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CYCLE TIME REDUCTION FROM DESIGN TO MANUFACTURING 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-CAPP integration for a small scale die manufacturing industry to reduce lead time during production.

Keywords: CIM integration, cycle time reduction, die manufacturing

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. The success of computer integration will depend on the expertise of managers in implementing existing methods to take advantage of the potentials offered by new technologies [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 the unwanted effect of system on 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

CURRENT PRACTICES & PROBLEM IDENTIFICATION

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.

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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.

REASONS FOR TIME REQUIRED IN CURRENT PROCESS

Lack of systematic approach

Designers often base their decisions on past experience rather than theoretical knowledge and to some extent; it remains a process of trial and error. In today's highly competitive industrial scenario where there is a shortage of experienced die designers, this is not easily possible in current methodologies of die manufacturing in small scale industries to reduce cycle time of die [1].

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, which results in increasing time & cost of the manufacturing phase because of lack of planning and process design [7].

There is no any idea or pre planning for bottleneck situations which can effectively reduce the work in progress and can reduce the manufacturing cycle time of product.

Elimination of unnecessary process

The major issue in such small scale industries is the overall complexity of the manufacturing system [4]. Because of this, some unnecessary process may also get implemented, for eg. If the required quality of die has no need to do micro finishing over its surfaces still some time micro finishing is done on that surface area this takes more time as well as cost associated with the operation.

Unpredictable processes and/or high degree of downtime variance usually lead to inconsistency between cycle times of production units and time taken (that is – the maximum time per unit allowed producing a product in order to meet demand). This situation usually increases the waiting times between each stage of the process and most importantly, raises the need of investing on capital assets in order to cope with peak capacity requirements [5].

Working in isolation

This problem is one of the cause of producing poor quality product. As well isolation produce fear because of fuzzy ideas about the product and manufacturing process. This makes the people uncomfortable regarding designing and manufacturing issues. For ex. Design department and process planning department has not known the complication faced by manufacturing department. When any issue occurs on production floor the operator makes change 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 as well as increase in lead time of manufacturing cycle . This happens in small scale die manufacturing industries where current methodology is adopted which forces people to work in isolation.

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Conventional machining

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. Also where large work in process is there, convention machines are not suitable as it takes extra time for manufacturing because lead time of such machines is not favorable [6]. Because of using conventional machines for critical dimensions there are possibilities of producing errors which consumes more time for correcting at final stage. Because of bottleneck situations most of the jobs are done manually thus, the work force is the major resource utilized, and its effect on cost is larger than that of the machines and material used. This adds more machining time for manufacturing cycle [6].In modern practices the given the nature of shapes and form of a component model of the product is in softcopy format, in such condition the conventional method is not adoptable [9].

Make or buy decision

Most of component in die are repetitively used or some time they are manufactured previously for manufacturing some other die. But due to isolation and poor management issue those designs & process plan are not readily available. Also due to unavailability of the recent market information the higher authority goes for manufacturing of those parts although they are readily available at lower cost than that of manufacturing cost. This adds time in manufacturing cycle of die.

PROPOSED SYSTEM

CIM user interface in proposed system :

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 a close-knit software interface that integrates the design with the development of the die. Using a 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. A 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 & process planning department. It provides close knit observation to the superior authority for watching development of the product.

The software provides four different logins at present i.e. admin, head & team members. Admin have privilege to access the details from all department, head have privilege to access data from other department and the team members have privilege to download the data from their own department.

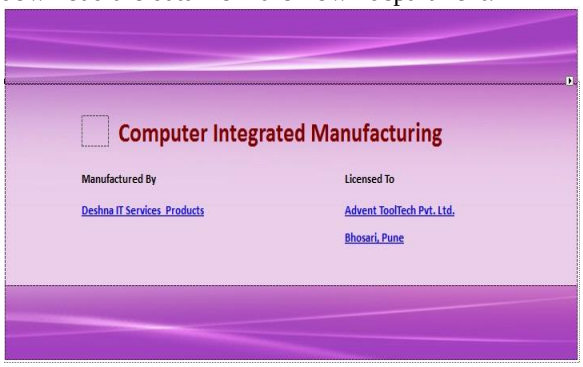

Fig 2.1 Splash screen

Fig 2.2 Login Screen

Product screen :

