

# MANUFACTURING EXECUTION SYSTEMS INTEGRATED WITH ERP & SIX SIGMA FOR PROCESS IMPROVEMENTS

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## **ABSTRACT**

Majority of the today's firms are trying to implement information integration systems with the help of Enterprise Resource Planning (ERP) planning tool for the effective execution of the plan in the shop floor. Manufacturing Execution System (MES) is one such tool used for effective execution in the shop floor. This Paper deals how MES could be used and linked to ERP & six sigma methodology in effective execution & also reducing cycle time, increasing machine productivity & process improvements.

## **OVERVIEW OF ERP**

ERP being an effective tool in planning and its successful implementation in most of the firm's have created a great impact in boosting productivity and improving business processes. How far the firm's have succeeded in implementing ERP and are they successfully executing the plan done with the help of ERP? Answer for this question is no. However effective the planning tool is, the execution in the shop floor does not happen according to the plan because of the changes that occur in the demand and the planning tool will not be responsive to the changes due to which there will not be any synchronization. Hence, ERP is not a closed loop which will help for the effective execution in the shop floor. MES is emerging as an effective execution tool which could be linked to the ERP & other planning tools.

## **MANUFACTURING EXECUTION SYSTEMS (MES)**

MES is a tool used for executing shop floor activities effectively & efficiently as per the plan. It basically executes the production plans from the ERP in the shop floor & also helps in real time coordination of the production process. This real time coordination of the production data to the ERP helps to respond dynamically for any changes in the plan and executes the changed plan very effectively. This eliminates waste and also MES will track the production process while it is in progress and captures the data which could be converted into useful information in real time. The data here could be production report, resource capacity, labor capacity, machine capability. This real time capturing and tracking the production

process and giving feedback to the production supervisors & managers for any changes that has to be done makes MES an effective tool for the execution.

Overall, MES fills up the gap between the planning & the execution & forms a closed loop from planning to execution by giving feed backs back to ERP. MES mainly focuses on the real time capturing of the product process data or any shop floor data and converts the data into useful information for the production managers to take an effective decision upon the process. This also helps in preventive maintenance of the machines and also helps to improve the process capability of the production process by capturing the real time process data and improving the productivity. MES helps in incorporating changes in the plan happened due to the change in the demand forecast. ERP helps to fulfill the order requirements of the customer & MES helps in changing the production plan being responsive & flexible for changes without hampering the on going production in the shop floor, there by meeting the customer requirements and satisfaction.

### **Integration of ERP & MES:**

ERP and MES must be integrated for the organization to perform effectively by reducing the cycle time & satisfying its customers. The critical drivers for the integration of ERP & MES are *responsiveness, flexibility & productivity*. Integrated supply chain will demand for an effective responsive system & ERP helps in matching customer requirements & to incorporate if there is any change in the demand, it requires a system which should be responsive & flexible for any changes. So, MES helps in being responsive & flexible for the changes. Even

Productivity measurement & control has to be done in order to fulfill the demand. MES helps in tracking & monitoring the production in real time and make any changes required to meet the demand.

### **Impacts after Integrating MES & ERP:**

- i) *Cycle time reduction:* cycle time after integration is reduced to 50%.
- ii) Reduction in *Work in Process (WIP), raw materials & finished goods inventory (FGI).*
- iii) *Setup reduction* to 30%, management time scheduling time reduced to 75%.
- iv) Finally, customer satisfaction by reducing *customer backlog* by 90%.

## **INTEGRATING MES WITH SIX SIGMA METHODOLOGY FOR PROCESS IMPROVEMENTS**

The integration of MES with six sigma methodology really helps to improve the process performance & its capability, throughput, cycle time & operating costs. MES forms an information system which involves in collecting, processing, analyzing the materials, finished goods, machine time & cost. This tracks the production data and process and helps in monitoring the Work in Process (WIP). MES forms a hub for different elements like data acquisition, operations scheduling, production data management, and product tracking & performance

analysis linking the database which helps for effective decision making. MES integrates with DMAIC of the six sigma in reducing the cycle time, process performance & overall productivity for the organization to gain a strategic fit in today's competitive market.

MES combines with all phases of the DMAIC such as define measure, analyze, improve & control and helps in continuous improvements of the activities in shop floor.

The Phases are as follows:

Defining phase- In this phase the scope, idea & goal should be identified which involves in closing the gap between the VOP (Voice of the Process) to the VOC (Voice of the customer) by capturing the MES data.

Measuring phase- This phase is the most challenging phase; data is collected from the process with the help of MES and then the data is plotted in the form of a control chart, Pareto chart, and Gantt charts. This involves in measuring process performance with the help of the VOC & finally tracking the process with time to find out the variation in the process.

