



Contents lists available at SciVerse ScienceDirect

Expert Systems with Applications

journal homepage: www.elsevier.com/locate/eswa



Supply chain management with lean production and RFID application: A case study

Q1 James C. Chen^{a,*}, Chen-Huan Cheng^b, PoTsang B. Huang^b

^a Department of Industrial Engineering and Engineering Management, National Tsing Hua University, Hsinchu, Taiwan, ROC

^b Department of Industrial and Systems Engineering, Chung-Yuan Christian University, Taoyuan, Taiwan, ROC

ARTICLE INFO

Keywords:
RFID
Lean production
Supply chain management

ABSTRACT

This study applies lean production and radio frequency identification (RFID) technologies to improve the efficiency and effectiveness of supply chain management. In this study, a three-tier spare parts supply chain with inefficient transportation, storage and retrieval operations is investigated. Value Stream Mapping (VSM) is used to draw current state mapping and future state mapping (with lean production and RFID) with material, information, and time flows. Preliminary experiments showed that the total operation time can be saved by 81% from current stage to future stage with the integration of RFID and lean. Moreover, the saving in total operation time can be enhanced to 89% with cross docking. In addition, utilizing RFID technology, the cost of labors can be significantly reduced while maintaining current service capacity at the members in the studied supply chain. Return-on-investment (ROI) analysis shows that the proposed method is both effective and feasible.

© 2012 Published by Elsevier Ltd.

1. Introduction

Substantial competition force companies to ensure customers' demands can be satisfied as much as possible at the lowest cost. Therefore, companies attempt to develop new solutions to improve the quality of their supply chains and simultaneously reduce their operational costs. In the past decades, radio frequency identification (RFID) technologies have attracted considerable attentions (Sarac, Absi, & Dauzère-Pérès, 2008). Currently, RFID is emerging as an important technology for revolutionizing a wide range of applications including supply chain management. Numerous organizations are planning to, or have already adopted RFID in their operations in order to take advantage of a more automated and efficient business processes (Sheng, Zeadally, Mitrokotsa, & Maa-mar, 2011).

Lean production was introduced by Toyota under the names "Toyota production system (TPS)" or "just-in-time (JIT)" manufacturing in the 1960s (Bruun & Mefford, 2004; Reichhart & Holweg, 2007; Taj, 2008; Wu, 2003). JIT manufacturing aims to eliminate waste and to improve their productions by using a continuous improvement approach, including maintaining the only required inventory and reducing setup times to decrease lead times, queue lengths, and lot sizes to reach minimum cost. Lean production enables the integration of various tools in the production system and supply chain and focuses on waste elimination to reduce costs, improve quality, and decrease lead time, inventory, and equipment

downtime. Numerous enterprises have applied lean production to improve their productivity and competitiveness over the past decades.

This study explores the application of lean production and RFID technology for improving the logistics efficiency in a three-tier spare parts supply chain. This supply chain consists of a head quarter (HQ), one central distribution center (CDC), 10 local distribution centers (LDCs), and repair shops (RSs). HQ and CDC are responsible for supplying spare parts to ten LDC on a daily basis, and these LDC in turn supply spare parts to more than 400 local RS. HQ has an Information System (IS) and each CDC, LDC, and RS has a Warehouse Management System (WMS). There exist space for improvement in current operations with both information flow and material flow among the members in the studies supply chain, and therefore this research adopts lean production and RFID to increase the effectiveness and efficiency.

Preliminary experiments show that about 99.5% average reading rate was achieved with a fixed Ultra-High Frequency (UHF) RFID reader and four antennas installed in CDC and LDC receiving/shipping docks and UHF passive tags mounted on cartons or pallets. The benefit and cost of using RFID in the supply chain management are analyzed and promoted, e.g., increasing the whole supply chain efficiency and decreasing labor cost. Furthermore, this study uses return-on-investment (ROI) analyses to show that RFID implementation is effective and feasible.

The remainder of the paper is organized as follows. Section 2 presents a review of relevant literature, and Section 3 analyses the supply chain operations without RFID. Section 4 redesigns a new supply chain process with lean and RFID, and Section 5

* Corresponding author. Tel.: +886 3 574 2695.
E-mail address: james@ie.nthu.edu.tw (J.C. Chen).

84 evaluates the efficiency improvement and provides ROI analysis.
85 Finally, Section 6 draws conclusions and proposes future research
86 directions.

87 2. Literature review

88 In this section, literature related to RFID technology in supply
89 chain applications, lean production and Value Stream Mapping
90 (VSM), and ROI is reviewed.

91 2.1. RFID application in supply chain

92 RFID technologies offer several contributions to supply chain
93 through their advanced properties such as unique identification
94 of products, easiness of communication and real-time information
95 (Michael & McCathie, 2005; Saygin, Sarangapani, & Grasman,
96 2007). The progress through RFID can be observed in different
97 types of supply chains such as warehouse management, transpor-
98 tation management, production scheduling, order management,
99 inventory management and asset management systems (Banks,
100 Hanny, Pachano, & Thompson, 2007).

101 RFID can ameliorate the traceability of products and the visibil-
102 ity throughout the entire supply chain, and also can make reliable
103 and speed up operational processes such as tracking, shipping,
104 checkout and counting processes, leading to advanced inventory
105 flows and more accurate information (Chow, Choy, Lee, & Lau,
106 2006; Sarac, Absi, & Dauzère-Pérès, 2010; Tajima, 2007). Compa-
107 nies can achieve better supply chain planning and management
108 by integrating and storing more accurate data obtained through
109 RFID technologies in their information technology systems
110 (Whitaker, Mithas, & Krishnan, 2007). There is thus a strong link
111 between IT applications and RFID technologies.

