

Implementing Manufacturing Execution Systems through Lean Manufacturing Approach

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Abstract— In today's age, where product witness major changes in shape and size within short time, it becomes necessary for an organization to set control over its manufacturing processes so as to make efficient use of its resources to produce optimum output. While introducing new parts or products in an organization, it becomes essential to bring on all functional departments in that organization to a platform which is product data oriented. Manufacturing Execution System (MES) helps to bring on all functional departments within extended organization to that platform, through real time data collection. It signifies functioning of each department with the help of key performance indicators (KPIs). Manufacturing Execution System through Lean manufacturing approach is focused on creating a perfect process of value creation in product development and operations; along with the supporting processes within organizations.

Keywords: Manufacturing Execution System (MES) ,Lean manufacturing approach, Key performance indicators (KPIs).

I. INTRODUCTION

Lean manufacturing is a strategy which is aimed to achieve smooth production flow by eliminating waste occurred during activity. While Lean manufacturing has been implemented from almost last four decades ,its importance is still increasing. In the early years of Lean initiatives, organizations made implementation by fixing shop floor and manual dependent issues without interface of IT systems. In today's world of globally spread manufacturing organizations, the business location has drastically changed. With these changes, manufacturers must now recognize that software has become virtually a requirement for successful implementation of Lean manufacturing.

Today's emphasis on global market, distributed production and shorter lead time is pushing manufacturing to a whole new level of Lean. For organizations that have operations spread far and wide, optimal performance requires frequent adjustments, as markets and supply sources shift. Manufacturing operations that are Lean, shift more readily. In global economy environment it is essential to consider a Lean program within the silo of a single location. Waste must be removed from as many processes as possible; these processes now extend across the supply chain, throughout operations as well as across distributed production sites. Streamlining the process of instituting change and refinement lets manufacturers to achieve greater success. More improvements can be implemented helping to drive an efficient, successful Lean program.

MES controls the production operations that enable the realization of management's plans, and provides feedback from the plant shop floor to management thereby closing the execution gap. MES delivers information that enables the optimization of production activities from order launch to finished goods. Using current and accurate data,

MES guides, initiates, responds to and reports on plant activities as they occur.

The contribution to supply chain inventory accuracy and reduction is seen through the MES's management of work orders in the plant. Due to these accurate views into the production status can be observed. MES allows for more effective customer service, and is particularly essential as companies move closer to real time response. MES can also perform some of the subgoals based on manufacturing order execution such as

- Improves communication inside a facility; for example, production activities can be rescheduled to reflect unexpected machine down time or production priority changes.
- Improves communication capability between production and other activities in a manufacturing enterprise, such as product design, process planning, resource planning, supply chain management, service and sales, and equipment control.
- Monitors production to control operations within desired performance parameters.
- Provides up to date communication between the facility and facility management.
- Manages production related data, including resource data, performance data, process data, job scheduling data, in a better way.

II. LITERATURE REVIEW

Japanese industrial leaders such as Toyota, Shigeo Shingo, and Taiichi Ohno researched a new, disciplined, process oriented system, which is known today as the "Toyota Production System," or "Lean Manufacturing". Lean manufacturing is very significant productivity improvement technique whose benefits can be described as the reduction of wastes in organization[1]. Lean manufacturing is a systematic approach to identifying and eliminating waste through continuous improvement. Some characteristics are common to the majority of lean manufacturers that are waste reduction, integrated supply chain, and enhanced customer value, value creating organization[2]. There are many lean tools and techniques which help manufacturing organizations to implement best manufacturing practices[3]. Change factors such as change readiness, team development, leadership and management support, effective communication, employee training, employee empowerment and review process have significant influence on lean manufacturing implementation[4]. There are many philosophies, tools and supporting management behavior to successfully implement lean manufacturing and continuous improvement[5].

MES is a collection of hardware and software components that enables the management and optimization of production activities from order launch to finished goods [6]. There exists a high degree of agreement in literature for

the benefits of MES. MES has reduced the cost of production in several discreet manufacturing industries [7]. Plants using MES are found to be able to reduce costs more dramatically than plants not using MES [8]. The scope of MES includes, but is not limited to: Resource allocation and tracking, Scheduling, Data Collection, Labor Management, Quality Management, Process Management, Maintenance Management and Production Tracking [9]. After the initial MES adoption, Lean IT must manage change incrementally and continuously to be able to achieve full system potential [10].

III. CASE STUDY

In the home appliance industry, management is facing with a competitive customer market, where high energy costs must be considered with the demands of increased quality at lower prices. To be competitive when it comes to meeting these demands MES must be used in order to produce on time customer orders and shorter delivery cycles. Real time information direct from the shop floor is provided through the MES for production management to reduce reprocessing rate and increase first time quality production. In this market the competitive advantage must be obtained by combining better operational management with business systems to plant floor connectivity, just as MES offers. Improved quality, customer responsiveness and efficiency are fundamental business drivers. An industry focused on bottom line management needs execution strategies that maximize plant capacity, throughput and utilization of resources.

MES delivers substantial benefits by improving both sides of manufacturing. For the operations side, it reduces lead time on new product start ups, lowers work in process (WIP) inventories, improves product quality, reduces paperwork and provides speedier data collection. MES provides real time management of complete process definitions, production and support activities, assuring compliance to engineering plans and specifications. It helps greatly in achieving corporate goals including realizing improved return on assets, lowering operating costs, reducing capital expense and improving regulatory compliance. By improving plant efficiencies and reliability, MES boosts return on the fixed assets tied up in plant and equipment. It contributes not only to return on invested capital and return on assets, but also to overall enterprise information flows.