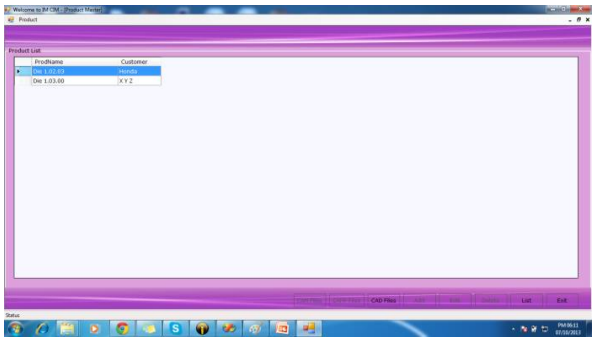

Fig 2.3 Product Screen

Here product name list with customer name is displayed. User can view the entire CAD, CAM or Process planning sheet by selecting the product name. Also user can add / edit new file name. The new file can be saved by product Id, product name & customer name.

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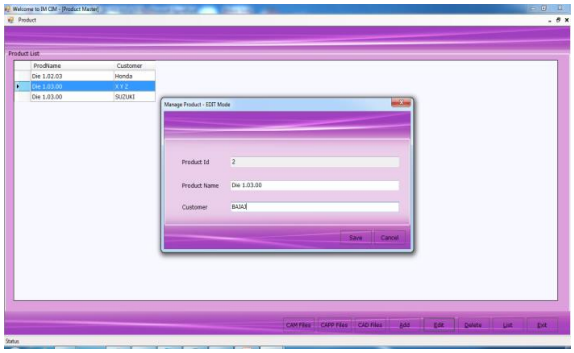
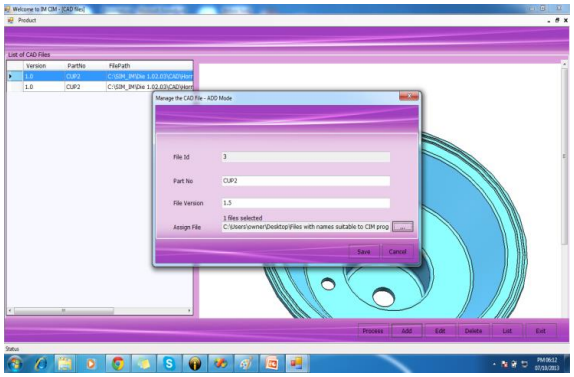


Product edit screen.

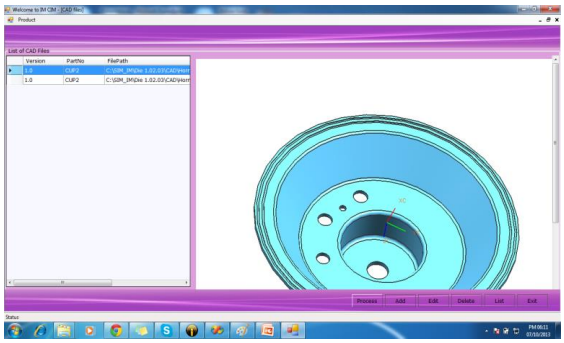
On product screen if user clicks on the CAD, CAM or CAPP buttons he will able to see all files of CAD, CAM or Process planning sheet respectively for the selected product. User can see the preview of the selected CAD file on left side of screen. By double clicking on the file the file will open in the compatible software installed on local computer. For example if user selects a product of certain company and click on CAD button he will able to see all CAD file list on the CAD file listing screen, he can see the preview of selected file and by double clicking on the name of CAD file the installed CAD software will open the file for downloading as well as editing the file.

User can add new file by add button, by clicking on add button user can save the file from local machine. The file can be saved by File ID., Part No., File version. Here only care is to be taken that for creating file version, if file is to be saved first time new file ID should be given else by giving same file ID the file will be over written on previous one. By mistake if wrong name is given to file there is facility to edit file name by CAD file edit screen.

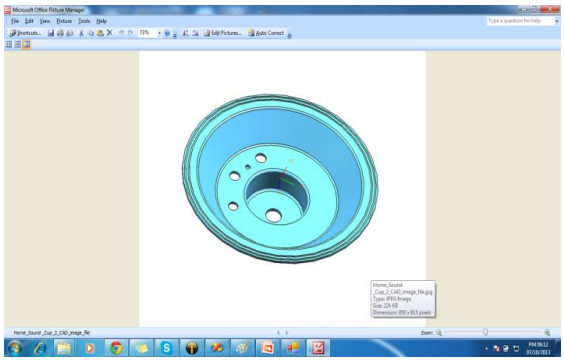
Same facility to add/edit file as well as to view the list of file and saving them by appropriate file ID and version is given to CAM & process planning files.



