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PRODUCTIVITY & QUALITY IMPROVEMENTS BY USING COMPUTER INTEGRATED MANUFACTURING (CIM) IN DIE MANUFACTURING INDUSTRY

Vinayak P. Bavchikar*, Prof. P.N.Gore

* PG Student, Department of Mechanical Engg.,DKTE'S Textile & Engg. Institute, Ichalkaranji, India
Associate Professor, Department of Mechanical Engg.,DKTE'S Textile & Engg. Institute, Ichalkaranji, 416115 India

ABSTRACT

In competitive environment of quick market changes, developing an interoperable manufacturing system is a necessity. To realize interoperability, the exchange of part and product data must be independent of their platforms. Conventional manufacturing process in die manufacturing industry has limitation on productivity, quality and integration of various activities. This paper focuses on CAD-CAM-CAPP integration concurrent engineering and standardization implementation to ensure the high productivity and quality in a small-scale die manufacturing industry. Any Die manufacturing unit is designed to benefit from integration of various activities. It is necessary to build system that integrates all the departments of production system by computerized information system, which focuses on exchange of part, product and process data.

CIM co-ordinates all relevant activities associated with both the product and its manufacturing automatically. In general, CIM offers to integrate separate applications, such as computer-aided design (CAD), computer-aided-process-planning (CAPP), computer-aided manufacturing (CAM)

KEYWORDS: CAD, CAM, CIM, computerized information system, integration, cycle time reduction.

INTRODUCTION

Computer integrated manufacturing covers the entire range of product development and manufacturing activity with all the functions being carried out with help of dedicated software packages. The data required for various functions are passed from one application software to another in a seamless manner [12]. In most manufacturing organizations, design and manufacture are separate areas and information has to be passed across the boundaries. Traditional methods of data exchange via paper often result in duplication of data, the occurrence of errors, time delays and more generally lack of organizational and occupational flexibility. The emerging integrated systems are potentially a means of integration of design and manufacture and other functions within the organization via software in real time. The purpose of a computer integrated manufacturing system is to transform product design and materials into saleable goods at a minimum cost in the shortest possible period. CIM builds on the premise that management should work to optimize the whole business process rather than individual functions. Integrating CAD,CAM and CAPP not only plays a key role in achieving digital manufacturing and computer integrated manufacturing, but also is vital to the competitiveness of mechanical manufacturing enterprises and their ability to respond rapidly to market changes, and one of the most critical links for the integration is the link between design, process planning and manufacturing activities.

In the conventional manufacturing process die, industry faces the problem of production delay, poor quality and not achieving the set targets. This is because of not implementing proper processes and use of old machines, processes and lack of data integration. In addition, the shop floor employee cannot implement the process plan as per planned because of the limitation of bottleneck. Use of CNC, CAD-CAM, CAPP, data integration software will help the organization to overcome these problems. This paper helps the organization to keep up-to-date record related to

design, process planning and manufacturing of the system and to place the required information at one place so that while extracting data it should be easy to extract as well as to upload.

This paper is focused on the concept like con-current engineering implementation in small-scale industry. First part of this paper includes conventional process i.e. the system presently works in small-scale manufacturing industry and error identification in current process, next part includes the proposed system i.e. eliminating loopholes in the current system.

PRESENT THEORIES AND PRACTICES

The conventional product development process shown in fig.1 is a sequential process. It includes product design, development of manufacturing process and supporting quality and testing activities, all carried one after another.

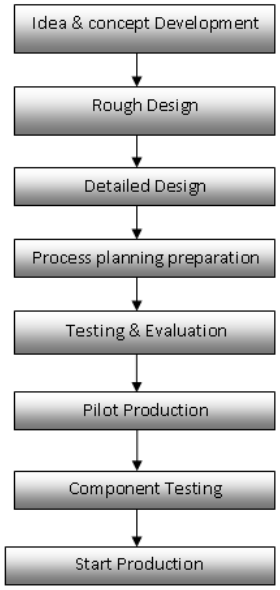

Fig. 1 Conventional Product Development Process

The design department completes the design task and passes the data to planning, which in turn passes the information to manufacturing and so on. If any downstream department wants to introduce any change, the process has to backtrack. The design often the need for engineering changes is identified during planning, manufacturing, or assembly. These changes are however to be incorporated in design. This often involves additional expenditure as well as inevitable delay in realizing the product, time taken to product development is large and the response to the market requirements will be slow [10].

In current system, components are manufactured on the conventional machines. Drawings of the components are in 2D format. Complicated component shapes are manufactured on the CNC machines using manual programming. There is absence of using CAD/CAM, simulation technology. There is lack of implementing process planning. Shop floor employee decide their own path of manufacturing sequence hence component manufacturing time increases. Quality checking at each stage of process is not done. Quality is checked after final product hence component rejection rate is very high. The documentation such as drawings, QAP, process planning, assembly drawings are not kept at centralized location. There is lot of time waste in searching the documents. Sometimes drawing /document revision is not properly communicated to the each section hence possibility of work on the old revision drawing which results in rework, rejection, increased production time etc. At each step if any problem arises people manages the problem according to their knowledge & experience. Due this system tends to force the people to work in isolation.

As shown in following schematic diagram fig.2. In this system concurrent engineering concept is not implemented There is lack of communication, co-ordination between each section such as design, process planning and manufacturing any suggestion, improvements new concept cannot be communicated at initial stage feedback is given at later stage, which results in waste of time, rework etc. In previous days the method used for process planning and die design are costly due to some reasons. Initially the process planning is done when the final product design received from the product designer and after that tool is designed, die construction is made and finally tool is shifted for tri-out this is what conventional method of die design for a particular product. If everything goes well then the die is sent for production. On the other hand, if tryout fails and part showing undesirable results then development team goes for die reworking and if problem not solved after die rework, new die design or new process planning is required, in some cases product design is also changed and in all this activities the lead time go on increasing as well as cost and time. All this happens because problem observed at the last stage of the development. [1]

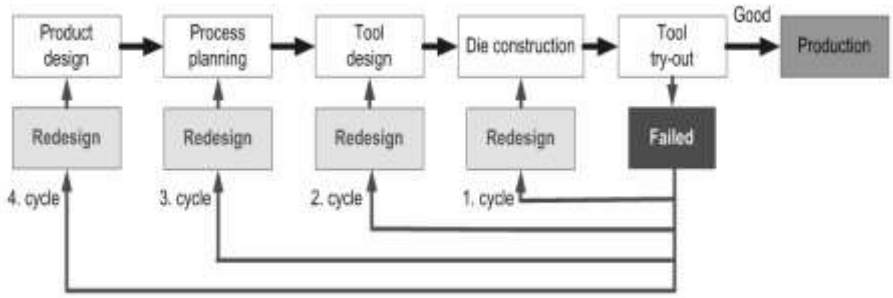

Fig.2: Work flow in current system

PROBLEM IDENTIFICATION IN EXISTING PROCESS

A. Not implementing the process planning properly

Proper process planning gives reduced lead-time & economical way of manufacturing of the dies. However due to lack of planning shop floor people not follow the process plan properly resulting in increased lead time.

B. Working in isolation

This problem occurs due to absence of total management system. Person from design department not know what exactly going on in production department. The operator makes certain changes in production if he faces some problem regarding manufacturing. The lack of knowledge of CIM system is also one of the causes behind this reason. Also, this problem is one of the reasons of producing poor quality product. For example, design department has not known the complication faced by manufacturing department and process-planning department has no need to understand the importance of design features implemented by design department. When the actual manufacturing is going on if any issue occurs on production floor the operator make changes in design or in process plan as per his knowledge and finishes the operation. In all this process, there is possibility of losing key features of object or production of errors i.e. poor quality product. This happens in small-scale die manufacturing industries where current methodology is adopted which forces people to work in isolation.[6]

C. Lack of standardization

In this process standardization of component are not done. Most of the parts are made in house which are readily available in the market. Making the component in house is costly & consumes more time.

D. Lack of Systematic approach

It is observed that most of the attention and capital investments are being done in manufacturing and very low attention paid to design and process planning phase, if more attention paid to primary design, product design & process planning phase then it will greatly reduce time & cost of the manufacturing phase.

E. Use of conventional machines

The conversion of Design into a manufactured component or assembly by conventional methods consumes time and effort not favorable to the strict time-lines with a high rate of obsolescence. The strict time lines and poor machining ability causes to produce poor quality product. The high degree of freedom in the processing of manufacturing orders requires various tools to meet the production requirement this is very difficult and sometimes not possible with the conventional machines.

F. Communication gap

Improper design consideration because of neglecting or not understanding the production floor issues this problem occurs because of improper means of communication between design & production department or there is lack of information regarding required product reflects on increased errors of product.

PROPOSED SYSTEM

In the proposed system use of CNC machines, CAD-CAM will improve the quality and productivity instead of conventional machines and manual programming. CAD helps in getting the analytical results very quickly. This will enable the designer to evaluate more than one design alternatives, which would otherwise not be possible. Also optimum design solutions can be obtained by using sophisticated programs. This will result in significant savings in unit costs, improved information access and manufacturing data creation. Creation of programs through CAM software packages is a significant development. This method eliminated the drudgery involved in writing large programs. Errors are reduced and thereby wastage is avoided. Proper process planning implementation will reduce the production time & improve the quality of the product. Make the list of standard components available in the market and take the decision of make or buy.[11]

As shown in following schematic diagram fig.3 Efficient use of simulation techniques from the earliest stage of product development, to give feedback from each step to make the necessary corrections and improvement when it takes the least cost. With this technique product, defects may be minimized and even eliminated before the real die construction stage. If any correction or redesign is needed, it can be done immediately, with a very short feedback time, thus it leads to a much smoother die tryout if necessary at all and to significantly shorter lead times with less development costs.[1]

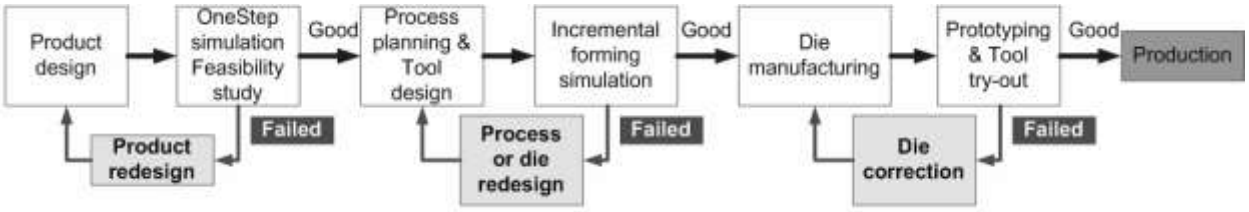

Fig.3 Workflow in simulation based process planning and die design

The challenge to engineering information systems today is to have the ability to handle very large amount of data and information. Design changes, status reviews, releases and there effects on cost, delivery and quality have to manage. It has to be sure that the employee should not be overloaded to make the work ineffective. Concurrent engineering is an orthogonal concept that defines how concurrent and simultaneous workflows are organized and the information flow, storage, retrieval and decision making can be supported and controlled. Concurrent engineering integrate these activities through the information technology. Tools for all engineering functions have to be integrated. IT assures productivity increase and shorter overall cycle times with improved quality.

The pressure to be the first in the market with a new product requires to design to be right from the beginning. Therefore, in every phase of the product development, from concept to final design, sufficient information has to be provided to the design engineer, which enables him to take the right decisions with respect to production, planning and product support. Special attention has to be given to the adoption of new production technologies and to take, make or by decisions including the early integration of the suppliers into the development process. [10]

Because of these requirements, information systems have to be developed which integrate the different engineering disciplines and their support tools, promoting and pushing a conversion of the currently practiced sequential workflow into a more concurrent workflow to shorten the whole product lead-time. To eliminate the isolation in the current system it is necessary to integrate the all the activities with each other. Parts and products data must be easily and rapidly exchangeable among the different computer systems. Simple software is installed on the main server, which provides the interface for CAD, CAM and process planning activities in the organization, which enables the user to upload and download the required file by generating version of the file. This helps the organization to keep the data at one place securely. Hence there is no wastage of time for searching the file as well as it provides the facility of close knit observation to supervisory persons for production of die. This also helps the managerial persons to eliminate the errors and quality related problem during the entire manufacturing cycle of die. The software provides three different logins at present i.e. admin, head & team members. Admin have privilege to access the details from all departments, head have privilege to access data from other department and the team members have privilege to download the data from their own department.

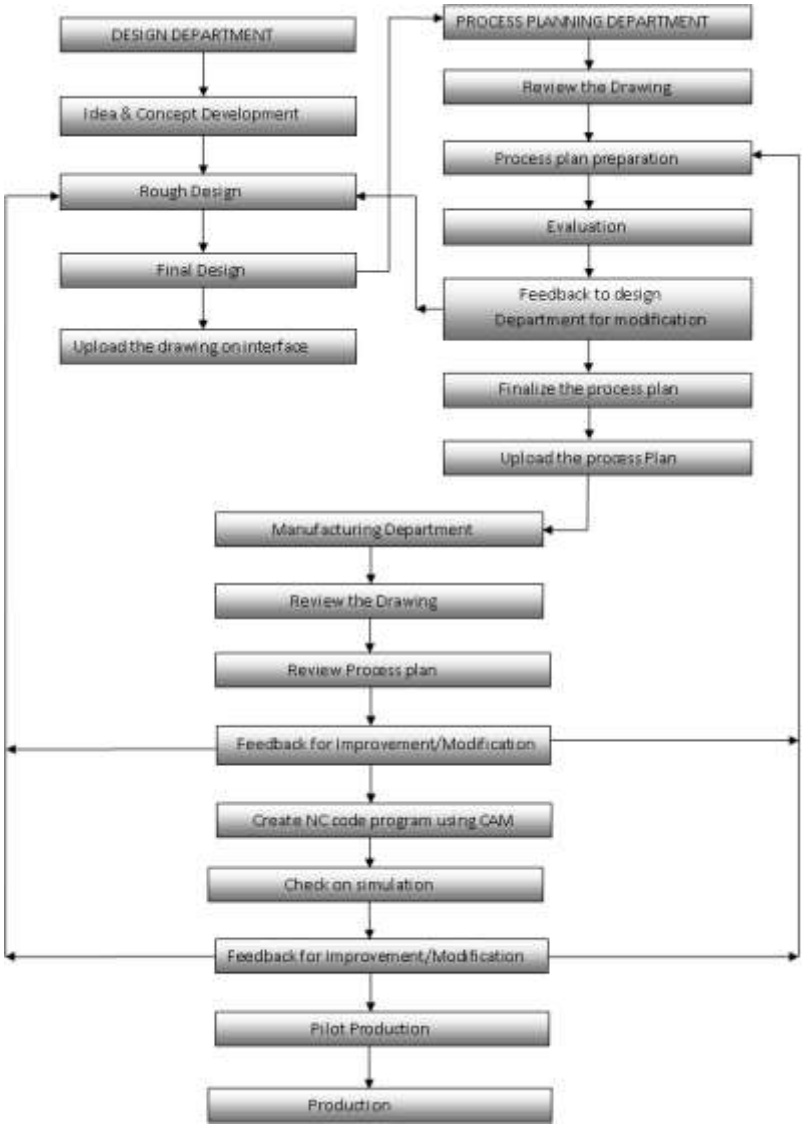

Fig4: Work flow in proposed system

ERROR ELIMINATION IN EXISTING SYSTEM BY IMPLEMENTING PROPOSED SYSTEM

A. Implementation of concept of concurrent engineering

Concurrent engineering is a methodology of restructuring the product development activity in an organization using a cross-functional team and is a technique adopted to improve the efficiency of product design and reduce the product design cycle time. Concurrent engineering brings together a wide spectrum of people from several functional areas in the design and manufacturing, materials management, quality assurance, marketing etc. Develop the product as a team. Everyone interacts with each other from the start, and they perform their tasks in parallel.[10]

B. Elimination of isolation

Concurrent engineering provides clear communication between all levels and finishes the tendency of working in isolation. Clear communication made among production, design & process planning department by means of a software link having simple user interface to eliminate the isolation. So that each departments can communicate with each other for help or reviewing whenever issue raised viz. process synchronization.

C. Elimination of unnecessary process and combination of operations

By observing the required essential process and making categories, a proper synchronization is made between all processes. Also by doing combine pre-discussion, it is possible to think on all processes and to eliminate unnecessary process. For e.g. Effective utilization of VMC or CNC reduces the job loading & unloading time as well as inspection time. The combination of operations is one of the most profitable means of eliminating elements. It can be achieved by simulation and by integration. Simulation means the occurrence of two or more elements at the same time, such as when machine and operator are both working at the same time. Integration means combine the several operations together. Machining as well as handling costs can be reduced by combining operations.

D. Standardization of the components

In the proposed system use of standard components instead of making in-house. Standard components are readily available in the market. Generally standard parts prices are lower than when they are made in-house, it has good quality. Making standardization of the component improves productivity, quality & reduces the cost.

E. Using advanced machines & software

By use of advanced CNC, VMC machines in place of conventional machines helps most of the operations are to be done on single machine instead of several machines. Thus, component loading unloading times saves resulting in reduced manufacturing cycle time & improved quality. CAD-CAM software using for component designing & manufacturing will improve the productivity & quality of the product.

CONCLUSION

The objective of this exercise is to administer the use of computer-integrated manufacturing as a way to logically and sequentially to reduce time and errors and improve the quality during developing a Die. Changing and increasingly competitive business climate.CIM brings automation, exchange of data and integration which results in shorter product development cycle time, lowers production cost. Responsiveness to changing markets and technologies, increased productivity and product quality.

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