EFFECTIVE MANAGEMENT OF COMPUTER-AIDED DESIGN AND COMPUTER - AIDED MANUFACTURING (CAD/CAM) SYSTEMS

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ABSTRACT

The use of Computer-Aided Design & Computered - Aided Manufacturing (CAD/CAM) systems has been and is increasingly a governing factor in productivity improvement from small companies to multinational corporations. There is a growing application of this systems in industries here in Tanzania as well. In order to realise increased productivity, CAD/CAM systems must be established on a firm foundation and must be managed effectively. This paper outlines what should Tanzanians industries do in order to effectively implement or manage CAD/CAM systems.

INTRODUCTION

Industrial organizations remain under constant pressure to increase productivity in order to maintain or gain a competetive advantage in their respective markets. Companies which are slow in reducing the cost of production will almost certainly have difficulties maintaining a competetive position.

Efforts to increase productivity through optimization of existing systems have in many cases reached the point of diminishing returns. Companies are looking for more than the small increments in efficiency that occur when traditional productivity systems are optimized. Implementation of Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) strategy has been adopted by industries in general as the most realistic and rewarding path to increased productivity[1].

Industries have realised that to get out of the crust of low productivity they certainly have to improve their traditional productivity systems through adaptation of CAD/CAM systems. However, to produce reliable

multifunctional products with improved methods and increased productivity, CAD/CAM systems have to be established on a firm foundation and managed effectively. It should be understood that CAD/CAM systems will not increase productivity automatically. CAD increases productivity of design departments only in case of frequent adaptions of one standard design to special needs.

By definition, CAD is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAM can be defined as the use of computer systems to plan, manage, and control operations of a manufacturing plant through either direct or indirect computer interface with the plant's production resources[2]. CAD is a tool, and only as good as the people who use it. The objective in automating the design process with CAD is to create engineering drawings that are useful but not redundant[3].

The real power of CAD as a design tool is however larger than simply speeding up the design cycle. CAD also has a built-in ability to integrate all the tasks related to the entire design and manufacturing processes. The efficancy of the system, however, depends on HOW it is managed[4]. Through proper management, designers will be able to find existing drawings that will fit the need of their current projects. In this way, design retrieval functions are streamlined and costs are further reduced.

In Tanzania very few industries or companies, like D.M. Investment Co. Ltd of Mwanza, TEMDO of Arusha, and TATC (Nyumbu) of Kibaha have adopted this technology; and those few ones have managed to implement only the CAD system.

In this paper, the authors outline what should companies/industries do in order to effectively implement or manage CAD/CAM systems.

TECHNICAL ASPECTS

Technical aspects can be grouped into five categories: technical documentation, operations, acquisition of hardware and software, training, and personal workstations.

Technical Documentation

In order for the CAD/CAM system users to maximize their productivity improvements and extend the benefits of CAD/CAM technology, they must establish a comprehensive database; a process that normally requires large scale transfer of existing drawings to their CAD/CAM systems[5].

CAD/CAM system can store this information easily, and can associate related documentation more efficiently than can be done off-line. Design work, by the time the documentation is completed, is largely finished. Production department is then asked to fabricate the part based on information provided by the designer. Good communication between the design and production departments is crucial to making the physical part. The transfer of information from one department to the other must be clear and thorough.

With a single up-to-date database to draw from, the manufacturing department has a perfect source of information available, and the communication problems of old become moot. When CAD/CAM installation is properly implemented, the design and manufacturing departments exist together in a single database. The manufacturing department is free to use the information to create tapes for its NC-machines or for its manufacturing robots[6]. In this way, the design data are applied to the manufacturing tasks directly. The result is faster manufacturing turnaround and much less room for error.

Operations

In order to ensure that the system operates smoothly the following points should be considered[7]:

i) Error recovery: Backups are an essential part of protecting and maintaining the integrity of the database.

ii) Maintenance: All equipment will need to be maintained, usually by the manufacturer under a service contract.

iii) Security: Most systems should have a log-on ID and password

protection to give controlled access to the database.

iv) Database structure: Working files should be kept separated from approved or released files if the system will allow. Demonstration files as well as training files should also be kept away from the working area of the database.

v) Monitoring performance: The operational performance, as well as cost or financial performance, of the whole facility must be measured and monitored.

Acquisition of Hardware and Software

Both hardware and software are critical to good productivity. The hardware should have a combination of interactive capability (for development) and batch processing (for production). Its capacity must be sufficient to handle projected volumes of work and expected increases. However, it is not economically justifiable to purchase a complex hardware to meet just less demanding drawings.

Software should largely be device and machine independent. It must be compatible with existing corporate applications (if any), and must be flexible and capable of growth to meet future needs. Programmer support level required to develop and maintain the software should not be excessive.

The system must be user-friendly, i.e. more than having polite error messages, all the standard operations a user is likely to encounter should be easy to conduct. Most CAD systems are justified on their modelling capabilities rather than on drafting. Companies should look forward to automating such tasks as numerical control, finite element analysis, robotics, mass property calculations, interference studies, and circuit simulation. These applications, along with the ability to automatically extract accurate information from the model, produce the CAD/CAM payback[7].

Training

Difficult-to-operate CAD/CAM systems require lengthy and specialized training. This can be avoided by providing system that are easy to learn and easy to use. These userfriendly systems will provide not only more immediate productivity, but also will encourage existing users to take full advantage of their system. Once system fundamentals are mastered, designers can begin to use the additional application packages and advanced CAD/CAM features that add new design and analysis capabilities.

