

# Quality enhancement by integrating CAD-CAM and process planning activities in small scale die manufacturing company

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**Abstract—** In small scale industry the current environment tends to force employee to work in isolation also it observed that they works on conventional machines when CNC or VMC machines are available, this is because of some certain problems which are not analyzed properly or failure to find root cause by system. To eliminate this mentality of workers there should be close neat observation of supervisory control is essential, also it is necessary to built an error proof system which lead to develop a system which focuses on productivity & quality control. This paper deals with design of low budget system for CAD-CAM-Process planning integration for a small scale die manufacturing industry to enhance productivity & to improve quality of the product.

**Index Terms—** CAD, CAM, CIM integration, die manufacturing, quality of die

## I. INTRODUCTION

The modern tool room cannot say updated unless there is CNC or VMC machine set up. But still the company may face the problem of production delay & poor quality. This is because of lack of awareness towards proper process implementation. This is because of lack of knowledge of CAD-CAM system. Also the shop floor people cannot implement the process plan as instructed because of the limitation of bottleneckness. The overall effect of soul behavior is increase in production lead time, increase in the production time of individual element, poor quality management and imperfection of quality of end product [13].

For implementing CIM it needs education and training for the employs [2]. Although people go through some training, seminar & workshop but due to not getting exactly what they want to do they cannot use the system related CAD-CAM.

To overcome this deficiency & to implement the CIM integration this project 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.

Also this project is focused on the concept like con-current engineering implementation in small scale industry. First part of this paper contains current practices i.e. the system

presently works in small scale manufacturing industry and error identification in current process which makes the unwanted effect on system of production floor, workers strategies etc., next part includes the proposed system i.e. eliminated loop holes in the current system, then the last part focused on comparison between the current system and proposed system.

## II. CURRENT PRACTICES

In current system, when there is new order is placed the product growth flow is as bellow,

- 1) Idea & concept is explained by the super authority to CAD department.
- 2) Rough design is generated by the head of CAD department
- 3) Design/ drawing/ modeling is created by CAD department i.e. team member of CAD department.
- 4) Forwarding the design to process planning department.
- 5) Generate the process plan for individual component
- 6) Generate process flow for entire process.
- 7) Forwarding process plan to manufacturing department i.e. CAM department along with NC code.
- 8) Running simulation of each component.
- 9) If problem arises making the change as per previous experience or knowledge.
- 10) Starting the production.
- 11) Send the component for testing.

Although the flow looks like running smoothly & no back flow in the process flow but the truth is that at each step if any problem arises people manages the problem according to their knowledge & past experience. Due to this the system tends to force the people to work in isolation as well as such system causes the error in process flow this issue invites the bottleneckness in the process and large work in process (WIP) this problem leads to cause increase in production cycle time also this problem causes the tendency of people on production floor to work on conventional machining, although due to working on conventional machining they tries to make smooth process flow but it affects workers efficiency and they suffer fatigue and stress this cause more error and mistakes, increase in work load and this affects entire productivity of organization.

The main reasons observed in the current system is

- 1) Lack of systematic approach
- 2) Work in isolation
- 3) Tendency to work on conventional machines

These problems cannot be getting solved in small scale industry because of unavailability of proofs or notification logs i.e. when manufacturing department conveyed to design department for change in design, when design department made changes as per requirement, when they provided it to design department again etc. so when problem arises people blames each other (because there is no proofs available) due to this at last it is very difficult to find out the exact reason of problem raised and impossible to eliminate the reason so that the problem should not arise in the future.

### Reason behind poor quality because of presence of error in existing system

#### A. 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 [3].

#### B. Unnecessary process implementation

Most of the operation while manufacturing die, proves unnecessary in current approach for eg. There are various operation which performs on conventional machines although there is availability of CNC or VMS machines but due to some certain loop holes in the system people spend time to loading & unloading of job on conventional machines from one machine to other machines. For eg. for making the surface truly flat from comparatively small surface area no need to engage conventional milling machine.

#### C. 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 cause behind this reason. Also, this problem is one of the reason of producing poor quality product. For ex. 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.

#### D. Use of conventional machines

The conversion of Design into a manufactured component or assembly by conventional methods consumes time and effort not favourable to the strict time-lines with a high rate of obsolescence [5]. 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 [6].

#### E. 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 increase in errors on end product.

For eg. If the bottleneck situation occurs the buffer size increases this makes the increasing in mental stress and fatigue of workers on production floor resulting it the tendency to bypass the process in process plan takes place. This situation can be handled by redesigning the process flow but because of lack of communication between intradepartmental activities this issues is remain unhandled.

#### F. List of category wise types of error

Following are the list of various types of errors present in the process or end product and their category.

TABLE I  
Table for errors and their category

Errors	Category / Reasons
Wastage of material	design error
Part dimension size more than tolerance limit	human error / machining error
Die component error <ul style="list-style-type: none"> <li>• Shrinkage</li> <li>• Wrinkles</li> <li>• Tearing</li> <li>• Earring</li> <li>• Surface scratches</li> <li>• Die life</li> </ul>	Poor design error + Machining error
Bottleneckness	process design error
Buffer size	process design error
Unnecessary process implementation	communication error + process design error
Testing error	human + machine error
Machine error	insufficient maintenance

### III. PROPOSED PROCESS

In proposed system a simple user interface is provided which integrates the 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.

Work flow through various departments is as shown in fig.1.

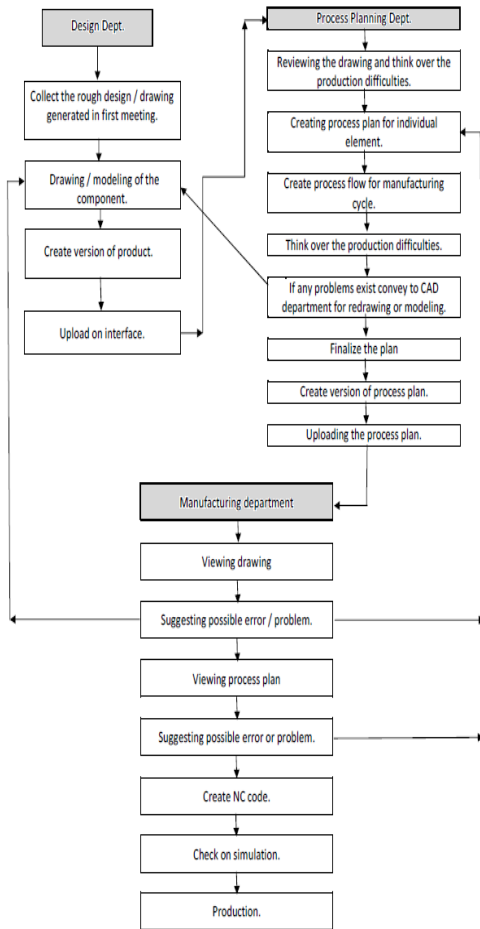


Fig.1: Work flow in proposed system

Beside the UI some extra steps are added to improve the quality of end product by eliminating errors, some of them are as follow.

IV.

**Error elimination in existing system by implementing proposed system**

A. Implementation of concept of concurrent engineering

Concurrent Engineering is an integrated product development approach; CE can improve quality, cost effectiveness, responsiveness and much faster production with flexibility in product design. It also supports multidisciplinary team values of co-operation and trust; thus, sharing and exchanging required knowledge and information is simple to enhance decision making processes in all aspects so one can give better performance when he get the constrained about the end product quality [1][4].

B. Elimination of isolation

Concurrent engineering provides clear communication between all levels and finishes the tendency of working in isolation [4].

Also, a try is made to clear communication amongst production, design & process planning department by means of a software link having simple user interface to eliminate the isolation.

So that design, manufacturing and process planning departments can communicate with each other for help or reviewing whenever issue raised viz. process synchronization

C. Elimination of unnecessary process

By observing the required & essential process & making categories a proper synchronization is made between all processes. Also by doing combine prediscussion it is possible to think on all processes and to eliminate unnecessary process. For eg. Effective utilization of VMC or CNC reduces the job loading & unloading time as well as inspection time.

D. Elimination of conventional machining

By synchronizing the machining processes and sequence of operation the use of conventional machines is eliminated. Also, the practical problem occurs on production floor can be solved by the clear communication between manufacturing and other departments, because of which the unnecessary need of conventional machining, should be eliminated.

Any productivity improvement can be obtained by reducing the cycle time [9]. By making proper process plan and eliminating the need of conventional machining it is possible to reduce the time required for machining and ultimately reduction in manufacturing cycle time.

V. RESULTS AND DISCUSSION

According to proposed system the integration of the tool design and tool room activities using CIM errors present in the released die is as follow

TABLE II

Table of comparison between current process and proposed process for no. of error identified

Type of die →	A	B	C	D	E
No. of error ↓					
Current process	5	4	5	4	6
Proposed process	3	2	2	2	3

Above figures shows the no. of error observed in the die during development phase, in current process and no. of error of same die by adopting proposed system.

$$\text{percent reduction in error using proposed system} = \frac{24 - 15}{24} \times 100 = 37.5 \%$$

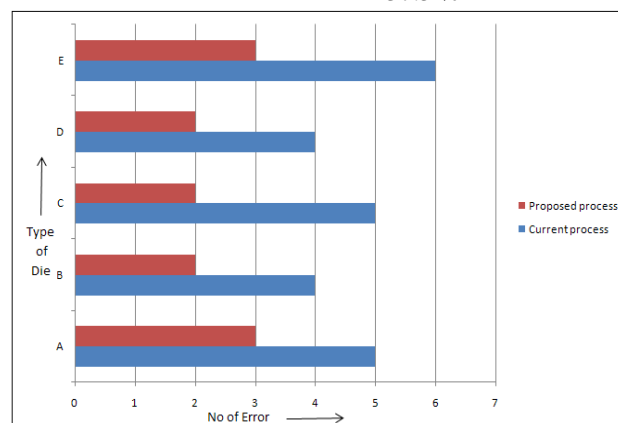


Fig. 2: Graph of comparison between current process and proposed process for number of errors identified during development phase.

## VI. CONCLUSION

The error identification during development phase is more than that of previous process so by eliminating error, quality enhancement can be possible.

According to data available from reading & calculation it is observed that –

By using the current process the percentage error reduced by 37.5 %.

The objective of the proposed process is reducing production cost by reducing error is also achieved.

Due to prior discussion, all ideas and doubts behind the process being implemented are cleared during the first stage. This makes possible to make the correct planning for manufacturing department, design department, purchase department etc. Supervisor can decide the correct flow of machining process so that process should not remain the trial and error type. Due to prior discussion it is possible to identify and eliminate unnecessary process which is lengthy and complex. Use of modern machining process, part program for each individual element and facility to simulate the code helps to eliminate the mistakes in machining and provides correct solutions for error prone calculations which is not possible while using the existed process. Thus, there is no need to change the process plan during production.

Thus the proposed system reduces the dependency of workers skills and experience and emphasizes on the effective utilization of resources especially machines for producing quality product.

## VII. FUTURE SCOPE

The proposed process is limited up to manufacturing process i.e. design and production if interface is provided for financial activities it is also possible to reduce the time of project planning and delivering the product.

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