliers to attach RFID tags to their products [5]. Yet, the adoption landscape so far has dotted with results observed at the company-level, lacking a holistic view of the supply chain [6]. We see examples of application of RFID in supply chain partners of the garment industry. For example, the Lawsgroup uses RFID technology to manage raw materials and in-house products of 15 Asia sites [7]. Earlier, DHL Solutions Fashion uses RFID to track item-level fashion items in a DHL distribution center near Paris [8]. UK food and clothing retailer Marks & Spencer, was assessing the use of RFID item-level tagging of three different packaging (hangers, flat in toes and boxes) at a store near London [9]. In each case, ROI is the main focus at the corporate level, not so much of looking at benefits gained with respect to efficiency in a complete supply chain as a whole.

Therefore, we currently lack systems to integrate supply chain partners by sharing information. This is actually where the true potential lies in supply chain management. Traditional supply chain management literature, for instance, discuss that efficient information sharing can reduce the supply chain inventory [10] [11]. The full potential of RFID technology in a complete supply chain remains elusive, with the lack of compelling business cases on a supply chain level [4]. As a matter of fact, organizations are too much influenced by the RFID pioneers [12] and follow the bandwagon by replicating the pioneers' RFID applications into their own organization. This can lead to disappointing results, as mindlessly following the leaders does not always fit the organization's need [13]. Thus in order to gain supply chain efficiency and visibility, supply chain partners must reach beyond the organization boundaries and effectively share supply chain information.

Methodology

The main objective of this study is to develop a RFID-enabled information sharing platform for supply chains. However, the current literature lacks examples of how information is shared among supply chain partners and platform. Therefore an in-depth case study is used as an illustration of a typical supply chain. This research methodology is well suited for this problem, as it can bring out the problems that arise during information sharing. Moreover, case studies can provide information about a given context and eventually deduce theories from it [14].

The limitation of in-depth case studies is that the results are only applicable to the case study. We minimize this limitation by utilizing SCOR model (Supply Chain Operations Reference) to analyze the supply chain. SCOR can be seen as a universal language to describe supply chains and is a benchmark to measure supply chain performance [15]. By using SCOR organizations can better compare the case study's supply chain and reflect whether it is applicable in their context.

Case studies

In this study, our objective is to address the sustainability of competitive advantage of an existing complete supply chain in the garment industry with RFID-based enabling technology. The supply chain in question handles reputable high-end men's fashion wear. The partners in the supply chain are a brand owner, fabrics and trims suppliers, parts suppliers, garment manufacturers, distribution center and retailer shops (see Figure 1). In this garment supply chain the brand owner sources all the fabrics and trims to ensure a high quality standard. The suppliers are usually located in Europe and South-east Asia. All the fabrics and trims will be first received in the brand owner's despatch warehouse, which is located in Hong Kong. Subsequently, the despatch warehouse ships the fabrics and trims to parts suppliers located in Shenzhen, where the fabrics and trims are produced into parts. Once finished, the Shenzhen parts supplier ships out the parts to Hong Kong where the parts are assembled together in the HK factory, also owned by the brand owner, to form the final garment. However, in some cases final touch-ups are required, which are performed by the Shenzhen parts suppliers. Besides, not all garments are produced in-house and some products are sourced from third parties, who are mostly located in China, again the fabrics and trims are sourced by the brand owner in order to ensure the high quality standards. The finished garments will be stored in the distribution centers, located in Hong Kong, where it awaits to be shipped out to the Hong Kong, China, and Taiwan retail stores.

The supply chain shows that a close relationship between the brand owner and the other supply chain partners is required for a smooth supply chain operation. The brand owner can be seen as the orchestrator of the supply chain. Information sharing is mainly one-sided where the brand owner places orders with the supply chain partners. The order placing is usually done through fax and email. The supply chain partners must where possible adjust their planning to the brand owners plan (see Figure 1). However, supply chain partners cannot always meet the brand owner's plan, which causes delay in production and can lead to lost sales at the retail shops. The brand owner, therefore, must keep a high inventory in the distribution centers to satisfy the volatile demand of the fashion industry. The brand owner typically plan one year ahead, as the lead-time of the fabric can take up to six months. The long fabric lead-time and the high dependency of the supply chain partners cause the supply chain to be highly inflexible. Besides, it is difficult for the brand owner to keep track of the unused fabrics and trims at the SZ parts supplier. Fabrics roughly account for half of the production cost and left-overs cannot always be used in the next seasons.

