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Productivity Quality Enrichment through Time Reduction for Small Scale Manufacturing Industries

Sachin Bhole[1], Asst. Prof.D.B.Pawar[2], Prof. Ajitabh Pateriya[3]

[1]*M.E. Student, Department of Mechanical Engineering, Pad.Dr. VBKCOE Malkapur, India*
[2]*Assistant Professor, Department of Mechanical Engineering, Dr.Sou.K.G.I..E.T.Darapur, India*
[3]*Assistant Professor, Department of Mechanical Engineering, VBKCOE Malkapur, India*

ABSTRACT

To ensure the high productivity and quality by using computer integrated manufacturing in small scale die manufacturing industry some important aspects need to focus which is main motto behind this research work. In small scale industry, it observed that they work on conventional machines when CNC or VMC machines are available; this is because of some certain problems which are not analysed 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 build an error proof system which lead to develop a system which focuses on productivity & quality control. This research deals with design of low budget system for a small-scale die manufacturing industry to enhance productivity & to improve quality of the product.

Keywords—CIM integration, die manufacturing, quality of die, CAD, CAM

1. 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 bottlenecks. The overall effect of soul behaviour is increase in production lead time, increase in the production time of individual element, poor quality management and imperfection of quality of end product .For implementing CIM it needs education and training for the employs . 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.

2. CURRENT PRACTICES IN DIE MANUFACTURING

In Indian Small-Scale industries, the die design is done by using thumb rule and past experience for deciding the dimension of the die. The expert from the design department decides the dimension of the die. Once the rough design is generated, the design is used for developing model through software. [05] In most of the industries it is proprietary software. This software file of models is next send to process planning department where process plan prepared for each element of die. While deciding the process plan, the planner has to maintain the record of tools and inventories which are required for smooth conduction of manufacturing process.

Further, manufacturing can be done either conventional machining or by advanced machining processes. In some case, hybrid manufacturing is also used where some part of manufacturing is done on conventional and remaining part of manufacturing is done on advanced machining.[08] After manufacturing of

all elements of die it send for hardening process. The die is send to outside vendor for hardening purpose. The time required for hardening is 8 hours to number of days depending upon the queue at the vendor side. Once the die is hardened, the die elements are assembled according to drawing. In this process, first rough assembly is made and screws, fasteners are used to hold the assembly. After making correct assembly, dowels are hammered in assembly to provide rigidity to the die. All elements tend to hold and mesh with each other by means of screws and dowels. Then this die is sent to further inspection where actual production of required sheet metal component is done by the die. The components are compared with the design supplied by the customer for the dimensional accuracy, geometric accuracy and other quality constraints. If the components are within tolerance limit the die is considered as final and spent to customer otherwise accordingly the error generated on component the die is reprocessing or reworks for the certain correction, till the sheet metal component is within tolerance limit.

3. EXISTING SYSTEM

In existing system although the flow looks like running smoothly and 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 and 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 bottleneck in the process and large work in process this problem leads to cause increases in the 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 causes more error and mistakes, increases in work load and this affects entire productivity of organization. The main reasons of increasing production time and poor-quality product observed in the current system is

- Lack of systematic approach
- Working in isolation
- Communication gap
- Use of conventional machining
- Make or buy decision
- Unnecessary Process

4. PROPOSED SYSTEM

After studding the existing system some loop holes in the systems are come to notice and drawbacks of this problems are wastage in material due to excess error or damaging of work piece while machining, increased lead time, quality less product, wastage of time in searching old files etc which in turns reduce profit of the industry.

So, to overcome these problems and eliminate the loop holes a try is made to build up a new system where the systematic approach is introduced. First of all, a simple user interface is provided to upload and download the files where all files will have collected in one place in systematic manner. Secondly a part of concurrent system is introduced to work on new task. And third and most important the environment is made in such a manner that people should motivate to work on non-conventional machines for obtaining higher production rate by reducing lead time. For this an experiment is carried out to notice the top management importance of following process plan by worker and forcing the entire environment towards non-conventional machining processes.

4.1 CIMUI

In the proposed system, to eliminate the isolation present in the current system it is necessary to integrate the design activities with the manufacturing activities through CIM and to determining the flow of manufacturing operations in the close-knit software interface that integrates the design with the development of the die. Using suitable CAD software and CAM subsystem for detailing out the operation over a machining centre for reducing the total cycle time within the tool room. Firstly, small software is installed on the main server which provides the simple user interface for each department in the organization as well provides the simplicity to keep records, logs etc. The software integrates design, manufacturing and process planning department. It provides close knit observations to the superior authority for development of the product.

