Functionalities and Position of Manufacturing Execution Systems

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Introduction

Efforts to separate unequivocally substantial signs of versatile tools of manufacturing management are usually marked by a narrowed view of the field of their use. Similarly, it is so also in the case of specifying the functionality and position of MES (Manufacturing Execution Systems) in the hierarchy of information systems. Presentations generalising MES in this field do not always correspond with models that have a generic character. For that reason it appears useful to investigate the mentioned MES characteristics from a number of angles, and particularly in relation with the basic types of manufacturing systems.

BACKGROUND OF MES EVOLUTION

From a historical point of view, the infiltration of information technology into manufacturing technology was conditioned by the development and advancement of host mainframe computing in the 1950s and '60s. It gave manufacturers the ability to capture, manipulate, and share information and automate calculation and analysis in order to support design of increasingly complex and capable products. Simultaneously in the framework of manufacturing management, an inventory control took on great importance and most of the software in the 1960s was developed for this purpose. Typically, tools called BOM (bill of materials) processors, which were used as a means to represent process plans, handled inventory control. The focus shifted in the 1970s to Material Requirement Planning (MRP) as the complexity of manufacturing operations increased. This managerial instrument enabled financial managers to both view and control their business processes much more closely. The tools to automate business processes were enhanced by adding further functionalities to meet the increased requirements. Subsequently in the 1980s, the term Manufacturing Resources Planning (MRP II) became popular. An MRP II presented extension of MRP functions to integrate all aspects of the planning and control of the personnel, materials and machines (Kimble & McLoughlin, 1995). Following, solutions that are marked by the acronym ERP (Enterprise Resource planning) were performed in the early 1990s. An ERP system can be defined as an integrated information processing system supporting various business processes such as finance, distribution, human resources and manufacturing (Choi & Kim, 2002). The newest version of ERP II has been much publicized by the Gartner Group. Fundamentally, ERP II signals a shift in traditional ERP applications from focusing on internal data gathering and management process information to partners, vendors and customers externally via the Web (Farver, 2002). The overall view on evolution of ERP systems is shown in Figure 1. Initially this concept attained a huge popularity among manufacturers, but as the scope of managed systems increased, the ERP system was not suitable for controlling activities on the shop floor level. For this purpose, new tool of manufacturing management called "Manufacturing Execution Systems" was evolved and utilized during the 1990s. There are more interpretations of MES depending on different manufacturing conditions, but the common characteristic to all is that an MES aims to provide an interface between an ERP system and shop floor controllers by supporting various "execution" activities such as scheduling, order release, quality control, and data acquisition (MESA 6, 1997).

VIEW ON MES FUNCTIONALITIES

A concept of Manufacturing Execution Systems is one of several major information systems types aimed at manufacturing companies. MES can be in simple way also defined as a "tool for manufacturing management". The functions of an MES range from operation scheduling to production genealogy, labor and maintenance management, performance analysis, and to other functions in between. There are several general models of typical MES functions that are principally divided into core and support functions. The core functions deal primarily with actual management of the work orders and the manufacturing resources. Other functional capabilities of MES may be required to cover support aspects of the manufacturing operations. According to McClellan (1997), the function parts pertaining to first group of functions include:

Figure 1: Functionality evolutions of ERP systems
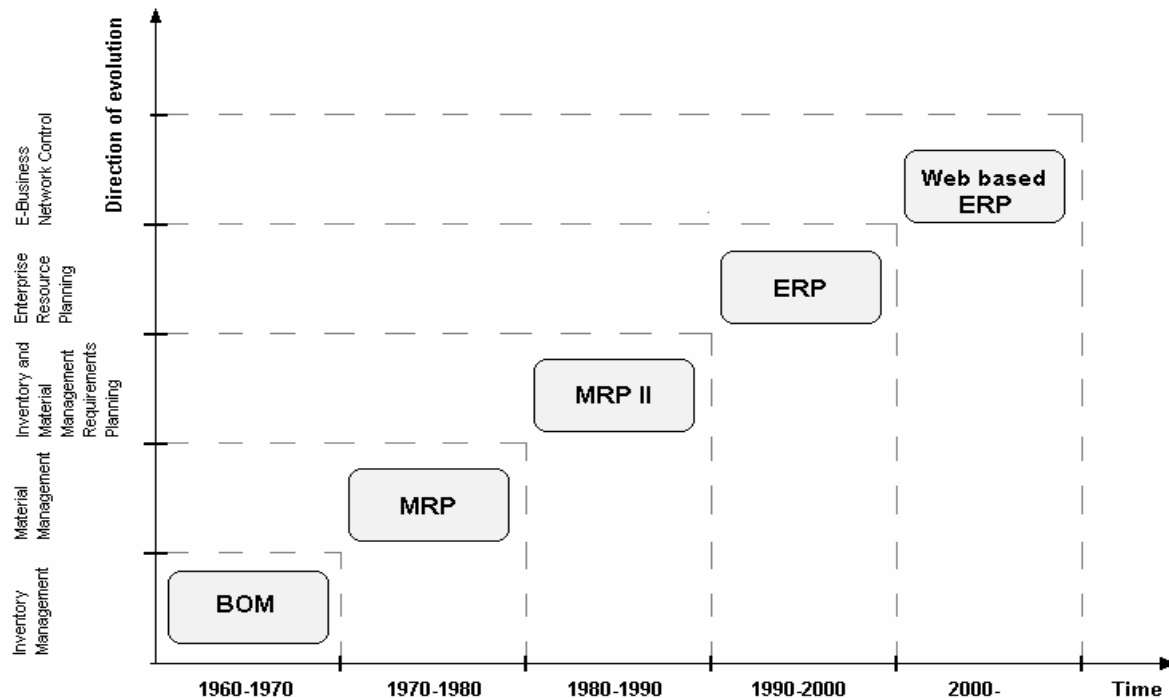
- Planning system interface
- Work order Management
- Workstation management
- Material movement management
- Data collection
- Exception management
- Inventory/materials.

The same author describes support functions as open systems and simultaneously gives a picture of which other functions the MES should include:

- Maintenance management
- Time and attendance
- Statistical Process Control
- Quality assurance
- Process data/performance analysis
- Documentation/product data management
- Genealogy/product trace-ability
- Supplier management

Alike quantity of core and support functions along with some identical components are identified in other concepts (Kisiel, 2001) that are depicted in Figure 2.

MESA International presents another attitude to MES functionalities that is more-or-less based on the assumption of profitability to begin to deal with wider model of basic elements to ensure incorporating all-important func-

tions into MES (MESA 2,1997). Accordingly, MES would include functionalities such as:

1. Resource Allocation and Status
2. Operations/Details Scheduling
3. Dispatching production Units
4. Document Control
5. Data Collection/Acquisition
6. Labor management
7. Quality Management
8. Process Management
9. Maintenance Management
10. Product Tracking and Genealogy
11. Performance Analysis

A point of debate about MES functionalities also is connected with different types of manufacturing. Commonly, manufacturing can be divided into three types (Grover, 1987):

- Job Shop Production. The manufacturing lot sizes are small, often one of a kind.
- Batch Production. This category involves the manufacture of medium-sized lots of the same item of product. This type is called also discrete manufacturing.
- Mass Production. This is the continuous specialized manufacture of identical products.

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