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DEVELOPMENT OF LEAN ASSEMBLY LINE USING 5S AND RFID TECHNIQUE

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Abstract: In an assembly plant, line feeders manually inspect the availability of raw material in every workstation and transport the required materials from the logistics department with the help of trolleys. Since this process involves only manual inspection, the assembly process gets halted until the raw materials reach the workstation, and the lead time is increased. This work aims to improve this logistics performance by interfacing Radio Frequency Identification (RFID) technique with the assembly line in a cellular manufacturing system. The RFID technique provides details to the logistics department about the assembly line materials movement and availability of materials in each workstation through radio frequency. Based on this feedback the logistics department transports the raw materials to the respective workstation with help of the line feeders. The line suppliers then release the raw materials with the help of respective trolleys. This eliminates the need for manual inspection and reduces the man power required. The initial step in implementing lean manufacturing is to ensure clean and tidy environment which ensures effective work environment. Implementation of 5s in logistics and supply chain area will greatly reduce all delays and snags.
Keywords: Lean manufacturing, Radio frequency identification, Cellular manufacturing

1. INTRODUCTION

RFID technology is ideal for many assembly applications. It can be used to sequence the delivery of outsourced components, monitor and track work in process, error-proof build instructions, ensure correct tool usage, trace the history of parts, improve product quality, RFID can play a vital role in improving assembly line efficiency and productivity. RFID reduces human mistakes and improving the traceability, RFID information can be used to ensure that the correct labor, machine, tooling and components are available and ready to use at each processing step, thereby eliminating paperwork and reducing downtime, As raw materials are consumed and assemblies created, triggers can be set off, controlling inbound materials and impacting work-in-process inventory or post-process inventory.

One of the biggest benefits of RFID is ensuring the accuracy of build instructions in a manual assembly environment. Traditionally, work orders and build sheets must be updated at every workstation. With RFID, updates can be written to the tag so that it is constantly being updated without risk of operator error. That means critical tasks aren't skipped or executed incorrectly have began to use the technology to "track tools, fixtures or pallets, to trigger the picking of kits, or to trace products.

The ABC Group (considered for this research work) strategy of ensuring that production is tuned to market demands around the world also applies to smaller markets with worthwhile potential, in which customs regulations may, for example, complicate the import of complete automobiles. In such areas, the ABC Group manufactures automobiles from parts kits in assembly plants. This is the so-called "Completely Knocked Down" (CKD) production. In the CKD process, certain parts and components are packaged as kits in precisely defined assembly steps and exported for assembly in the respective countries. These kits are then supplemented with locally manufactured parts in the partner countries. Assembly takes place on location with adherence to the ABC Group's global quality standards. Currently, the ABC Group uses CKD assembly to manufacture automobiles with partners in six locations (Thailand, Malaysia, Russia, Egypt, Indonesia, and India). The materials are supplied to ABC Plant Chennai in three categories: Lot, Local and EV (Bulk).

- Lot parts. Once the containers are arrived to the Chennai Plant, Goods Receipt has been raised:

- 3 series – 1 lot (24 cars parts) – 13 containers
- 5 series – 1 lot (24 cars parts)– 13 containers

- Bulk parts: Bulk parts are imported in bulk as they are low value parts less than 2 Euro with bulk consumption. A separate warehouse location for bulk supply is maintained and the assembly line is replenished using SAP and KANBAN Triggers.
- Float stock: Float stock is a part of the contingency plan to keep the assembly line running in case of material discrepancies such as defects in the parts and material damage during transit and handling. The float stock is issued on receipt of MCDR's.
- Consumables: Consumables are maintained separately in an air conditioned warehouse and the ordering process is based on consumption by the assembly line and issues are done based on assembly line material requests and subsequent approval.
- Pack check: Pack check is a process in which all the parts are physically checked before sending into the assembly line. There are three possible discrepancies: Wrong part (with right part number), Part shortage and Quality issues (scratches, broken parts etc.)
- Pack month: It is a month on which packing of materials at packing plant in Europe and ordering process for any pack month to be done in two months advance.
- Master Plan: Production planner maintains an excel sheet which shows production request to AG, plant production plan & stock plan
- Production Planning Schedule: Production planner maintains an excel sheet which shows the detailed capacity on daily basis.

2. BRIEF LITERATURE REVIEW

RFID Technology has the potential to be an enterprise wide technology with inter- organizational implications in the same vein as the internet and networked PCs. It can bring fundamental changes to business process and society. Its benefits include replacement of the UPC and readers with the RFID. However, RFID when fully deployed and integrated can integrate and help manage purchasing production process inventory control inter organizational movement of materials and information in the logistics process to name a few areas not including personal and social use the technology mainly consist of four parts: RFID tags, readers and antennas, RFID middleware, and backend RFID enterprise service. Frequently, innovations in technology have shaped ever-changing business dynamics, requiring careful attention; accordingly researchers have paid significant attention to factors that influence the organizational adoption of innovative technology [1]. Noticeably, compatibility, relative advantage, and complexity have been identified as the three characteristics that determine the technologies that are adopted in practice.

