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APPLICATION RANGE OF INTEGRATING MANUFACTURING EXECUTION SYSTEM FUNCTIONS IN ENTERPRISES

STANO, P[avol]; SIMEONOV, S[imeon]; CIROVIC, I[van] & PFAFF, O[ndrej]

Abstract: *This article is focused on Manufacturing Execution System (MES) functions, their main classification according to Manufacturing Enterprise Solutions Association International, division from other view by their information value and utilization for various purposes in enterprises. Furthermore, this paper discusses how the appropriate selection of core or support functions can help with meeting the challenges of greater competitive advantage and increasingly complex problems solving. MES are widely used in many branches of manufacturing and automation for their possibility to link MES with planning and scheduling systems, simulation software, quality management tools, and other applications for improving working process.*

Key words: *manufacturing execution system (MES), MES functions, planning and scheduling, quality management tools*

1. INTRODUCTION

Manufacturers of all types are changing business environment. To keep pace and achieve high performance, manufacturers are pursuing a range of new approaches in implementation of manufacturing execution systems functions, especially the right choise, usability features and their benefits. So they rely on the ability to share information across the information system and therefore it is particularly suitable to rethink the design of MES thoroughly and select necessary functions for each enterprise extra.

Due to increasing economic pressure, the manufacturing companies often invest large sums of money in advanced production facilities such as computer hardware and software, robotics, automated material handling, machine tools, etc. However, the results of better quality and faster throughput which are expected from the use of these facilities have not been reached in many cases. One of the primary reasons for this is the difficulty of involving in scheduling and controlling manufacturing activities (Yunqing, 2008). A solution may be found in full MES solution, which can bridge the gap between the production or assembly floor and engineering, accounting, production control, purchasing, quality, manufacturing engineering, research and development and testing. MES functions as the central depository for data distribution and collection for all other enterprise systems (Hwang, 2006).

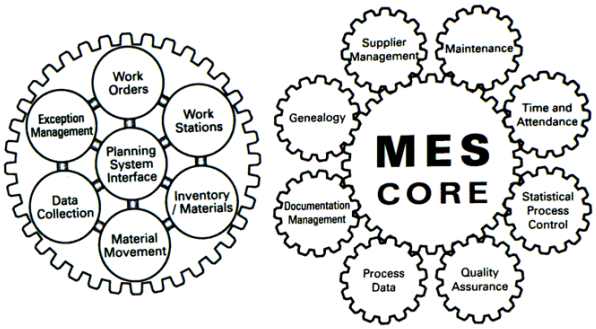
2. MES FUNCTIONS

The MES layer can be divided into functional parts. This allows pieces to be understood and developed in building blocks instead of one large massive software package. Although not every MES product has to include exactly the same functions, these sections are a part of nearly every production system in one form or another (McClellan, 1997).

MES would include a list of functions that are distinguished into two main divisions: *core functions*, which are directly associated with managing production, and *support functions*, which include peripheral or support activities.

Core functions: Planning System Interface, Work Orders, Work Stations, Inventory Tracking, Material Movement, Data Collection, Exception Management.
Support Functions: Maintenance Management, Time and Attendance, Statistical Process Control, Quality Assurance, Process Data Analysis, Documentation Management, Genealogy - Product Traceability, Supplier Management.

Another view to MES functions can bring a classification by their information value for users. Module of Data Collection and Documentation Management can be covered by *Static Information Support* as compared with modules of Inventory Tracking, Material Movement and Genealogy – Product Traceability, which come under the *Dynamic Information Support*. *Short Term Schedule and Simulation* assure Planning System Interface, Work Orders, Work Stations, Exception Management, Maintenance Management and Supplier Management. Among others, there are also Statistical Process Control, Quality Assurance and Process Data Analysis, which are part of *Quality Management Tools*.



a) b)

Fig. 1. a) Core functions, b) MES core and support functions

3. STATIC INFORMATION SUPPORT OF MES

Plants have tended to be isolated from one another and manufacturing as a whole has been disconnected from the rest of the business. Those information gaps make it difficult to coordinate the activity and manage the manufacturing performance across the enterprise.

However, in contrast to ERP systems, MES systems are specialized by subject. Therefore, they correspond very closely to the technological features of particular production processes and often include systems for supporting appropriate staff training (Zagidullin, 2008).

Data Collection and Documentation Management are very important to enterprises with the large volume of production and process efficiency. It is essential to have an overview of compliance with the production speed and number of units produced. Often the main task of the implemented system is automated monitoring and collecting data from tens of machines – such as production cycle, idle time, breakdowns, number of wasters. Actually positive effects include the ability to monitor time order status, execution of production plan,

identifying faults on production machines, the evaluation time foundation using Gantt's charts, automatic reports, etc.

4. SHORT TERM SCHEDULE AND SIMULATION OF MES

Simulation is commonly used to gain an insight into manufacturing systems and it gives a general knowledge about interact of many processes. It can be also used as a tool for real-time evaluation in manufacturing systems and with manufacturing execution system, which can collect real-time production information and execute an optimized task to increase manufacturing efficiency, are very strong tools in optimization (Rogers, 1993). In addition, by sending back work in process system information to production scheduling and considering future production conditions and limitation, they can provide the basis for prediction of future production in complex and fast changing manufacturing environment.