112 Bottani and Rizzi (2008) indicated that reengineering models
113 increased possible benefits gained through RFID for all processes
114 of distribution centers and retailers. Pigni and Ravarini (2008) ana-
115 lyzed the effects of RFID technologies in the fashion industry. They
116 showed that RFID technology integration improved the system
117 business process and provided an inter-organizational information
118 system that promoted the efficiency and effectiveness of the entire
119 supply chain. Ferrer, Dew, and Apte (2010) studied 21 RFID appli-
120 cations across a wide variety of industries. Their conclusion was
121 that there were four common benefits: replacement of labor
122 through automation, cycle time reduction, enabling self-service,
123 and loss of prevention. Through these numerous benefits, RFID
124 technologies can provide cost reduction, increased revenue, pro-
125 cess improvement, service quality, etc. Lee, Ho, Ho, and Lau
126 (2011) discussed demand and supply chain management and
127 examined how RFID technology can enhance the responsiveness
128 of the logistics workflow. They concluded that the synergy of using
129 a combination of advanced technologies to form an integrated sys-
130 tem can help achieve lean and agile logistics workflow. Lao et al.
131 (2012) proposed an RFID-based system to help a distribution cen-
132 ter to facilitate the food safety control activities. A real-time food
133 management system was developed that integrated RFID technol-
134 ogy and case-based reasoning technique for the distribution center
135 operators in launching a food safety plan. The study concluded that
136 the real time data capturing nature of RFID technology further im-
137 proved the efficiency and timeframe requested for the actions.

138 An RFID-based system can provide real-time information to
139 operators, managers, and supervisors in order to control actual sit-
140 uation in the supply chain. Therefore, they can manage customers'
141 demands and timely adjust the production plan to improve the
142 whole supply chain efficiency and effectiveness (Cheung, Cheung,
143 & Kwok, 2012; Ko, Kwak, Cho, & Kim, 2011; Poon et al., 2011).

2.2. Lean production and VSM

144 Seth and Gupta (2005) presented that the goal of lean manufac-
145 turing is to reduce waste in human effort, inventory, time to mar-
146 ket and manufacturing space to become highly responsive to
147 customer demand while producing quality products in the most
148 efficient and economical manner. This approach focused on the
149 elimination of waste. Waste took many forms and can be found
150 at any time and in any place. It may be found hidden in policies,
151 procedures, process and product designs, and in operations. Waste
152 consumes resources but does not add any value to the product.
153

154 Taj (2008) indicated lean thinking started off in manufacturing
155 representing the meaning of 'manufacturing without waste', and
156 waste can be anything other than the minimum amount of equip-
157 ment, materials, parts, and working time that are essential to pro-
158 duction. So and Sun (2010) emphasized that lean production was
159 proved to be an effective tool for companies to improve continu-
160 ously. Becoming a lean enterprise enabled manufacturers to im-
161 prove throughput, reduce costs, and deliver shipment with
162 shorter lead times.

163 Lasa, Castro, and Laburu (2009) pointed that one of the latest
164 contributions of the lean production movement is the develop-
165 ment of the VSM technique. It was introduced as a functional
166 method to help practitioners rearrange manufacturing systems
167 according to a lean perspective and was based on applying the dif-
168 ferent tools explained above in a systemic or holistic way (Pavna-
169 skar, Gershenson, & Jambekar, 2003; Rother & Shook, 1998;
170 Womack, Womack, & Jones, 2002). Abdulmalek and Rajgopal
171 (2007) presented that a value stream is a collection of all actions
172 (value added as well as non-value-added) that were required to
173 bring a product (or a group of products that use the same re-
174 sources) through the main flows, starting with raw material and
175 ending with the customer. These actions considered the flow of
176 both information and materials within the overall supply chain.
177 As regards the real-world application of the technique, different
178 practices have been developed and disseminated since VSM was
179 created. Lasa et al. (2009) concluded that VSM was a suitable guide
180 for the application of different lean techniques at a dock-to-dock
181 level in serial production companies.

2.3. ROI analyses of RFID implementation in supply chains

182 Fleisch and Tellkamp (2005) indicated that there are several sig-
183 nificant costs and benefits of RFID implementations. Thus, compa-
184 nies must decide whether to invest or not to acquire RFID
185 technologies. Hence, ROI analyses are helpful to support decisions
186 on the feasibility of RFID deployments. Sarac et al. (2008) showed
187 RFID technologies can provide important benefits to companies.
188 However, because of their high costs, integrating RFID technologies
189 in companies still require important investigations. Furthermore,
190 every company should perform its own ROI analysis, because an
191 RFID technology can be more beneficial for a company than an-
192 other technology and/or for another company's environment. In
193 addition, the ROI analyses have often been studied through analyt-
194 ical models, simulations, case studies and experiments (Sarac et al.,
195 2010).

196 Ustundag, Kılınç, and Cevikcan (2010) presented that for man-
197 agers and professionals, it was very important to accurately mea-
198 sure the benefits of an RFID project in the planning phase. Using
199 the most proper investment evaluation methods, the managers
200 can take the accurate decisions on RFID implementation projects.
201 Lee and Lee (2011) reported that net present value and ROI were
202 commonly used to evaluate investment in new technologies. As
203 there existed RFID technology uncertainties and risks such as glo-
204 bal standardization, chip price, security and privacy and high
205

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات