Supply Chain Efficiencies Through E-Kanban: A Case Study

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***Abstract*- Electronic Kanban (e-Kanban) is a system of signaling that makes use of information technology (IT) to trigger the movement of raw materials to allow for a real time view of inventory throughout a supply chain. This paper presents a case study of the use of an e-Kanban system to minimize operational and logistics issues for a parts supplier within the automotive industry. Measures of operations and logistics performance are examined both before and after the implementation of the e-Kanban system through a series of observations, in-depth interviews, and documentation reviews. The results indicated improvements in production lead times, financial costs, effective and efficient work processes, and reductions in waste. The enhancement of the e-Kanban system through radio-frequency identification (RFID) is also discussed.**

***Keywords*- supply chain management, just in time, kanban, automotive industry, case study**

I. INTRODUCTION

Organizations are consistently looking for information technology (IT) that can improve performance and their bottom line. In order for organizations to attain the full benefit of any given IT, however, it has to be widely and fully adopted. Given the difficulties that many organizations often have adopting technology, it becomes imperative that firms take an active approach to ensure its success.

This research discusses a case study involving the use of an e-Kanban system to minimize operational and logistics issues for a parts supplier within the automotive industry. The objective of this research is to present both the opportunities that this technology presents, supported by actual performance improvements and cost savings, as well as the challenges that still exist after implementation. A brief literature review is first presented followed by the case study results. The paper then ends with some concluding remarks.

II. KANBAN

A Kanban (Kan or 'card' and ban or 'signal') system is a manufacturing control technique used in just-in-time or lean management to efficiently and effectively improve the flow of goods and inventory within business processes. It was originally created by Toyota at around 1955 and since then, the system has been widely adopted by manufacturing firms all over the world.

In the Kanban system, each workstation produces and delivers products or components only when it receives a Kanban card from the upstream workstation. In other words, work is performed only when it is needed. The system is simple and has a low cost to implement. Kanban helps production units quickly respond to changes in a supply chain by precisely and systematically transferring production information. Not all manufacturing firms, however, can benefit from implementing a Kanban system.

A Kanban system is not suitable for firms that have mixed and fluctuating demand, poor quality production processes, or having a relatively large variety of products. Sudden decreases or increases in mix or demand of products can also cause problems for a Kanban system. As manufacturing processes involve more parts or product mixes, they can increase the complexity of a Kanban system, which in turn can lead to a system breakdown. If a situation does not perform as expected, the whole manufacturing process has to be shut down.

III. ELECTRONIC DATA INTERCHANGE

Pfeiffer (1992) states that electronic data interchange (EDI) is an information technology system adopted by at least two partnering business organizations to exchange transaction data via telecommunication links. In the past, many organizations, especially small and medium sized enterprises, have been reluctant to acquire EDI capabilities due to the high costs of implementation and maintenance (Smith, 1990). Thus, for EDI to provide full benefit for all business partners, the system has to be widely and fully adopted to share the costs (Bouchard, 1993).

Iacovou et al. (1995) interviewed seven executives of small organizations and found that their main reason to adopt EDI was due to the external pressures exerted by more powerful trading partners. However, the success of EDI implementations depends on the organizational readiness and the awareness of the potential benefits of EDI. Hill and Scudder (2002) argued that the key success of supply chain management is based on how much EDI is fully integrated in the supply chain. EDI can make a supply chain more visible through better cooperation and integration among supply chain members. Their study also found that organizations are more willing to accommodate customers' needs than that of their suppliers' needs when using EDI.

Despite the substantial costs, the notable benefits of implementing EDI are improvements in terms of quality, timeliness, administrative costs, strategic advantage, and operations management (Bergeron and Raymond, 1992). As EDI has become more widespread in addition to advances in Internet technologies, Internet based EDI on virtual private network technology provides more opportunities for organizations of all sizes to realize the benefits of being EDI capable.

In this study, we examine a company that has implemented EDI with a Kanban system, known as electronic or e-Kanban, to improve its logistics processes through observation and documental analysis.

IV. CASE STUDY RESULTS

A parts supplier within the automotive industry that produced a cockpit module (CPM) for a Japanese car manufacturer was the organization that was examined in this study. This case study was conducted through a series of observations, in-depth interviews, and documentation reviews. We examined the work processes both before and after the implementation of the e-Kanban system (see Figure 1 for the material and CPM flow for the organization examined in this study) and then analyzed the impact that this technology had.

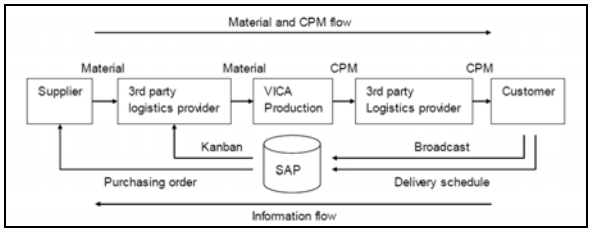

Figure 1. Material and CPM Flow for the Organization Examined in This Study

First, the customer (a Japanese car manufacturer) broadcasted its cockpit module delivery schedule on its website. The company then retrieved the schedule and imported it into a SAP program (an enterprise resource planning [ERP] system) to process and send purchasing orders to its suppliers. The bottleneck of this supply chain process occurs when the third party logistics provider delivers materials from the external warehouse to the production line. This is done using a traditional Kanban system and the loss of Kanban cards happens during the put in, pick off, delivery, and production processes. As a result, a company often cannot deliver CPMs to its customer according to the issue schedule.

