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Expanding Dimensions of Computer Technology in Manufacturing and Service Sector

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Abstract: Traditional machining process planning, which passes manufacturing information through 2D drawing, fails to meet the requirement of current 3D manufacturing environment. Thus, model based definition technology, which uses 3D technology to upgrade the current manufacturing capacity, comes into being. The aim of this research paper is to show new trends and options for the use of Computer Technology (CT) in industry; Link or integrate different technology fields in the broad area of computer-applications for industry; Link or integrate different application areas of Computer Technology in industry. The unique application of Computer Technology in business processes such as design, engineering, manufacturing, purchasing, physical distribution, production management and supply chain management has been discussed in the research. The industrial use of Computer Technology in knowledge intensive fields such as quality control, logistics, engineering data management, and product documentation has to be considered. Demonstration of enabling capabilities of new or existing technologies such as hard real time systems, knowledge engineering, applied fuzzy logic, collaborative work systems, and intelligence agents are also welcomed by current 3D manufacturing environment.

Keywords: Computer Aided Design (CAD), Computer Integrated Manufacturing (CIM), Computer Aided Manufacturing (CAM), Advanced Manufacturing Technologies (AMT), Computer Integrated Construction (CIC)

I. Computer Technology Applications

Computers are playing an increasingly important role in our lives. Keeping pace with the application of the latest technology is a challenge for all of us. In the manufacturing in general, computers are being put to use designing products, processing and managing the operations and resources of a processing plant. A manufacturer needs to keep up with the latest technology to remain competitive.

Computer-based systems in manufacturing are known as CAD, CAM, MRPII, and CIM. APICS, the American Production and Inventory Control Society defines the acronyms representing the various computer-based systems as follows:

CAD (Computer-Aided Design): The use of computers in interactive engineering drawing and storage of designs. Programs complete the layout, geometric transformations, projections, rotations, magnifications and interval (cross-section) views of a part and its relationship with other parts.

CAM (Computer- Aided Manufacturing): Use of computers to program, direct and control production equipment in the fabrication of manufactured items.

MRPII (Manufacturing Resource Planning): A method for the effective planning of all resources of a manufacturing company.

CIM (Computer-Integrated Manufacturing): The integration of the total manufacturing organization through the use of computer systems and managerial philosophies that improve the organization's effectiveness; the application of a computer to bridge various computerized systems and connect them into a coherent, integrated whole. For example, budgets, CAD/CAM, process controls, groups' technology systems, MRPII, financial reporting systems, etc., are linked and interfaced.

II. Various computer applications in Industrial Manufacturing

With the developments in commercially available computer technology, the application of computers in manufacturing started to emerge by producing a variety of new technologies.

- Use of computer at various management levels in Industry.
- Use of spread sheets to calculate, Present and Analyze engineering data.
- Use of different Statistical methods to analyze engineering data.
- Use of Minitab (TM) software.
- Use of different mathematical techniques to solve engineering problems.
- Use of Mat Lab (TM) software.

A. CAD/CAM

CAD is the contraction which stands for Computer Aided Design and CAM is the Computer Aided Manufacturing. This term means different things to different people involved in designing, manufacturing and mechanical engineering. CAD or Computer Aided Design has brought a revolution in the Textile industry. The time consuming and cumbersome process of textile designing has been made easier by CAD. Now thought-full and innovative designs are available to the textile designers and textile manufacturers at the click of a mouse.

B. Application of computer technologies in Textile Industry

The textile designs are the original works of the designers. CAD helps them to visualize and see their imaginative design in final form without producing any sample swatch. Sometimes, the customers too provide ideas for designing according to their particular requirement. These are in the form of painted artwork or fabric samples and sometimes film negatives. The textile designers, with the help of CAD, convert them into workable designs. For this, the sample is scanned with the help of either scanners or digital cameras and then they are edited to obtain the final design.

Computer systems used to design and manufacture products. The term CAD/CAM implies that an engineer can use the system both for designing a product and for controlling manufacturing processes. CAD is a broad term used to represent use of computer in designing. CAM is a term that denotes the computerized control of manufacturing process. Almost all industry sectors are using CAD in their designing departments. CAD can help to draw textile designs for the textile industry.

We should not confuse CAD only with drawings. CAD covers many aspects of designing like design calculations, data analysis and simulations. Commonly used softwares for CAD are AUTO CAD, MSVISIO, and Smart Draw etc.

C. Application of computer technologies in Food Industry

The food industry is facing increasing global competition and consumer demands. These require new technologies and practices for competitive advantages in the market. The needs for increased automation in the food industry is due to the elimination of extremely repetitive and monotonous tasks, which resulted in repetitive strain injury to workers, better quality control, needed because of consumer sophistication, regulatory labeling requirements, and narrow quality boundaries, the elimination of off-line quality control due to the need for more rapid correction of deviations from process and quality standards/specifications, and the detection of foreign and contaminant material in food. CIM (Computer Integrated Manufacturing) is the term used to describe the total automation of a manufacturing system under the control of computer and digital information. CIM involves all of the functions in the organization related to production including design, engineering, manufacturing, production scheduling, inventory control, quality control, maintenance scheduling, materials handling, order processing, and finance and accounting. CIM systems are supported by a network of computer systems tied together by a single set of integrated databases. This integration facilitates the communication between different areas as well as the sharing of manufacturing information data.