Analyzing phase- In this phase the root causes of the problems are identified and they are analyzed using data analysis tools. Using MES data like WIP, resource information, order fulfillment information the statistical tests like F-test, t-test, Bartlett's test are carried out using the help of control charts. The results got will be used in the final stage for the process improvements.

Improving phase- This is also called as proactive analysis which provides solutions for the business processes. Improving phase introduces experimental

design analysis tool with Design of experiments (DOE) which aims in identifying a process and which simply provides an acceptable number after analyzing it by selecting an appropriate factor of the process. DOE uses factorial design & Response surface method (RSM) for identifying the best process. MES provides data for DOE to analyze the process and DOE improves the process by resolving and finally moves to control phase.

Controlling phase- This phase is responsible in capturing data from the DMAI phase & keeps the business processes improved in day to day business. In this phase first it establishes a control plan from data obtained from MES which involves standardization of the process using SPC & FMEA tools. Next, it aims in setting up a poke-yoke device for mistake proofing and error proofing of the process. Also, plans for the scheduling of the production of MES. MES sets demand and provides resources based on demand for the production. MES finally links ERP which helps for the leverage of its investment. MES helps in accessing the real time manufacturing data and converting it into manufacturing information in ERP to keep track of throughput, WIP & business processes by verifying the plant capacity & fulfilling orders as and when they receive. Thus it aims in controlling all the activities by visualizing the manufacturing the data in MES. This data can also be linked to other business operations like Supply chain management (SCM), SSM (sales & service management) & PPE (Product & process engineering) activities.

## **Noticeable measurements after integrating MES and Six Sigma:**

### Process performance & capability-

Using MES & six sigma methodology the process can be improved and its process capability index can be calculated & analyzed which is the ability of the process to satisfy the customers. This is achieved by integrating MES & DMAIC phases and eliminating the variations in the process. It uses short term variability & long term variability analysis in reducing the variation of the process.

### Cycle time-

Cycle time is the time between the customer order and delivery of the product to the customer. Reducing cycle time and eliminating non value added activities in the value stream is important for the process improvement. After integrating MES & DMAIC,

MES helps in providing real time order information for the enterprise and it calculates the cycle time with the help of the statistics software. Using Pareto charts they found 20 % of the machines are non value added and they are responsible for 80% delay. So, integrating

MES & DMAIC we can overcome such problems and work towards continuous improvements.

### Rolled Throughput Yield (RTY)-

By integrating MES & DMAIC the yield can be measured and monitored continuously in the production line. Also, if there is any defect in the process or any machine in the line. MES reads out an electronic data of the defective process or if finds out if there is any variation in the process. Hence, MES is

really helpful in tracking and monitoring the production there by corrective action is performed on the deviated process, thus increasing the throughput.

#### Operating costs-

Finally, the overall operating costs can be reduced by reducing WIP, inventory costs, rework cost, operator cost. Also by eliminating the non value added wastes operating cost of the activities can be reduced considerably.

## OVERVIEW OF MES SOFTWARE & ITS IMPLEMENTATION IN INDUSTRIES

The MES software package has got 25 modules and its implementation will take few months and the cost will be around \$200,000. Basically, MES helps to remove the barriers between the all the functional departments in the shop floor by sharing the real time information. MES software has got 6 functions:

- 1) Managing resources and its availability such as machines, labor, and materials.
- 2) Scheduling based on the priority.
- 3) Manages a control flow in the production line between the machines.
- 4) Managing labor.
- 5) Managing maintenance activities, quality of the products, process.
- 6) Finally, automating and control of the documents.

