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Productivity Enhancement by Digital Manufacturing

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Abstract*—Digital manufacturing has been considered, over the last decade, as a highly promising set of technologies for reducing product development times and cost as well as for addressing the need for customization, increased product quality, and faster response to the market by integrating various areas of the business functions. This paper describes the information technology systems in manufacturing and employment of Digital Manufacturing methodologies with the aim of improving the flexibility and the efficiency of the organization.*

Keywords—Digital Manufacturing, Information technology, CAD, CAM.

I. INTRODUCTION

Improved productivity is anessential goal in any aspect of an enterprise, particularly under overwrought economic conditions. It is a goal that takes on considerably more weight in manufacturing planning processes. Waste and interruptions here can have direct consequences on a company's productivity that affects many things including the ability to meet targeted product launches. Many companies find that their ability to achieve this goal is hampered by obstacles resulting from limited facility resources and variations in employee knowledge and skill, among other issues.

The need for reduced development time together with the growing demand for more customer-oriented product variants have led to the next generation of information technology (IT) systems in manufacturing. Manufacturing organizations attempt to integrate their business functions and departments with new systems in an enterprise database, following a unified enterprise view. These systems are based on the digital factory/manufacturing concept, according to which production data management systems and simulation technologies are jointly used for optimizing manufacturing before starting the production and supporting the ramp-up phases. Digital manufacturing would allow for, first, the shortening of development time and cost, second, the integration of knowledge coming from different manufacturing processes and departments, third, the decentralized manufacturing of the increasing variety of parts and products in numerous production sites, and, fourth, the focusing of manufacturing organizations on their core capabilities, working efficiently with other companies and suppliers, on the basis of effective IT-based cooperative engineering.

II. ROLE OF IT IN MANUFACTURING

Over the past few decades, the extensive use of IT in manufacturing has allowed these technologies to reach the stage of maturity. The benefits of the new tools have been thoroughly examined and their competence in many applicationshas been recognized. Their application ranges from simple machining applications, to manufacturing planning and control support. applying manufacturing tools for enhancing productivity of the company.An example of the introduction of IT, in the manufacturing world, is the concept of computer-integrated manufacturing (CIM). This concept was introduced in the late 1980s, favoring the enhancement of performance, efficiency, operational flexibility, product quality, responsive behavior tomarket differentiations, and time to market. The inventory control and material requirements planning (MRP) systems were introduced in the 1960s and 1970s respectively. Such systems were further improved withintegration of tools capable of providing capacity and sales planning functionalities together with scheduling capabilities and forecasting tools. The result was the introduction of the closed-loop- MRP. The evolution of information systems over the last decade has played a vital role in the adoption of new information technologies in the environment of manufacturing systems.

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2.1 COMPUTER AIDED TECHNOLOGIES

CAD is considered among the technologies that have boosted productivity, allowing faster time to market for the product and dramatically reducing the time required for product development. The CAD systems have become essential to today's manufacturing firms, because of their strong integration with advanced manufacturing techniques. CAD models are often considered sufficient for the production of the parts, since they can be used for producing the code required to drive the machines for the production of the part. Rapid prototyping is an example of such a technology.

Process planning activities determine the necessary manufacturing processes, their sequence in order to produce a given part economically, and competitively. Towards this direction, the computer aided process planning (CAPP) systems have been used for the generation of consistent process plans and are considered as being essential components of the CIM environments. Computer-aided engineering (CAE) systems are used to reduce the level of hardware prototyping during product development and to improve the understanding of the system. Following the development of the CAD systems, the concept of computer-aided manufacturing (CAM) was born. The great step towards the implementation of CAM systems was the introduction of computer numerical control (CNC). Apart from the fact that this new technology has brought about a revolution in manufacturing systems by enabling mass production and greater flexibility, it has also enabled the direct link between the three-dimensional (3D) CAD model and its production. From that point on, CAD and CAM systems have been developed allowing for part design and production simulation. Engineers have the ability to visualize both the part and the production process, to verify thequality of the product and then physically to perform the manufacturing process with minimum error probability. Other systems, such as computer-aided quality systems, have also started to emerge and to become part of the engineering workflow. Product data management (PDM) and product life-cycle management (PLM) systems, on the other hand, allow for performing a variety of data management tasks, including vaulting workflow, life-cycle, product structure, and view and change management. PDM systems are claimed to be able to integrate and manage all applications, information, and processes that define a product, from design to manufacture to end-user support. PDM systems are frequently used for controlling information, files, documents, and work processes and are required to design, build, support, distribute, and maintain products. Typical product-related information includes geometry, engineering drawings, project plans, part files, assembly diagrams, product specifications, numerical control machine-tool programs, analysis results, correspondence, bill of material, and engineering change orders. Digital manufacturing has arrived as a technology and discipline within PLM that provides a comprehensive approach for the development, implementation, and validation of all elements of the manufacturing process, which is foreseen by researchers and engineers to be one of the primary competitive differentiators for manufacturers.

2.2 MANUFACTURING CONTROL

Integration of control systems with CAD and CAM and scheduling systems as well as real-time control, based on the distributed networking between sensors and control devices currently constitute key research topics. New developments in the use of wireless technologies on the shop floor, such as radiofrequency identification (RFID), as a part of automated identification systems, involve retrieving the identity of objects and monitoring items moving through the manufacturing supply chain, which enable accurate and timely identification information.

2.3 ENTERPRISE RESOURCE PLANNING

Enterprise resource planning (ERP) systems attempt to integrate all data and processes of an organization into a unified system. A typical ERP system will use multiple components of computer software and hardware to achieve the integration. A key ingredient of most ERP systems is the use of a unified database to store data for the various system modules. ERP has been associated with quite a broad spectrum of definitions and applications over the last decades. The ERP systems often incorporate optimization capabilities for cost and time savings virtually from every manufacturing process.

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III. DIGITAL MANUFACTURING IN INDIAN INDUSTRIES

Digital manufacturing is an IT-enabled solution that has been improving the productivity and efficiency of the Indian manufacturers, especially the automotive players. Indian manufacturers such as Tata Motors use this technique to achieve savings on time and cost of at least 20–30 per cent in most of the cases. Most manufacturers still rely on traditional and outdated models of planning. By migrating to advanced planning systems, and using digital technologies, they can gain greater visibility into their manufacturing operations.However, most of the design sector is widely using various design and simulation software so as to design the product with ease and in less amount of time. This data is integrated with the system such that various departments in real time can use it.The last few years have seen SME's recognizing technology as a key business driver, but its adoption is still low, as compared to other countries with large SME setups. This is due to a combination of the following:

- Lack of understanding of business benefits technology can deliver across end-to-end value chains.
- Lack of guidance on the inherent abilities of technologies and how these can be integrated and institutionalized in their businesses.
- Resistance to incurring upfront investment-related costs to implement technology.
- Lack of skilled labor to manage technology setups.

IV. CONCLUSION

Digitizing is now a priority for most CEOs of industrial companies in India. It is still in its initial phase for most of the SMEs, which is limited to implementing ERP system. By digitizing the essential functions within internal operational processes both revenuegrowth and operational efficiencies can be achieved.

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