Before implementing e-Kanban, the company had to process 52 material parts and over 26,000 items each day in operation. Its process of material delivery involved steps including picking up Kanban cards and emptying baskets in the line production, collecting Kanban cards and making a record, moving empty baskets and bringing Kanban cards back to the warehouse, sorting the Kanban cards, preparing the materials and attaching the Kanban cards, delivering the materials to the factory, and bringing the materials on the production floor. This results in 255 minutes in lead-time, 219 square meters of storage area, and 19 million baths in inventory costs (see Table 1 for the traditional Kanban system process times).

TABLE 1
TRADITIONAL KANBAN SYSTEM PROCESS TIME

Steps	Process Time (minutes)
Pick up Kanban cards and empty baskets in the line production	40
Collect Kanban cards and record	15
Move empty baskets and Kanban cards back to the warehouse	35
Sort Kanban cards	15
Prepare materials and attach Kanban cards	50
Deliver materials to the factory	30
Bring the materials to the production floor	70
Total Lead Time	**255**

After implementing e-Kanban, the company was able to eliminate steps in the process and reduce a lead-time of production into 190 minutes. In addition, the e-Kanban system only needed to process 24,000 items, which resulted in 14 million baths of inventory costs and 170 square meters of storage area. The steps in this new work process include collecting and scanning Kanban into the EDI system, transferring information, printing the Kanban barcode and attaching it to the prepared materials, delivering it to the factory, and putting the materials on the production floor (see TABLE 2 for the e-Kanban system process times).

TABLE 2
E-KANBAN SYSTEM PROCESS TIME

Steps	Process Time (minutes)
Collect and scan Kanban into EDI system	40
Transfer information via network	0
Print Kanban barcode and attach it to the prepared materials	50
Deliver materials to the factory	30
Put the materials on the production floor	70
Total Lead Time	**190**

The benefits of implementing the e-Kanban system in this study were a reduction in the overall steps in the work process, lead times, Kanban circulation, amount of materials, storage area, and inventory costs (see TABLE 3 for a comparison of the supply chain before and after the organization implemented the e-Kanban system). With the cost savings in inventory alone, the company was able to break even with the e-Kanban investment and operations within 18 months. To further improve the process, the company is seeking to the implement radio frequency identification

(RFID) technology instead of utilizing the current bar code process. The company has to balance the trade off between the benefits gained from using RFID and the cost to implement RFID.

TABLE 3
COMPARISON OF THE SUPPLY CHAIN BEFORE AND AFTER IMPLEMENTING THE E-KANBAN SYSTEM

	Before e-Kanban	**After e-Kanban**	**Change**
Steps in the work process	7 steps	5 steps	2 steps
Lead-time	225 mins	190 mins	65 mins
Numbers of Kanban circulation	700 cards	530 cards	170 cards
Amount of materials	26,226 items	24,479 items	1,747 items
Storage areas	220 sq meters	170 sq meters	50 sq meters
Inventory costs	18.83M baths	14.59M baths	4.24M baths

Although there was much enthusiasm from the managers for the cost savings from adopting e-Kanban, issues still exist regarding the performance of e-Kanban. These issues are related to the inconsistent performance of its current EDI service provider as the EDI system must often be shut down or is unable to operate. As a result, the company feels that it is losing control of the performance of the e-Kanban system. In addition, the company still lacks the IT personnel that can further integrate EDI within all aspects of the company's operations. Consequently, there are still many issues that still need to be addressed so that the full benefits of the e-Kanban system can be realized.

V. CONCLUSION

This research presented a case study of the implementation of an e-Kanban system to improve the supply chain of a parts supplier within the automotive industry. This case study was conducted through a series of observations, in-depth interviews, and documentation reviews. The objective of this research was to present both the opportunities that an e-Kanban system presents, supported by actual performance improvements and cost savings, as well as the challenges that remained after its implementation. The results indicated improvements in production lead times, financial costs, effective and efficient work processes, and reductions in waste. A discussion of the challenges that exist after implementation were also identified as well as additional opportunities for technology (e.g., RFID) to improve organizational performance.

Indeed, organizations are consistently scanning their environment to identify new technologies that can improve performance and their bottom line. This research presents the implementation of one such technology, e-Kanban, and the benefits made possible through its utilization. It is through such cases that an organization considering the adoption of a particular technology can understand the benefits and challenges that the technology present to them, and allow that firms to take an active approach to ensure a successful implementation.

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