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Research paper

A Study on RFID Technology Combined Lean Implementation in Malaysian Automotive Industry

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Abstract

RFID technology is one of the prominent and progressive technology from the previous years. Currently the RFID technology has utilized in different prisms and works like a catalyst in case of Lean Manufacturing as it certainly speeds up the manufacturing processes through providing them operational visibility. Based on this idea, the authors of this research study has conducted a case study which results in a real time based pilot study that has been done to explain the implementation of RFID technology in combination of lean manufacturing in plant operations for application in real world. This research is not only beneficial for engineering managers but also for academicians as it includes ROI to confirm the usefulness and viability of research and also enlightens the way to how to achieve improvements.

Keywords:*; Case study; lean implementation; pilot study; radio frequency identification; technology induction.*

1. Introduction

Radio Frequency Identification (RFID) is helpful for lean implementation in manufacturing industry [1]. The idea of RFID-based lean manufacturing was operated to minimize wastes and logistic issues [2]. It has observed that RFID is extremely appropriate for lean application in manufacturing industry as the leading barriers for lean implementation like requirement of operational visibility, management commitments, poor employees handling, unstable inventory controls because of the properties of RFID like operational visibility, labor guidance, asset tracking and improvement in operational efficiency [3-5]. The common equipment required for RFID implementation are antenna to detect tags signals, router to process signals, software to controls and other system like printing labelers. Vlachos [6] clearly explained that RFID is far better than manual bar coding system because of its abilities like highly computerized system and extremely reliable because of its potential benefits like operational visibility, product availability, product traceability and profitability as shown in Fig 1[7, 8]. RFID technology is considered to be one of the leading and most attractive technology for both industrialists and academicians [9, 10] because of its excellent properties like 10 times more faster than bar code technology and it's automatic detection of materials through the RFID tags which comes in its range without any interference [6, 11-14]. The leading properties of RFID like real time data traceability, asset tracking, production control and many more are highly beneficial to implement lean operations. In 2012, it has observed that in order to deploy RFID technology, the most risks that seem to be involved were high cost, risk on working and the last but not the least is the requirement of management commitment for its deployment.

Keeping this aspect in view, the RFID controlled system named as AUTOPS has introduced which has limitation regarding cost but been highly helpful to achieve positive results from RFID [5]. Afterwards, Dai & Zhong [4] in their research study on case study methodology on automotive engine valve manufacturing further confirms that RFID when implemented in junction with Enterprise Resource Planning (ERP) controlled systems appears to be highly effective and opened a new gate that RFID implementation is also feasible in small and medium enterprises rather than large industries. Then, in 2014, Chen and Chen [3] observed an ORFPM (Online RFID frequency-based Facility Performance Monitoring) system, which helped to implement lean through real time VSM which utilizes online RFID control systems. Afterwards, Haddud & Dugger [15] showed the results of its survey on US based manufacturing industries and confirmed that RFID is highly feasible to handle wastes in plant operations because of its abilities of queuing materials inline and many more. In 2016, the recent research by Rafique et all., [16] clearly explained that RFID is highly beneficial to implement but nowadays, companies start rushing towards its implementation without utilizing any pre deployment studies like TOE and many more regarding its feasibility. Hence, a requirement has observed regarding the availability of research work that can show and explain about the initial contraptions and etiquettes required for the proper implementation of RFID technology in Malaysian automotive industry and considered the leading objective of this research study. Hence, in order to achieve this objective, the remainder of paper structured as follows. The section 2 explains about the methodology which is the case study, section 3 is about results, section 4 about Result on Investment (ROI) and in last, section 5 is about conclusion the paper.

2. Methodology

It has been observed that in this case, as the deep study of operations was involved, so the authors have decided to go for longitudinal case study and they have selected a company named as XYZ automotive parts as a case study"(The original name of company is confidential). An in depth study has been conducted on the selection of methodologies that have been utilized and all the authors mutually agreed to go for "Case study".

