IMPROVING TRACEABILITY FOR BETTER PERFORMANCE

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This thesis investigates the best possible solution to improve traceability of lead acid batteries throughout the supply chain. This will enable the company to manage warranty claims, to handle batch related issues and to estimate the life cycle of the batteries. A six-step methodology i.e. select process, data collection & analysis, map "current process", identify opportunities, map "to be" process and recommendations is used for this study. After analyzing the current process, we explored suitable technologies available to improve the supply chain traceability i.e. Barcode & RFID. Feasibility study of implementing each technology is conducted. Implications of using fully barcode system, fully RFID system and a hybrid system are analyzed.

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KEY INSIGHTS

1. It is critical for a company to determine the item's status, processes items have gone through and the history of movements during transactions.
2. A well-structured traceability system may enable a company to have a better monitoring of items.
3. When choosing an identification and data capture tool, an enterprise should have a good understanding of specific constraints coming from its products or processes.
4. The decision to select technology (Barcode/RFID) to improve supply chain traceability is completely dependent on the volume of transactions and business requirements.

Introduction

It is critical for a company to determine the item's status (identity, precise location, physical status – outdated damaged or not-, any other features), processes items have gone through and the history of movements during transactions. To have increased productivity and better monitoring of items for a rapid intervention in case of critical situations, traceability of items is highly desirable. An efficient and effective traceability system which transmits accurate, timely, complete and consistent information about items among supply chain members plays an important role in enabling these objectives. The desired functionalities of this system are to capture data from transactions (changes in items' physical properties, location, ownership); process data clean and organize to obtain relevant information used by enterprises' control, decision analysis and planning systems; store and share this information among intra or inter enterprise actors.

According to ISO 8402, traceability is the ***"ability to trace the history, application or location of an entity by means of recorded identifications."*** A traceability system can provide clear insight into the various steps in the manufacturing process that affects a finished product. That information can then be used for a variety of purposes including Process improvement, Defect resolution, Regulation compliance, Brand integrity, and Direct and indirect cost savings.

The objective of this research is to propose a comprehensive traceability solution for lead acid batteries and to identify potential impacts on the use of Barcode/RFID on all the processes involved.

Literature Review

Traceability is defined as the ability to identify and verify the components and chronology of events at all stages of a process chain (Paul, 2009). There are three terms which should come with traceability i.e. Traceability, traceability system and traceability method.

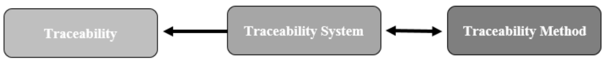

Figure 1: Terms of Traceability (Björn, 2008)

There are two primary technologies used for asset tracking: barcodes and radio frequency identification (RFID) (Abubaker, 2015). Organizations will be able to leverage the power of barcodes and RFID to achieve new levels of efficiency both internally and with partners (McCathie, 2004). Considering Information Technology (IT) to be the fundamental milestone that could revolutionize product traceability (Regattieri, 2007).

Barcode technology uses direct "line-of-sight" when scanning a barcode, this characteristic often results in human error, as barcodes often have to be scanned by hand. To prevent damage, barcodes must be relatively clean, be handled gently in abrasion-free environments, and not be exposed to extreme temperatures and harsh surroundings (McCathie, 2004).

RFID readers can scan multiple items simultaneously and this capability supports the automation of many SCM tasks which are labor intensive. Companies will also have accurate information on stock levels which will help to reduce inventory costs (Dongmyung, 2008). RFID technology plays an important role in satisfying the need for traceability with the development of the Internet (Nour El, 2006). Shiou (2007) journal also said that RFID can reduce the cost of collecting data on the front line and improve efficiency.

Traceability is important in logistics and supply chain management for a variety of reasons, such as managing risks, assuring quality, and enabling recalls (Steven, 2010). Product traceability requires that businesses have the expertise to retrieve product history information. Traceability has the potential benefit of protecting food safety by effective product recalls, the key measure used today to regain safety once a problem has been identified (Samir, 2014).

Bevilacqua has done research to improve traceability by using business process reengineering approach. He said that BPR is right approach to create a computer-based system for the management of the supply chain traceability information flows (Bevilacqua, 2009)

Many organizations have turned to business process reengineering (BPR) as a mean to radically change the way they conduct business (David, 2001).

Yoon (2015) has done a research applying business process reengineering to propose an RFID-based ginseng traceability system architecture according to the Electronic Product Code (EPC) global framework. Teresa (2012) successfully achieve the aim of agro food traceability by using BPR according to the Business Process Modeling and Notation (BPMN) standard.