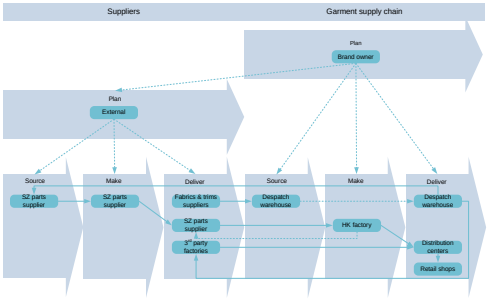

Figure 1. Garment SC case – SCOR level 1

RFID-enabled supply chains

We used SCOR level 2, 3, and 4 to analyze our case study. In SCOR level 2 we discovered that the supply chain utilizes mainly uses a make-to-order configuration, but due to the supply uncertainty of the fabrics and parts, make-to-stock configuration is used at certain points. In SCOR level 3, we analyzed which points are suitable for RFID. The SCOR level 3 diagram of the SZ parts supplier is shown inFigure 2. RFID-enabled SC processes – SCOR level Figure 2. These processes are carefully chosen to implement as they can improve the SC operation and visibility. For instance, the traditional S2.2 – receive fabric requires a manual verification of the fabrics in order to verify whether the correct fabrics are delivered and in the right amount. However, with RFID this is all automated by scanning the RFID-tagged fabrics. The system will automatically verify against the ASN whether the items are received correctly and timely. Moreover, the RFID reading in S2.2 also contributes to the SCOR defined metric Order Fulfillment Cycle Time. The RFID readings are actually all tied up to SCOR defined metrics, which can provide the supply chain partners with a supply chain dashboard. The dashboard can provide the user with a real-time performance assessment of the supply chain. We initially look at the Order Fulfillment Cycle Time, which measures how long it takes for materials to go through the supply chain, and Perfect Order Fulfillment metrics, measures whether the supply chain partners can live up to their commitments. SCOR level 4 is used to analyze how and which operations are changed due to RFID.

In order to provide a better guidance to potential RFID adopters we classified the RFID-enabled SCOR processes according to a RFID application applications typology [13], see Table 1. The analysis shows that RFID identification, typically help supply chain partners to improve efficiency by reducing the handling time. RFID assertion keeps track of the materials to ensure that the demand can be fulfilled, e.g. is adequate fabrics available to satisfy demand. RFID synchronization can provide real-time information to other supply chain partners on whether/how the demand is fulfilled, e.g. is a certain order fulfilled or delayed. RFID ownership can provide the supply chain partners with a holistic view of the current supply chain status, e.g. what is the order fulfillment cycle time of my supplier.

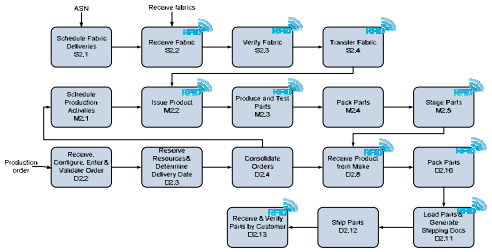

Figure 2. RFID-enabled SC processes – SCOR level 3

Table 1. RFID-enabled SC processes by RFID applications typology

RFID applications typology	RFID-enabled supply chain processes
Automation	D2.8, D2.10
Assertion	S2.4, M2.3, M2.5
Synchronization	S2.3, M2.2, D2.11
Ownership	S2.2, D2.13

In order to allow the information sharing we needed to develop a platform that allows supply chain partners to share RFID and supply chain information. After a careful evaluation of the existing applications we noticed that none of the existing applications can satisfy our requirements. We needed a platform that allows:

- Data integration - Sharing RFID information on its own has little meaning to supply chain partners as it is merely an electronic number (EPC code). The challenge therefore is to see how this information can be combined with the existing supply chain information [16].
- User expansion - Supply chains may look like a static environment, but this is not entirely true. Volatile supply networks might be a more appropriate term, as supply chains can adapt and change over time [17], and besides many different supply chains exists within an organization.
- Information representation – Managers have little value in knowing where a particular product is on a specific time. We therefore need to present our information in such a way that it is useful to the user and prevent information overflow of RFID data [18].