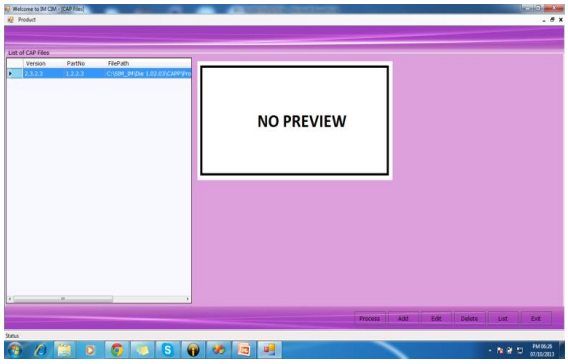
CAD file add screen



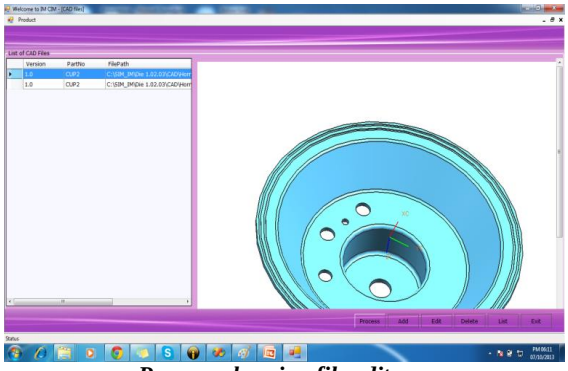
CAD file listing screen



Uploaded file is open in compatible software



Process planning file listing screen



Process planning file edit screen

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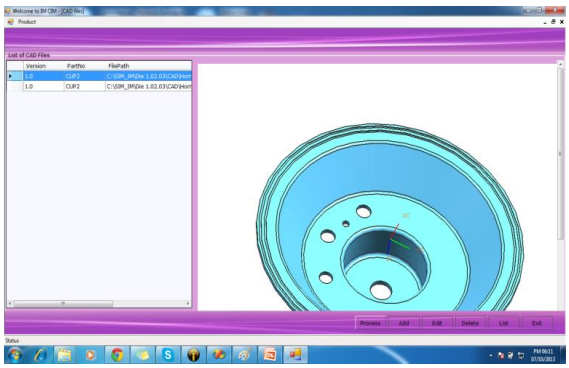

Fig. CAM file listing screen

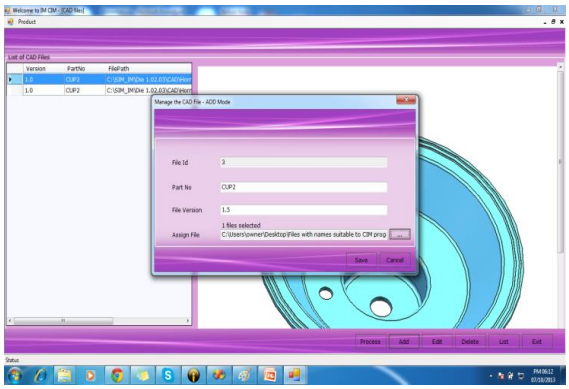

Fig. CAM file edit screen

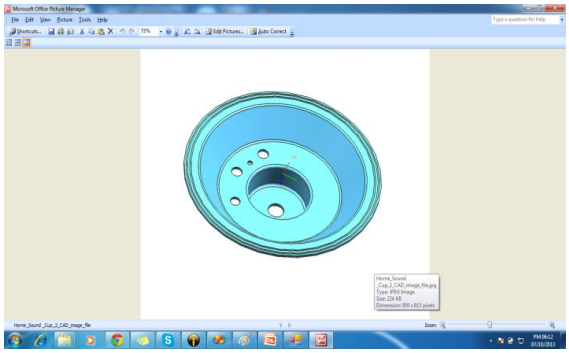

Fig. Uploaded file is open in compatible software

REASONS OF TIME REDUCED IN PROPOSED SYSTEM

Implementation of concurrent engineering

Concurrent engineering focuses on sharing and exchanging required knowledge and information in a manner that will enhance decision making processes [3,8].Concurrent engineering is the early involvement of a cross functional team to simultaneously plan product, process and manufacturing activities [8].