D. Application of computer technologies in Construction Industry

The problems of construction are well-known. Construction productivity lags that of manufacturing. Occupational safety is notoriously worse than in other industries. Due to inferior working conditions, there are work force shortages in many countries' construction sector. The quality of construction is considered to be insufficient. A number of solutions or visions have been offered to relieve the chronic problems in construction. Industrialization (i.e. prefabrication and modularization) has for a long time been viewed as one direction of progress. Currently, computer integrated construction is seen as an important way to reduce fragmentation in construction, which is considered to be a major cause of existing problems. The vision of robotized and automated construction, closely associated with computer integrated construction, is another solution promoted by researchers. New concepts emerge and the content of old concepts changes. The same concept is used to refer to a phenomenon on several levels of abstraction. It is not clear where to place the boundaries between related concepts. Just In Time (JIT), Total Quality Control (TQC) and Total Productive Maintenance (TPM) are main concepts used in production.

In recent years, computer integration has become a major development target in construction. The basic idea in the pursuit of computer integrated construction (CIC) is to facilitate communication of data, knowledge and design solutions between project participants.

E. Application of computer technologies in Steel Industry

Steel is one of the basic building blocks of the modern world. Automobiles, appliances, bridges, oil pipelines, and buildings, all are made with steel. While steel manufacturing has existed for centuries, the process for making steel continues to evolve. To achieve the productivity improvements as well as product improvements, steel mills employ some of the most sophisticated technology available. Computers have been essential to many of these advancements, from production scheduling and machine control to metallurgical analysis. For workers, modernization of integrated, EAF, and finishing mills often has meant learning new skills to operate sophisticated equipment.

The steel industry pioneered the use of computers for process control. By the mid-1960's, almost a fifth of the world's process control computers were installed in the steel industry.

F. Application of computer technologies in Pharmaceutical Industry

One of the key challenges facing pharmaceutical companies is to reduce the time to market and cost of goods of their products whilst continuing to comply and exceed stringent regulatory conditions. Application of Computer Aided Design technologies has created a milestone in the way of reducing these challenges for pharmaceutical and chemical industries. Various application of technology in pharmaceutical industry can be listed as following:

- Computers in drug discovery
- Computers in pre-clinical development
- Computers in development decision making, economics and market analysis
- Computers in clinical development

G. Application of computer technologies in Nuclear Industry

The computer is ideally suited for rapid and early detection of abnormal plant conditions, faulty sensors, and malfunctioning equipment. By proper programming, the computer can either alert the operator or initiate corrective action in sufficient time to prevent or minimize equipment failure and plant outages. By performing essentially continuous calibration and checks of instrumentation, the operating limit uncertainties can be reduced with a consequential increase in the plant capacity. This is a particularly important advantage for nuclear plants which must adhere to technical specifications that impose power and other limits which are verified by instrumentation.

H. Benefits of Implementing New Computer Applications in Manufacturing Process

The major advantage of computers over simple hard-wired hardware lies in their general purpose nature, derived from their programmability. This allows much of the specific functionality in a particular application to be implemented in software and thus avoid some of the unreliability due to physical component failures that would be incurred if it were implemented purely in electro-mechanical hardware.

A number of techniques for flow process design and improvement have evolved. Through application of these techniques, the efficiency of flow processes can be significantly and rapidly improved.

- Reduce the share of non-value adding activities
- Increase output value through systematic consideration of customer requirements
- Reduce variability
- Reduce the cycle time
- Simplify by minimizing the number of steps and parts
- Increase output flexibility
- Increase process transparency
- Focus control on the complete process
- Build continuous improvement into the process
- Balance flow improvement with conversion improvement

III. Problems in Implementation of New Technology

The very advantages of software-based systems, however, bring some special problems of difficulty, novelty and complexity. Designers tend to take on tasks that are intrinsically difficult as a result of the very flexibility of software: when a computer system is introduced into a context where a conventional hardware solution already exists, it is commonplace to take advantage of this flexibility to offer extra (sometimes excessive) functionality. In more and more applications, however, there is no hardware system that the computer is replacing: instead, the great flexibility of software is being used to do something completely novel. These trends result in great complexity in the end product, with the attendant problems of human comprehension.

These problems cause difficulties both in building software-based systems that are sufficiently reliable, and in assuring that reliability so that justifiable confidence can be placed in the system's fitness for purpose.

Many applications of advanced manufacturing technologies (AMT) have not yielded their potential benefits frequently because the implementation has not been carried out in relation to strategic objectives. Maximum benefit will accrue if there is a fit between the capabilities of the technologies and the firm's business and manufacturing priorities.

Majority of benefits do not come from the technology of AMT but from non-AMT factors, (organizational changes, training, changed marketing and product strategy etc.) which are required to support it. Hence, these benefits cannot be separated to take into account individually for AMT and non-AMT factors. It is therefore, desirable to treat them together, considering the investment in both AMT and non-AMT factors

V. Conclusion

The foundation of the new production philosophy is that there are two kinds of phenomena in all production systems: conversions and flows. In the design, control and improvement of production systems, both aspects

have to be considered. Even if there are numerous examples of successful implementation of the new philosophy, there also are examples of failures and false starts. After all, the majority of companies has not yet launched full scale efforts for adopting these ideas. There are emotional and conceptual barriers for implementation. Ashton & al. (1990) argue that many managers derive their perceived knowledge from their position in the organization and they fear that their actual lack of knowledge would be exposed. Conceptual barriers are related to the difficulty of abandoning the conventional assumptions concerning organizing, controlling, etc. Management commitment and leadership is needed to realize this fundamental shift. Management must understand and internalize the need of new technology. It must create an environment which is conducive to change.

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