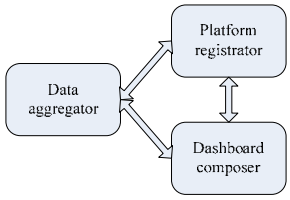

Figure 3. Information sharing platform architecture

In order to satisfy RFID-enabled supply chains requirement we developed a visibility platform consisting of the following three components (see Figure 3):

The data aggregator is intended to capture and combine the existing supply chain data, e.g. ERP data and RFID data. The component is designed in such a way that it becomes platform independent. This is done by analyzing which information needs to be shared between supply chain partners to enable a smooth supply chain operation. The information is converted to XML and communicated to the platform based on SOA architecture.

The platform registrator allows user to easily join or leave the platform. The purpose is that supply chain partners can join the platform at any given time and allows them to share their supply chain and RFID data. In return the supply chain partner can obtain the relevant data from the supply chain partners. When a supply chain partner is not a part of the supply chain anymore, the platform will revoke the information sharing privilege. XACML is used to ensure that information is only disclosed to bona fide partners.

The dashboard composer is the representation layer of the collective supply chain and RFID data. We aggregate the data to represent it according to the SCOR processes and SCOR metrics. This presents the users with a real-time dashboard view of the supply chain status and its performance. Moreover, many supply chain partners are unaware of what information they want to view. Therefore, we made the platform as flexible as possible, allowing the users to create their own supply chain information views. AJAX is used to ensure the user flexibility and that the user information is real-time updated in web browsers according to the RFID events.

Concluding remarks

In order to facilitate effective and efficient supply chains, a solution is needed to provide supply chain information visibility. This study proposes a framework/guideline for adopting RFID in supply chains and an information sharing platform. A case study of a complete garment supply chain is utilized to portray a typical garment supply chain. The case is in-depth studied by the use of SCOR, which improves the applicability to other supply chains. We believe that the framework can function as a guideline for potential RFID adopters and the visibility platform can provide design principles on RFID-enabled information sharing.

This study is an initial step to explore how RFID can benefit supply chains. We are currently still capturing supply chain and RFID data. With the data more insights can be provided by our framework, e.g. with an analysis on cost versus benefits per RFID applications typology or even per RFID-enabled process. The study will also suggest how RFID can alter the supply chain processes and ultimately lead to a RFID-enabled SCOR model. The visibility platform is still in development and the user created information views can give us a better understanding of what supply chain visibility means for different supply chain partners in the garment industry. Albeit the study is still in progress we can already observe that information is now shared more effectively. For instance, the brand owner now has a better control on their fabric management, the production status of each supply chain partner is now shared and allows partners to plan ahead of time, and many laborious manual processes are now automated with RFID. A limitation of the study is that it is based on one single in-depth supply chain case study. However, we are currently analyzing the applicability of our study in other garment supply chains and other industries. Besides, SCOR serves as a supply chain operations framework and the framework should therefore be applicable to other supply chains, as we analyzed RFID on a generic level 3. In the end we intend to develop an RFID-enabled SCOR framework, which can guide potential RFID adopters. The framework should describe on a generic level which supply chain processes can be RFID-enabled and how the supply chain can/need to be changed due to RFID. Since we use SCOR we can provide a more complete assessment of the actual RFID benefits. We do not only intend to look into the typical ROI, but we will rather look into the SCOR defined metrics, which are intended to measure the supply chain performance. Finally, we intend to develop an innovative RFID-enabled information sharing platform, which can facilitate a smooth supply chain operation based on the RFID-enabled SCOR framework requirement. A set of design principles of the RFID-enabled information sharing platform will be developed, as a reference for potential RFID-enabled system developers.

The name of author(s), affiliation(s), address(es), telephone number(s), fax(es), and e-mail address(es) should be set flush left with initial caps. Try not to use titles such as Dr., Professor, etc.

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