4.2 Reasons of time reduction in proposed system

- Concurrent Engineering implementation
- Elimination of Isolation
- Elimination of unnecessary process
- Proper Planning Systematic Approach
- Elimination of conventional machining

After completion of plan of proposed system, the reading and observation is taken for same product which was produce in existing system:
Comparison between lead time reductions from total machining time required:

Machining time required in existing system is comparatively more than that of proposed system. This is because of certain loop holes in existing system. When this loop holes eliminated in proposed process machining time greatly reduced.

Time difference observed in machining time when manufactured using existing and proposed system is shown in table 1 and graph 1. So, total time saved using existing system = 73 hours i.e. 33.95%.

Table 1: - Comparison between Machining Time

Die	Existing System (Hour)	Proposed System (Hours)	Time saved in Proposed system (Hours)
A	58	38.5	20.5
B	52	33	19
C	52	32.5	19.5
D	60.5	38.5	22
E	46.5	30.5	16
Total	269	173	96

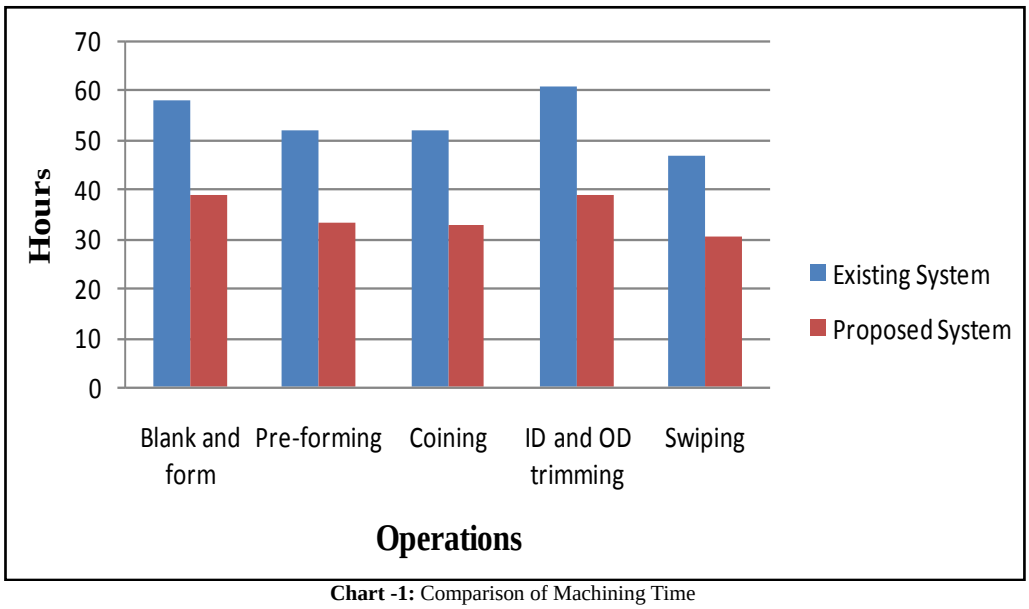

Chart -1: Comparison of Machining Time

4.3 **CAD & CAM Programming:**

In existing system, most of the time during design and planning phase were required to searching the old files and records, making the process plan etc. As design department and process planning department were working in isolation, any change at any time in component, process planning department should have no any information for that. Also, it is time consuming to model each department.

In Proposed system, CIMUI provides a mean for keeping up to date record of the design and process planning files. So, if there is change in any design file, the designer uploads the file on server using interface by creating the version and process planner can download the changed file by viewing the most recent versions. This eliminates the filling of working in isolation and reduces the time required for searching. by keeping old records systematically, no need to design each and every component if it is designed in past.

Table 2: Manufacturing cycle time

Sr.No.	Operation	Existing System (Hours)	Proposed System (Hours)
1	Design and CAD/CAM programming	40	32
2	Machining Process	269	173
3	Assembly	150	60
4	Trials	16	08
5	Heat Treatment	120	120
6	Vacuum Hardening	75	75
Total Hours required to complete the die		670	468