IV. PROBLEM STATEMENT

In a large extended enterprise a real time data for product become vital to the production. Collecting inputs from people on shop floor is time consuming and less accurate process. Sometimes it is misguiding process. In an esteemed organization there exist lot of issues with manual dependent such as No real time data for status of product on assembly line, Unbalanced schedules for manufacturing and assembly of sub assembly parts due to lack of information about process followed by product, Mismatched sequence of assembly, as no means of visual communication present for indicating operations performed on product, Occurances of mismatch of sub assembly parts or products are high due to lack of knowledge about product, Identification of

bottleneck processes in terms of idle time is very tedious job, Root cause analysis of defects is time consuming, High percentage of either product is waiting for sub assembly parts or vice versa.

V. METHODOLOGY

In an esteemed organization Manufacturing Execution Systems (MES) is implemented through Lean manufacturing approach. Lean manufacturing is a strategy which is aimed to achieve smooth production flow by eliminating waste and increase the activities value. Lean manufacturing approach is meant to transform non value added activity into value added activity. Lean manufacturing methodologies eliminate the wasteful activities by linking and balancing equal amounts of work steps together, enabling products to be consume directly into the next step, one piece at a time until completed. Lean thinking is focused on creating a perfect process of value creation in product development and operations along with the supporting processes within organizations. Following figure describes the input and output to the Manufacturing Execution System (MES). Each of the input is essential to implement MES successfully.



Fig.1: Input and Output for MES

Process status includes report of the conditions of a process being monitored. The report includes process changes or shifts, workpiece throughput, and so on. Manufacturing orders are instructions that are sent to factories to start jobs to fulfil customer orders. The starting dates are specified in the manufacturing order according to the production plan and the master production schedule (MPS). Process specifications are sets of description of standard engineering, manufacturing, and business practices that guide and control the product development process. Engineering changes are changes in process or design when some problems in the process plan were found. Changes include process parameter changes, tool changes, setup changes and so on. Production schedule is a plan that specifies starting time and finishing time of each job in the job queue, that is required for producing products. The plan contains job IDs, starting dates, and due dates. Product specifications are sets of description of standard

engineering, manufacturing, and business practices that guide and control the product development process.

Most important outcome from MES is Product genealogy. Product genealogy information may include who worked on the product, lot, serial number, current production conditions, and any alarms, rework, or other exceptions related to the product. Production status includes report on the state of all scheduled operations and production units. This also includes the information on resources, process setup, job schedule, etc. Work in Process (WIP) is state where finished goods or semi finished goods are waiting for completion. Part availability indicates status of sub assembly parts required to carry out assembly operation. Defect analysis helps to collate defects data, identify most common types of defects by performing pareto analysis, prioritize root causes, identify and develop solutions for root causes. It gives guidelines for implementation of solutions for removal of defects. Product inventory is inventory information on a product. Information is updated when finished products are sent to storage. Assembly sequence affects production and is relevant to many life cycle issues of the product. Quality inspection are measures aimed at checking, measuring, or testing of one or more product characteristics. Products that don't comply with the specifications are rejected or returned to improve. Bottleneck operations are those operations which consists non value adding activities and due to which throughput rate is being affected.

V. RESULTS

MES system has filled up the information gap between the shop floor and the business level of an esteemed organization. With an electronic interface between product and planning system, MES enabled management to get real time data for immediate decisions. Implementation of MES has offered following benefits

- Through the collection of real time data about product and processes, MES implementation helped to eliminate manual data collection that is often less precise and time consuming. Due to this human errors in the data collection are minimized.
- MES implementation has helped to minimize waste or scrap in esteemed organization as problems are identified instantly and affecting processes are improved or modified. This has resulted into limiting the number of defective parts and limiting the wastage of sub assembly parts.
- MES has helped to minimize inventory of sub assembly parts when main product is undergoing rework operation. As records are constantly updated with new production, scrap, non conforming material etc. management is now able to decide which parts are to be purchased, which parts are to be stored online and which parts are to be stored offline.
- MES has helped to minimize idle time for machines and man, as parts are not scheduled unless the source inventory is available. This in turn has lowered downtime cost in an esteemed organization.

- With implementation of MES part mismatch in products is minimum as product is tracked online. Real tracking provides list of eligible sub assembly parts with respect to main product. Also status of product and sequence of operation followed gives an information about which part is to be assembled.

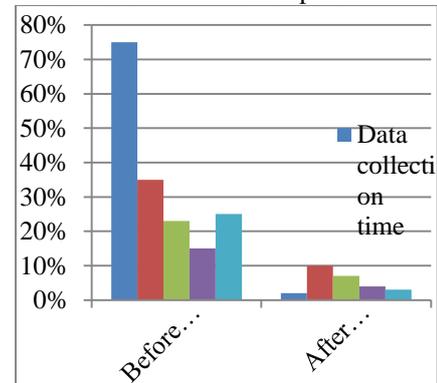


Fig.2: Benefits from implementing MES

VII. CONCLUSION AND FUTURE SCOPE

Proposed work is helpful to improve key performance indicators (KPIs) for manufacturing which are quality, productivity, cost and speed. Proposed methodology is useful to implement a long term business strategy as all functional departments in organization are involved in it. Mentioned work can smooth out the flow of strategic elements such as assembly operation, material flow, and supply chain activities. Good transparency of business processes and products can be maintained by virtue of this study. Existence of real time data will be beneficial to an organization as it will help to develop much deeper understanding of what is the thing that needs to be modified to make product more successful in the market. Through this system excellence in manufacturing environment can be achieved.

Future scope in proposed study can be suggested in terms of managing a good structured flow of processes within an esteemed organization.

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