As there are two types of case study methodologies i.e., a case study which involves in depth study of operations named as longitudinal/single case study and the other type which involves study of operations of different companies and named as multiple case studies [17]. Since, XYZ Automotive is one of the leading manufacturer of automobile parts in Malaysia and considered as one of the leading group that is producing good quality parts for almost all the leading automotive companies like Toyota, Proton and many more. The current manufacturing industry is one of the leading multinational group that has manufacturing plants in other parts of Asia as well. One of the leading reason of selection of XYZ manufactures as a case study is that, currently this manufacturing organization and its top management is struggling to adopt technology(RFID) controlled lean operations to improve their ongoing plant operations.

Hence, the authors of this research study have conducted a detail study of current operations of plant and collected data through Gemba walk (an in person walk in plant) , field observations and detail study of current company credentials, which are the most common ways to data collection and also adopted by previous researchers in literature[18, 19]. After detailed discussion of authors with the top management, it came in view that in current state of operations, the plant is facing many wastages like over- waiting, which results in prolonged lead-time from supplier to shipment. After the data collection, the authors have detail meeting with the management and joint consensus had been developed that, in current state of plant, wastes like over waiting and many more are more involved on the supplier and packing side of the plant due to lack of communication and information visibility among departments, which certainly require urgent fix to reduce that facet affecting the overall lead time. However, since the barriers like cost and lack of expertise are associated with the RFID implementation, so in order to cope up this situation, the authors have decided to provide details about setups required for deployment to provide clarity to how improvements can be achieved through this implementation and conducted a pilot study for RFID implementation in next section to give a real time demonstration.

3. Results and discussion

The leading aim of this research is to demonstrate and explain the deployment of pilot study regarding RFID application. In order to perform this task, the first and the foremost requirement was the availability and the arrangement of apparatus required to perform pilot study. The common equipment were consists of RFID tags, Antenna to detect tags signals, Router to process signals and Software to controls and other system requirements. The authors have utilized routers of impinge company which has been utilized through software named as Speedway Revolution. The data wire got connected in between router and Laptop to connect software and Antenna has been slotted in router to catch signals. RFID tags are in the form of small chips as in Figure 1, which are passive type and automatically detected when falls in range of antenna signals provided by the routers controlled thorough routers. Since, as per problem discussed with the management of selected case company and as observed by the researchers through actual field observations, it has concluded that in order to achieve lean operations to attain improved lead-time, the operational automation and feasibility was more required in packing and supplier area of the plant.

Fig 1: RFID Tags

To perform the task, the RFID implementation is tested first on the packing side because as per observations, the wastes like over waiting, over transportation and over motion were more involved on the packing side of the plant. Keeping this aspect in view, the authors of this study have planned to perform demo in the packing area of the plant. In order to implement RFID, the RFID tags were placed in the outside region of the packed boxes through manual settings as shown in Figure 2. The RFID induced tag when reached the region where there were RFID signals, then the tags got automatically recorded and confirms that the packing box have been ready to be shipped as in Figure 3.

Fig 2: RFID tag on packing box

Fig 3: RFID Tag passing from range

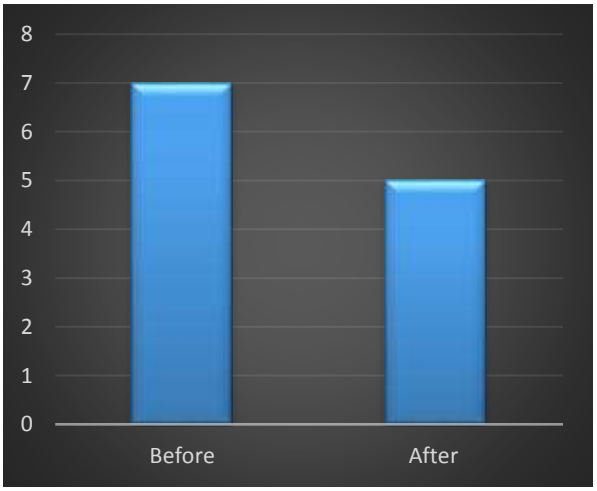

Fig 4: Reduction in number of operations

The recorded data sheet has been transferred to team leader after every one or two hours and then at the end of each shift, the team leader submits the data sheet to packing department. It is further observed that the recorded manual data sheet is then logged to excel sheet through key punch operators, and this excel sheet is then utilized to manage shipment scheduling which then forwarded to logistic department.