In general CE values relay on a single, but powerful, principle that encourages the incorporation the later stages of production concerns into the upstream phases of a development process. This would lead to shorter development times, improved product quality, and lower development–production costs. This works to find out the problem before they arises thus ultimately it reduces production time.

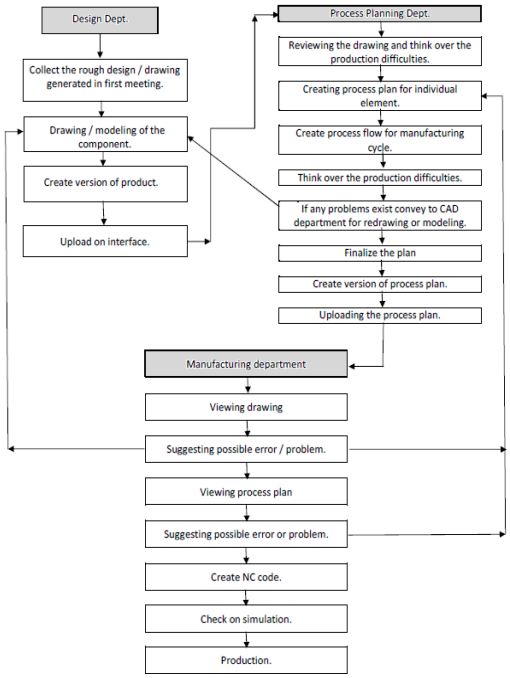

Fig. Task of various departments in proposed system,

Proper planning

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 [7].

Whenever there is a new product requirement experts from all departments meet together with the customer and rough design is generated during the discussion

All activities related to the development of a product are focused in the early stages of product design, so that the greatest benefits of such integration are achieved. This early involvement in the product design and development process includes material selection, process selection, selection of required tools and inventories, selection of available recourses etc.

Systematic approach

the requirement of high quality products with short lead times and low cost have emphasized the importance and urgency of developing computer aided die design systems with embedded and easily modifiable knowledge to reduce cycle time of die [1].

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This can be possible by providing a simple frame work where data can place together to avoid ambiguity when there is urgency of data retrieval.
It is observed that when most of the attention paid to primary design, product design & process planning phase then it will greatly reduce time & cost of the manufacturing phase [7].

Elimination of unnecessary process

By reducing overall complexity of manufacturing system i.e. process simplification it is possible to focus on each process thus it is easily understandable the time consuming as well as unnecessary process [4].Thus by eliminating such processes one can greatly reduce manufacturing cycle time of product [4]. For eg. If required quality of die has no need to do high degree of surface finish on it there is no need to perform time consuming and costly surface finishing operations on it.
Due to availability of data of old product it is easy to take make or buy decision because of CIM integration, the old product information includes the old designs, process plan, machine code and other necessary information associated with the product.

Elimination of isolation

CE provides clear communication between all levels and finishes the tendency of working in isolation [8].CIM requires a teamwork approach in which every member has a key role to play. Installation requires workers well trained in automation principles. Operation and maintenance requirements include workstations and computer interfaces, designed according to established human factor principles, and work environments that provide human interaction during the job performance and scheduled breaks in order to prevent feelings of isolation [4].
The isolation is removed by clearing all doubts in prior discussion which is one of the features of concurrent engineering and by implementing the simple software interface which enable the user to communicate with various departments for solving unexpected issues.

Eliminate conventional machining

Any productivity improvement can be obtained by reducing the cycle time [6]. 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.