Research has shown that, in general, different factors affect early and later adopters of innovative technology or practices while internal and external pressures drive late adopters the motivation to attain strategic competitiveness, which closely relates to expected benefits impels early adopters to take initiatives to adopt new and innovative technologies. If a new technology presents potential benefits that could bring a competitive edge to a company it would probably proceed to implement the technology although they may not see significant financial return in the near term. For instance expected desirability had a strong impact on the intent to adopt electronic trading systems in the early stages of their use among other factors there were mimetic, coercive, competitive pressures and organizational readiness [2]. Although competitive pressure leads many firms like suppliers of Wal-mart to adopt the technology, benefits from its adoption have been a significant factor influencing firms in their adoption decision. An empirical study reported that retailers adopted RFID primarily because they expected benefits such as being able to offer quality customer service.

3. PROBLEM ENVIRONMENT: DETAILS & OBJECTIVES

The ABC India operations (Figure 1), shows the different activities in different locations from the stage of forecasting to dispatching the car to dealers. The ABC National sales center collecting the data from sales forecasting and dealers demand based on this data the national sales center sending the production details to ABC India plant.

The ABC plant Chennai (Figure 2) doing the first operation is receiving the lot parts from Europe, and then pack checking whether ordered parts are came or not, as well as bulk parts after the pack checking operation the components are stored in the line supply ware house, then the components moving to the assembly line.

The assembly line layout (Figure 3) shows the different types work stations in cellular manufacturing systems. The starting stage of workstation called as trim line it's contains T0 to T9 workstations, and D1 to D3 workstations is sub assembly for door, OH1 to OH5 is over head workstations here doing the transmission system mounting process and engine, F1 to F4 workstations is final line here doing filling the lubrication and refrigeration process finally wheel aligning process.

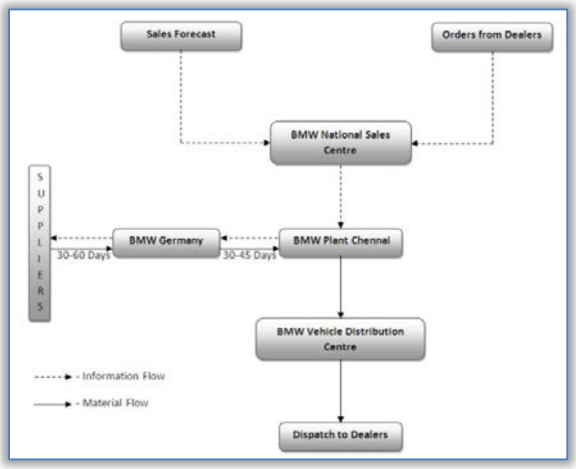

Figure 1. ABC India operations

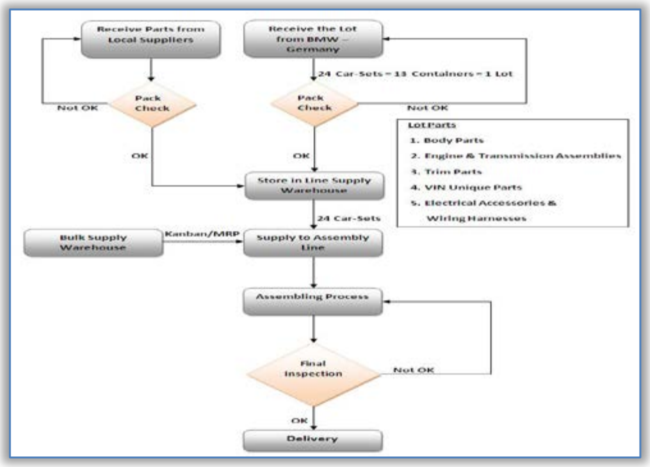

Figure 2. ABC Chennai plant operations

The logistics layout (Figure 4) contains various activities, the dock area is receiving the goods from the container with help of the forklift and then pack checking operation, after finished the pack checking operation the components placing into the respective trolley, then this trolley is placed respective workstation wit help of the toe vehicle, the empty trolley taken from the workstation and loading the components.

The following are the objectives:

- The Off line triggering in the assembly line due to the arrival of material from the logistics department, cycle time mismatching in the workstation due to the shortage parts in the respective trolley, more lead time in logistics department due to arrange the components in the respective trolley
- To reduce the time for pack checking process as well as reduce the box handling activity of the operator
- Improve the operator efficiency in assembly line
- To reduce the time for arrange the parts in the trolley