Personal Workstations

Personal workstations offer significant advantages over the time-shared central computing facility. Among these advantages are availability, consistency of response, portability, and the ability to dedicate significant resources to a single task without affecting other users[8]. Workstations can be connected to a large central computer (mainframe) for database management or for complex computational tasks. The end result will be an invironmment that enhances individual user effectiveness and improve the overall productivity of an organization.

ECONOMIC ASPECTS

Economic aspects can be classifed into product quality, work-order form, and product planning and control.

Product Quality

Most companies still implement CAD/CAM technology as if the primary goal were to reduce engineering costs rather than to improve product value and competitiveness. However, one should understand that even if drafting costs were eliminated, the product would not necessary peform any better. CAD/CAM systems can have an impact on design quality but only if they are implemented with a clear set of strategic design objectives. The emphasis on producing more drawings in less time rewards the wrong objectives. Hence, other strategies such as concentration of sales or marketing resources, etc, should also be

examined.

Work-Order form

While changes are usually faster using a graphics system, they can also cause a project to go over budget if engineers request more changes than they would otherwise make when manually working on the drawing board. Therefore, when jobs are submitted to graphics, a work-order should also be included with an estimte of the computer hours required. This way it will restrict designers from making unnecessary changes.

Product Planning and Control

We know that the interface between manufacturing systems and CAD/CAM is important to gain full benefits of CAD/CAM, however, without valid schedules we might have the best design product in the world but have difficulty building it. Thus, for the system to work effectively, CAD/CAM should be integrated with Material Requirement Planning, Financial Planning, and Market place simulation[9]. This will eliminate the frustration of creating plans that are not executed as conceived due to, for example, of long-lead parts that are not placed in time. Engineering changes can be effectively implemented, and part obsolescence can be minimized.

SOCIAL ASPECTS

Social aspects, i.e. labour relations are important in the effective use of CAD/CAM system[10]. They include management's responsibility and commitment, employee- management relationship, personnel hiring and training, and how the working environment affects an employee's performance (ergonomics).

Management Responsibility

The foundation for integrated CAD/CAM systems requires a broad base for implementation coupled with the direction and support of top-level management. The strategic implementation plan for a company must recognize the fact that any attempt to improve productivity encompasses

the entire organization and all of its systems and procedures. Management committment and bottom-up readiness are required to meet each goal, near term and distance future[10].

Employee-Management Relationship

Definitely there should be a friendly user-management relationship for better system's productivity and development. Treating people like mushrooms may produce good mushrooms! There is nothing quite as rewarding than for the user to feel as part of the system and its development. Better relationship can be enhanced through better communication, meetings, bi-directional information flow, performance appraisal, etc.

Personnel Hiring and Training

Effective use of CAD/CAM technology requires that managers and operators have skills and training specific to CAD/CAM or to its application. By and large, they should be dedicated to their job. Training is essential for both, new as well as existing users, and should not only be for operative personnel alone but also management as well. It is well known that, by virtue of their position, top-level management are always reluctant to share the same class with their subordinates. So, to avoid such inconveniences, they should be separated and their courses should be biased towards system management than technical issues.

Ergonomics

The term ergonomics is often applied more specifically to the study of effectively fitting production equipment to the physical and behavioral characteristics of workers. The importance of ergonomic considertions can not be overstated. They figure prominently in overall worker's performance. Job performance is a direct function of individual behavior, and behavior is dependent upon individual ability and level of effort. However, no amount of ability or effort can overcome the physical and psychological barriers, created by an inhospitable working environment. That is to say if the worker's working environment consists primarily of a computer workstation, then that workstation had better be suited to

meet the operator's physical and psychological needs.

Ergonomics extend not just to the worker's physical attributes and limitations, but also to his intellectual capabilities. Thus, system design features also influence operator's performance. In fact, any features of a CAD/CAM system that are poorly designed, such as screen arrays, prompts, or menu functions, can be as hindering to the operator's mind as an uncomfortable chair can be to his body. Another limitation facing operators is the inability to recall without error such crucial information as filenames, passwords, command syntax, etc. Here again the system can make up for this through the use of on-line record keeping and automatic reminders. These notes will help users to remember what files are where, what processing transpired during the previous day, week, or month, and what remains to be done on a specific project or set of projects.

CONCLUSION

We have arqued that top-management commitment and guidance are essential to the best use of CAD/CAM technologies, and that the success of an integrated CAD/CAM system is heavily dependent on management support. In addition, management should ensure that workers are highly motivated through the use of proper motivation methods such as bonus, fringe benefits, incentive schemes, etc, so that they become dedicated and committed to the system. Working environment should be improved, user-friendly systems with good design features employed, and training should be emphasized. Moreover, effective management of CAD/CAM systems requires good product quality control, product planning and control, capacity planning, inventory control, and proper master schedudes, so that the company's resources are fully utilised. Furthemore, personal workstations are recommended though the use of a mainframe computer with intelligent terminals can also make a good CAD/CAM system. Nevertheless, there should be a comprehensive database management, on-line data storage, multidisk operation, backups, log-on ID and pass word protection, maintenance of all equipments, monitoring performance, good hardware and software which are user-friendly and tailored for company's use.

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