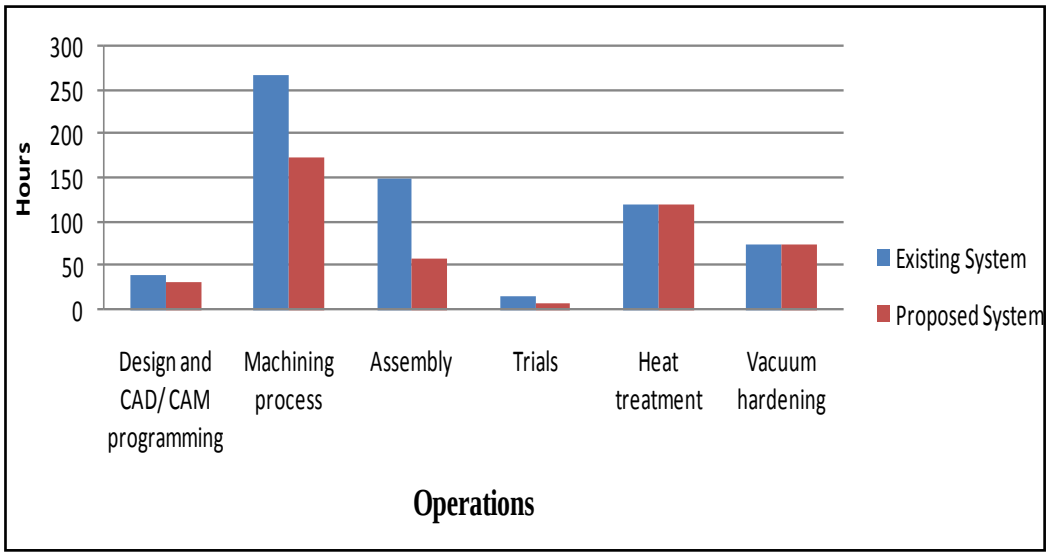

Chart -1: Comparison of Manufacturing Cycle Timesheet

4.4 Time Required for Assembly And Trials

In existing system, the time required for assembly process is increases because of manual machining process should not provide exact geometrical dimensions and tolerances. Due to lack of accuracy between meting parts of die and various errors like machine marks, wrinkles on the final component rework and re-machining is unavoidable, this in turns required more time for final assembly of the die and the process becomes error and trail type.

In Proposed system, as all the elements are produces by VMC or CNC turning they have proper geometrical dimensions and tolerances with higher accuracy so while assembling the component, all meshes correctly. Hence no need to rework on the component.

5. COMPARISON BETWEEN MANUFACTURING TIME FOR THE DIE USING EXISTING AND PROPOSED SYSTEM:

The time required for each individual process in existing system is large than that of the proposed process shown in table 2. by implementing the concept of concurrent engineering, introducing the software interface for data storing and by replacing the VMC and CNC turning. Thus, in proposed system, cycle time from design to manufacturing is reduced by 29.72%.

In existing system, because of manual operations and lack of systematic approach it was difficult to arrange the workers for third shift. In proposed system by introducing non-conventional machines where human interference is less and planning of everything systematically, third shift can be adjusting for machining process. Thus, it is observed that total number of days required for entire production cycle in existing system was 41 days where same risk can be completed in proposed system in 29 days.

5.1 Comparison between Various Cost of Manufacturing for Die Using Existing System and Proposed System from Design of Manufacturing

Table 3: Comparative statement of cost estimation sheets

Sr. No.	Process	Description	Existing		Proposed	
1	Material cost evaluation	Raw Material	101242		77220	
		Purchased Material	41750		41750	
			Total		Total	
2	Manufacturing cost evaluation	Design and CAD/CAM programming	40000		32000	
		Machining Process	33750		46710	
		Assembly	28500		11400	
		Trials	3200		1600	
		Heat Treatment	6000		6000	
		Vacuum Hardening	25350		25350	
			Total	136800	Total	123600
3	Inspection			13989		12261
4	Overheads			7150		5948
	Total inspection cost					
5	Profit			30903		26342
	Selling Price			331024		289771

5.2 Comparison between Profit for the Die of One Day Using Existing and Proposed System:

Profit is considered as 10% on the entire production cost as per company policy. Calculations for profit are shown in figure. Calculated profit by considering the time required to manufacturing, it is observed that proposed system is more profitable than existing system as proposed system helps to earn more profit per day

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Table 3: Comparative statement for Profit for the Die

Description	Existing system	Proposed system
Total Profit	30903	26342
Profit Per Day	30903/41(Days)	26342/29 (Days)
	Rs.734	Rs.908
Profit Per Month	734X30	908X30
	Rs: 22020.00	Rs: 27240
Profit Per Year	734X365	908X365
	Rs : 267910	RS: 331420

Increase in profit = 331420-267910 = 63510
Increase in Profit = 23.70 %
Thus, as per above calculations profit increased by 23.70%

6. CONCLUSION

According to data available from reading and calculation, it is observed that by using the proposed system, the total cycle time reduced by 29.72%, Machine time is reduced by 35.68%, Programming time reduced by 25%, Assembly timing reduced by 60% and trial timing reduced by 50%.

Also, error identification during development phase is more than that of previous system so by eliminating error, quality enhancement can be possible. Due to error identification and unnecessary process identification it is possible to eliminate some processes in system which should not affect the quality and performance functionality of product.

The main objective of this work is to enhance the productivity is also achieved.

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