Methodology

A six-step methodology i.e. select process, data collection & analysis, map "current process", identify opportunities, map "to be" process and recommendations is used for this study. After analyzing the current process, we explored suitable technologies available to improve the supply chain traceability i.e. Barcode & RFID. Feasibility study of implementing each technology is conducted.

Figure 2: Methodology

Results

A well-structured traceability system (described under "to be" process) will enable CMB to have a better monitoring of items. The use of information technology (barcode, RFID & WMS) permit CMB for the synchronization between physical and information flows and coordination of activities among supply chain partners. Barcode and radio frequency identification (RFID) systems are used to map "to be" process that enable CMB to collect data about logistics transactions of items, store and organize them in order to use this information for better management of warranty claims, to know lifecycle of batteries and to know the batch related issues.

When choosing an identification and data capture tool, an enterprise should have a good understanding of specific constraints coming from its products or processes. For a given application environment and product characteristics, two criteria can be applied to evaluate the performance of a traceability system

- The degree of detail of information about items (SKU level / individual item level) monitored by the traceability system
- The degree of automation (manual, semi-automatic, automatic) of the item identification and data collection process

We have discussed all the constraints coming from each solution in detail under previous section. Furthermore, all the three options discussed in previouse section, enables CMB to have complete traceability of batteries. By optimg any of the proposed solution, CMB may have complete track record of batteries. CMB may easily track that which specific battery was sold to which vendor and if receives a warranty claim even then may trace the complete life cycle of batteries. The important findings are that all the objectives of this study can be achieved with any of the proposed option. But, implementig RFID at battery level has many limitations like special way of pallatizing will be required. By implementing the barcode at battery level (100% barcode solution or Hybrid solution) or in current scenerio CMB may stack 120 batteries on one pallet but in case of RFID implementtaion at battery level they will be able to stack only lesser number of batteries per pallet (Figure 22).

Following table shows the status of all three proposed solution on above criteria,

	Information about each item monitored by traceability system	The degree of automation
100% Barcode Solution	100%	manual
100% RFID Solution	100%	automatic
Hybrid Solution	100%	semi automatic

Table 1: Performance comparison of proposed Systems

All proposed systems would provide CMB 100% traceability to the item level but they differ when the degree of automation is compared (Table 1). With reference to each of the options discussed, we have also computed the aproximate capital and operational cost for each. We have compared all the possible options on the basis of costs and payback periods. Assuming no addiotional labor cost and reduction in warranty claims by 0.2% of the sales, we concluded that 100% barcode is the most favorable solution for CMB. It has least capital cost (190, 000 MYR), least operational cost (6,000 MYR pm) and shortest payback period (7 months). On the otherhand 100% RFID has maximum operational cost (with significant limitations) due to the price of RFID tags which are much more expensive then a barcode tag. But, it still depends on the business strategy of CMB. If CMB do not want to make high capital expenditure then the 100% barcode is best solution. If CMB wants to make its operations less labor intensive and ready to make higher capital expenditure then hybrid is better option.Another important aspect is labor cost. During data collection and analysis, we realized that labor cost is not very high for CMB as they could easily get cheap labor on daily wages. That is why we assumed that no additional labor cost will incur for the implementation of any proposed option. But, in a scenario where labor cost is significantly high, the Hybrid solution will be more suitable as this options is less labor intensive having almost same operational cost as 100% barcode solution.

The use of a specific item identification technology or the decision of switching from a technology to another is an important decision since it could have expensive consequences like more capital expenditure, redesigning of warehouse and training of employees.

Keeping in view the current business environment at CMB, constraints coming from each of the proposed solution, performance comparison of each system and the cost benefit analysis, we would recommend 100% barcode solution to CMB. Referring to Table 10, CMB may also opt for other systems as per required degree of automation.

Conclusions

We analyzed the implications of using fully barcode system, fully RFID system and a hybrid system. We analyzed the constraints coming from each proposed system and we also evaluated the performance of each system. Furthermore, we estimated the approximate capital expenditure for each of the scenario. Based on average sales (computed from 3 years of sales data 2013-2015), we estimated the approximate operational expenses for each scenario.

Having improved traceability (by implementing the proposed traceability system) will enable the CMB to manage its warranty claims efficiently, to know the exact life cycle of batteries and to report any manufacturing fault found in specific batch. By implementing any of the proposed traceability system, CMB will be able to have improved Productivity, to implement FIFO method at non Finished Goods and Finished Goods Warehouse and will be able to have quick physical stock level update

After comparing each scenario, we proposed using fully barcode system (keeping in view the current business environment at CMB) due to the lower operating costs. Barcode system is less capital intensive as compared to RFID system. On the other hand, RFID system is more efficient and speedy. Therefore, the selection is completely dependent on the volume of transactions and business requirements.

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