It has observed that the logistic department usually takes one to two days at least to generate final approval of shipment to planning department. Because of all this system, the authors have observed that, planning department allocated 4-7 days from final production to shipment only just to be on safe side. However, this time is not giving any benefit to customer and considered as a big waste. Even though, they cannot remove that waste entirely, but the management can reduce that over waiting from 4.5 days to 2.25 days just only through the

utilization of RFID technology as the authors has observed that the data that tentatively seemed to be collected in 6 hours by workers through manual system was easily be calculated in half an hour through RFID tag utilization which is considered to be biggest contribution as the wastage time of over waiting can be reduced to 50% which is the leading contribution of this pilot study.
After performing this pilot study, the authors have provided convincing evidence to case study management and encouraged them towards complete implementation of RFID technology.

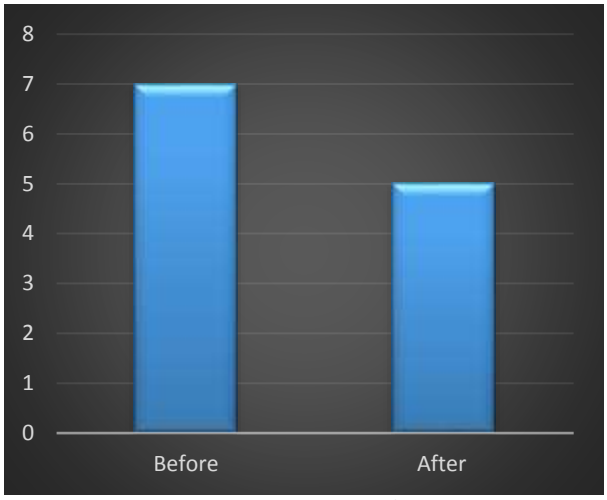

Fig 5: Reduction in number of workers

Figure 4 shows that reduction on number of operations is from 7 operations to 5 operations is achieved because the operations like manual recording of data and Submission of manual file to shipping office were not required anymore and the same the reduction in number of workers achieved from 7 to 5 as the worker for recording data and worker for submission of manual file were not required any more as shown in Figure 5. Hence, the leading benefits of pilot study conclude that, the current study has helped the reduction in operations and which in overall helped to achieve 28.57 % improvement in operations and cost saving.

4. ROI calculations

A pilot study regarding RFID application also helped them to estimate about the ROI (Return On Investment) by following the same strategy as utilized by previous researchers like Chen, Cheng [20] in their research study. The ROI has been calculated as follows.
Estimated Cost involved for first time RFID Installation per year for shipping department (PC, Software, system, Integration, Trainings, hardware, RFID tags, RFID Reader, Print labeler) = RM 154900/-

Relocation cost	= RM 7958/-
Electricity cost per year	= RM 3979/-
Maintenance cost per year	= RM 7958/-
Total Cost	= RM 174795/-
Benefits	
Total number of worker saved	= 2
Cost per worker	= RM 2487/-
Total benefits per year	= 2487x12x2
	= RM 59688/-

Total ROI calculated = Cost of investment/ Benefit through investment [20]

ROI = (RM 174795)/(RM 59688)
= 2.92= 2 Years and 10 months

So, the authors of this research study have observed that the estimated ROI attained for shipping department is almost 2 years and 10 months.

5. Conclusion

In this research study, the authors have conducted a pilot study regarding RFID application in one of the selected case company that is under consideration for technology deployments and requires a proper path to follow. The pilot study was conducted on packing area, which not only provided an excellent provision of details regarding equipment (required) but also provided details on how to systematically implement RFID technology in pl. In order to perform this study, the authors have selected the packing department for application because the waiting time from packing to shipment for customer is almost 4-7 days in the selected case company and it requires urgent reduction. The results achieved through this pilot study clearly indicates that the RFID is capable to minimize the current lead time to 50% with an increase in operational efficiency to 28.7% and cost reduction to almost 28.7% (through workers cuts) if implemented properly. Furthermore, this pilot study also indicated that the shipment department would be breakeven within 2 years and 10 month when ROI for the shipment department has calculated. In last, this research clearly states that the RFID is highly helpful to minimize wastes and helps to achieve lean and endorsed perfectionism for industrial managers and academicians.

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