Simulation of assembly processes allows to automatic visualization by workflow operations, provides easy management, immediate adjustment, change of workflow and application in production. Further advantage of visualization is displaying of manufacturing environment in graphical form with actual, exact location for each item.

In the planning production scheduling step, MES will improve the actual planning and creation of the manufacturing process. In effect, the MES has to complete, correct, and adapt the schedule to make it feasible, complete, and adjusted to the actual situation. Typically, the initial schedule only specifies the main activities at an aggregated level. The MES needs to elaborate those in more detail and add the missing activities as transport of goods, storage and material supply, etc. Moreover, the MES cannot rely blindly on the given schedule but needs to critically assess which information is valid and valuable, which information is stale or incorrect (Valckenaers, 2007).

5. DYNAMIC INFORMATION SUPPORT OF MES

Production managers need to have a good control over the condition of production equipment at all times and use the real time data or statistics data of the instruments and tools of production equipment as the basis for production scheduling and labour allocation.

Many enterprises use a manufacturing technology in production lines. For the purpose of such a type production, MES modules based on the inventory tracking and product traceability are extensively used. They can keep working process all the time under the control for situations, when a quick response to various changes in production is needed.

Practically, aims were achieved using ongoing verification, when the system detects pulses of each production facility. This procedure does not allow operator to continue, if the previous operation failed or did not finish. It enables significant reduction risk of incorrect assembly process, using the wrong part or skipping some important operation.

6. QUALITY MANAGEMENT TOOLS OF MES

Quality assurance has been and today still is an independent branch in many manufacturing companies. The historically caused division between quality assurance and production management has often resulted in an inhomogeneous system landscape (Kletti, 2007).

In recent years the manufacturing industry has successfully applied quality management tools, anyway, some of the projects failed due to insufficient data and human errors. Linking MES into SPC, DOE or six sigma application software can find out the best operation variables, understanding and evaluating problems, ensure higher process performance and capability, and compress the cycle time and operational costs (Hwang, 2006).

For the planning and execution of quality assurance measures, the MES system provides functions for managing basic data. These data should be held in a hierarchically organized structure. This will allow detailing of evaluations on the highest group level, starting with key defect areas. If the defect analysis criteria are to be available in detailed form and thus in a correspondingly large number, the MES will assist the user to link just the relevant subsets of these basic data to article groups, characteristics or inspection and test plans. This will help prevent incorrect inputs and increase acceptance at the data acquisition stations (Kletti, 2007).

7. CONCLUSION

MES systems allow users not only to use fewer resources but also to understand how those resources are being used throughout the production process. Thus MES are ideal for enterprises with the large volume of production and process efficiency, for using a manufacturing technology in production lines, linking MES with simulation software, SPC, DOE or Six Sigma methods that can provide the solution of problems with process performance, cycle time reduction or manufacturing environment visualization.

Another advantage of MES systems relative to other systems for the control of production processes is their openness on relatively complex quality tools and accurate mathematical models of planning and dispatching.

8. ACKNOWLEDGEMENTS

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9. REFERENCES

Hwang, Y. (2006) "The practices of integrating manufacturing execution system and six sigma methodology." *International Journal of Advanced manufacturing Technology* Vol.30, pp 761-768. *Available from*: http://www.springerlink.com/content/gr52770l30435679 *Accessed on*: 2011-05-14

Kletti, J. (2007) *Manufacturing Execution Systems – MES*. Berlin, Germany:Springer, 272 p. ISBN 978-3-540-49743-1

McClellan, Michael. (1997) *Applying Manufacturing Systems*. Florida, USA: CRC Press, 179 p. ISBN 1574441353

Rogers, P.; Gordon, R.; (1993) "Simulation for real-time decision making in manufacturing systems." *Proceedings of the 1993 Winter Simulation Conference*, pp 866–874. *Available from*: http://delivery.acm.org/10.1145/260000/256863/p866-rogers.pdf?ip=147.229.197.226&CFID=27595630&CFTOKEN=63041699&__acm__=1308599965_59c19c00d6e44a281a9bd8573ea625e0 *Accessed on*: 2011-03-29

Valckenaers, P.; et al. (2007). "Schedule execution in autonomic manufacturing execution systems." *Journal of Manufacturing Systems* Vol.26, pp 75-84. *Available from*: http://www.sciencedirect.com/science/article/pii/S0278612508000162 *Accessed on*: 2011-05-20

Yunqing, R.; et al. (2008). "On-Line Simulation for Shop Floor Control in Manufacturing Execution System." *Intelligent Robotics and Applications* Vol. 5315, pp 141-150. *Available from*: http://www.springerlink.com/content/r560n14873n30704 *Accessed on*: 2011-05-12

Zagidullin, R.R.; Frolov, E. B. (2008) "Control of Manufacturing Production by Means of MES Systems." *Russian Engineering Research* Vol. 28, pp 166-168. *Available from:* http://www.springerlink.com/content/j1536386559047th *Accessed on:* 2011-05-08