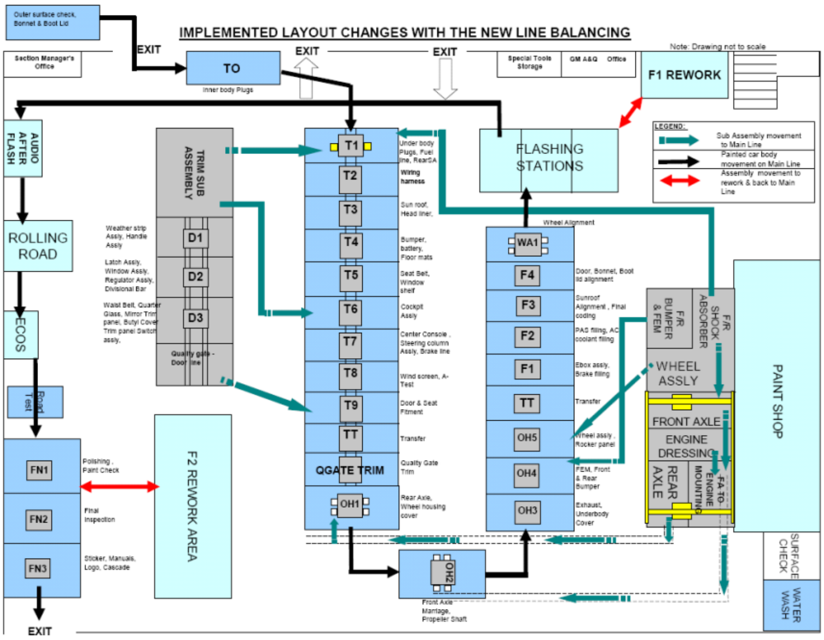

Figure 3. ABC Assemly line operations

4. IMPROVED SCENARIO

Optimization of production lines from the perspective of assembly logistics has become an important issue for automotive manufacturers that are sharpening their competitive edge by producing large variety of the product and shortening the time of delivery since the arrival sequence of different product model is randomly dispatched to workstations depending on the requirement, it is nearly impossible to obtain the optimal solution an 3-dimensional animation and visualized analytical tool is used for the

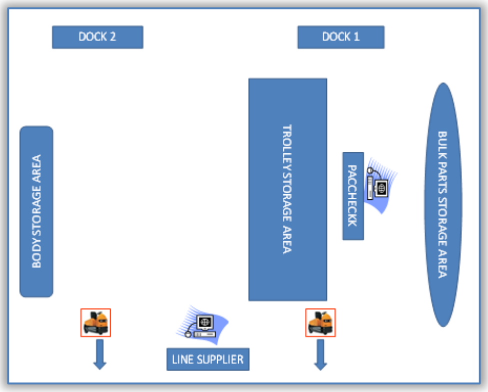

Figure 4. ABC Logistics operations

logistics simulation the simulation process indicates that the following aspects have an important influence of the efficient assembly line. Figure 5 shows the improved working condition using RFID.
The following categories of manufacturing waste are dealt:

- Waiting time: Waiting time in the assembly line due to arrival from the loaded trolley it can eliminate with help of the RFID techniques sending the feedback about assembly line status through radio frequency signal.
- Cycle time: In practice it is nearly impossible to find an assignment of operation to workstations that would perfectly match cycle times. Consequently if the cycle times defined for the work stations are too tight the amount of the time necessary to carry out the operations, the cycle time can be exceeded at some or all workstations. Under the circumstance, it is advisable to add a new workstation in order to find a feasible solution. Conversely, if the work times obtained in a solution are below the available time, it may be possible to eliminate a workstation in order to increase the line efficiency.

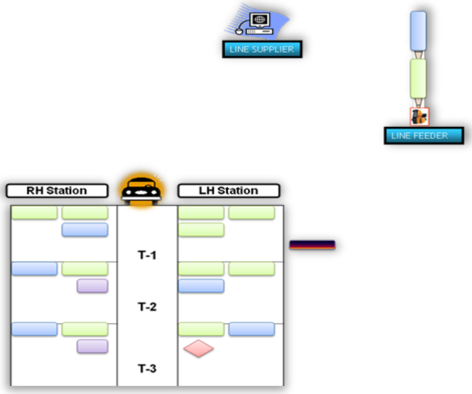

Figure 5. Implementaion of RFID

- Length of assembly lines: Generally, a short line integrated with several subassembly lines is easier to balance than those long lines. In this respect, combing tasks and workstations is frequently used. Higher flexibility of the line could be obtained as a result of interpenetration of operations that are traditionally done by different workers at several fixed workstations. To achieve this, the workers are expected to be cross-trained and more versatile than those working at fixed workstations.

With regard to 5S, the following improvements are done (Figure 6): SORT: sorting special trolleys and normal trolleys; SET IN ORDER: based on work station placing the trolleys; SHINE: keeping the component with the aid of hand glove; STANDARDIZE: creating standard sequence in the logistics dept; SUSTAIN: performing 5s audits weekly once with special teams.


Figure 6. Work place improvement

5. CONCLUSIONS

With the logistics simulation method, the automobile assembly lines are optimized, resulting in improved line efficiency and shortened time of delivery of vehicle products. However, during the simulation process the adjustment of control variables is done under a manual assembly line environment. How to optimize assembly lines with a higher automation level where the physical constraint becomes tighter and the freedom of adjusting the control variables become smaller remains to be an interesting research topic in the future.

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