RESULTS AND DISCUSSION

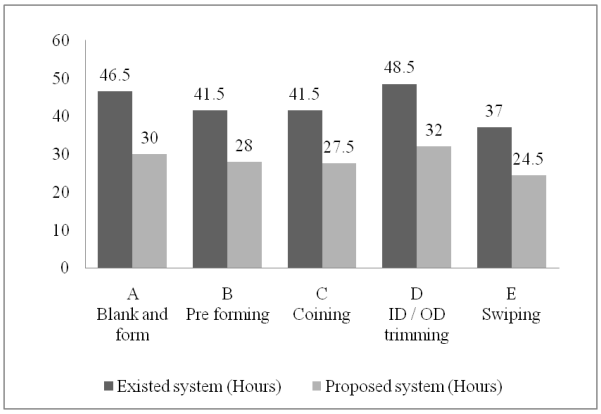
According to proposed system the integration of the tool design and tool room activities using CIM time required to release the die is

Table:Comparison between total machining time

Die No.	Current system Tc (Hours)	Proposed system Tp (Hours)	Time saved in proposed system Tc – Tp (Hours)
A	46.5	30	16.5
B	41.5	28	13.5
C	41.5	27.5	14
D	48.5	32	16.5
E	37	24.5	12.5
Total	**∑Tc = 215**	**∑Tp = 142**	**∑(Tc—Tp)=73**

Percentage reduction in machining time using proposed system	=	$\frac{\sum(Tc - Tp)}{\sum Tc} \times 100$
	=	$\frac{215 - 142}{215} \times 100$
	=	33.95 %

Graph 6.1: Comparison between total machining time



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CONCLUSION

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

By using the proposed process the manufacturing cycle time reduce by 33.95 %.

Also the error identification during development phase is more than that of previous process so by eliminating error, quality enhancement can be possible. Due to error identification & unnecessary process identification it is possible to eliminate some processes which should not affect the quality and performance or functionality of product as well it reduces the production time, also it is possible to reduce the rework in design & process planning department which result in reducing the cycle time of product from design to manufacturing.

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

In existed process the loss in time takes place because of following reasons,

i Manual work on conventional machining
ii Unclear ideas behind the process implementation
iii Worker experiencing fatigue and stress
iv Changes in process plan during the production

These reasons are eliminated in proposed process by

i Replacing the modern machines
ii Automated operation by part programming
iii Prior discussion before process implementation as part of CE
iv Strictly following the process plan.

Due to prior discussion, all ideas and doubts behind the process being implemented are cleared during the first stage. Thus, there is no need to change the process plan during production. Due to modern machines and part programming, manual work reduces in considerable amount which turns to keep workers fatigueless.

REFERENCES

[1] S. Kumar, R. Singh b. A knowledge-based system (KBS) developed for selection of progressive die components. Journal of Achievements in Materials and Manufacturing Engineering. Jan-Feb 2007. Volume 20, issues 1-2.

[2] John Johansen, Uday S. Karmarkar, Dhananjay Nanda, Abraham Seidmann."Business Experience with Computer Integrated Manufacturing: A Survey of Current Strategy and Practice". Proceedings of the 28th Annual Hawaii International Conference on System Sciences 1995, IEEE, 1060-3425/95.

[3] A.Gunsekaran. Concurrent engineering: A competitive strategy for process industries. The journal of the operational research society. Vol.49, No. 7. July 1998.

[4] A.Gunasekaran. Implementation of computer-integrated manufacturing: a survey of integration and adaptability issues. Int. J. Computer integrated manufacturing, 1997, VOL. 10, NO. 1-4, 266± 280.

[5] Mohammad Amin Okhovat ET. AL. Development of world class manufacturing framework by using six-sigma, total productive maintenance and lean, Scientific Research and Essays, 24 December, 2012 Vol. 7(50), pp. 4230 -4241, DOI: 10.5897/SRE11.368.

[6] A.Gunasekaran ,P.Cecille. Implementation of productivity strategies in a small company, Elsevier Science Ltd. Technovation, May 1998, 311-320, 0166-4972/98

[7] E.M. Shehab, H.S. Abdalla. Manufacturing cost modeling for concurrent product development. Robotics and Computer Integrated Manufacturing. 17 (2001) 341-353.

[8] R. Addo-Tenkorang. Concurrent engineering (ce): a review literature report. Proceedings of the World Congress on Engineering and Computer Science 2011 Vol II WCECS 2011, October 19-21, 2011, San Francisco, USA.

[9] Yogesh G. Jangale, Dr.R.R.Deshmukh. Cycle time reduction from design to manufacturing using computer-integrated-manufacturing (CIM) for enhanced productivity and quality. Proceedings of 3rd International Conference on Recent Trends in Engineering & Technology, Elsevier Publication 2014. Pg.No.268