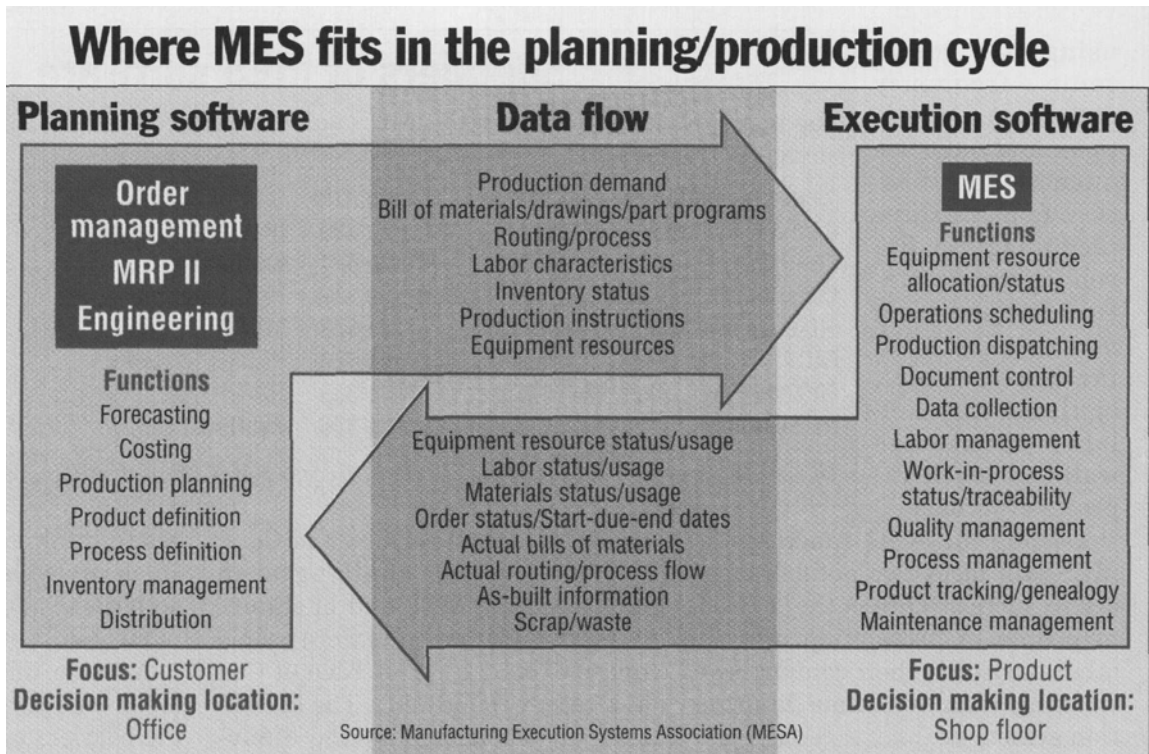
Most of the companies are going for MES because of the benefits they get from its implementation in the shop floor, some of the Industries & its benefits are a) Henderson Manufacturing, manufacturer of steel dump truck bodies has increased its capacity utilization to 85% from 60%, b) ITT Night Vision has

improved its throughput by 5%, c) Caterpillar, with MES the lead times has decreased from weeks to days, d) Advanced Micro Devices has reduced its cycle time to 40% and paper work to 90%.

Some of the Suppliers of MES are IBM, Aspen technologies, Camstar Systems, MES Solutions, Industrial Computer, SyQuest.

## CONCLUSION

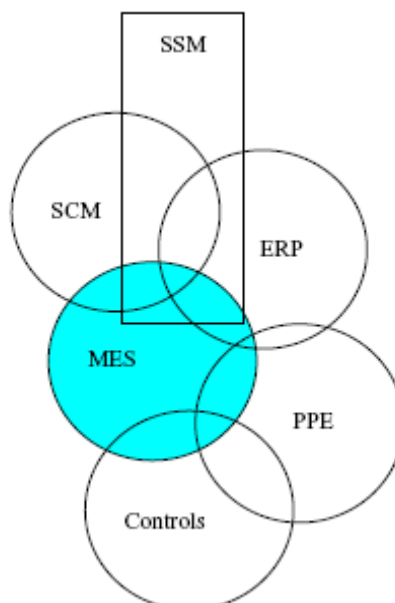
Manufacturing execution systems (MES) finally takes place a prominent position in the market linking the planning software like ERP to the shop floor. The Plan that is done using the planning software is effectively executed in the shop floor. The gap between the planning software and the shop floor can be closed using MES. MES can control the production and can give the feed back to the production supervisors and managers can take a decision based on that. MES can also be used for the process improvement processes by integrating with six sigma methodology. Overall, MES integrating with ERP and six sigma can change the complete scenario of the shop floor by improving the process, increasing production, providing quality products & customer satisfaction.



## HOW MES FITS IN THE PLANNING/PRODCUTION CYCLE & THE INFORMATION FLOW BETWEEN THEM

(Source: Modern Materials Handling: March 1997; 52, 3; ABI/INFORM Global, Pg 35)

## MES CONTEXTUAL MODEL (Int J Adv Manuf Tech (2006) 31: 146)



## REFERENCES

- 1) ERP & MES Integration: Reducing Cycle Time, Proceedings of the Industrial Computing Conference, Volume: 6, Year: 1996, Page no: 91-96
- 2) The practices of Integrating manufacturing execution systems and six sigma methodology, International Journal of advanced manufacturing technology, (2006) 31: 145-154 DOI 10.1007/s00170-005-0164-0
- 3) Take control of your shop floor with manufacturing execution systems. Gary Forger. Modern Materials Handling: March 1997; 52,3; ABI/INFORM Global Pg:34