COMPUTER INTEGRATED MANUFACTURING (CIM) IN DIE MANUFACTURING INDUSTRY FOR PRODUCTIVITY & QUALITY ENHANCEMENT

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Abstract - *The press tool die contains various complicated shapes and intricate profiles that cannot be produced using a conventional machining process. Die components manufactured on conventional machines and improper implementation of process planning will not achieve the dimensional and geometrical parameters. Sheet metal component manufactured on these dies results in poor quality such as wrinkling, tearing, thinning and dimensions variation etc. In the conventional system if the die tryout fails the die set, process planning will need to be modification results into rise in the cost and time of product development. This conventional methodology is replaced by latest CAD/CAM/CIM technique. Establishing the flow of manufacturing processes in a software that integrates the design with the die development. The component are designed using the 'Pro-E' CAD software. Die components are manufactured on the advanced VMC machine using a Del-CAM software which takes inputs from 'Pro-E' CAD models. This CAM software automates the machining programs creation which eliminate the difficulty in writing complicated programs. Tool designer can make revisions/modifications to the program based on the simulation data. The Simulation can detect inaccuracies in programming, tool crashes, speedy motion contact, gouges, surplus material, collisions etc. The conventional part prove-out method consumes a lot of time and money, therefore verifying part program ahead of time saves a lot of time and money. The die components manufactured by this modern technology and Sheet metal components manufactured on these dies achieves all dimensional and geometrical parameters same is validated on CMM.*

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

1.INTRODUCTION

An economical firm needs to be quickly responsive and flexible to survive in today's competitive markets. For this purpose, the information related activities such as design, manufacturing, production etc. Pertaining to the parts and products data must be easily and rapidly exchangeable among the different computer systems. This exchange may also happen between the vendors providing different applications and protocols. In such huge data transformation, information losses and misinterpretations between the departments and facilities would be unavoidable. The solution to tackle this problem is the computerized information system include a data bank consisting of several master data files, software of data acquisition and updating, information display and on line control.

The manufacturing process takes the longest time to complete in the entire product life cycle. An analogous rule applies to die making as well. The die contains various complicated shapes and intricate profiles that cannot be produced using a conservative machining process. The time required to manufacture a die increases when conventional machining processes are used. It is also difficult to deal with quality issues that arise in the manufactured product. Because of this, machining operations must be given top priority in order to cut down on lead time and quality problems. Due to a lack of implementation of proper process planning, CAD-CAM system and advanced CNC-VMC results in increased production lead time and poor end product quality.

This paper is focused on the concept like con-current engineering,CIM implementation in small scale industry. First part of this paper contains 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 loop holes in the current system, and the last part focused on comparison between the current system and proposed system.

2. Die Design and Development Conventional Methods:

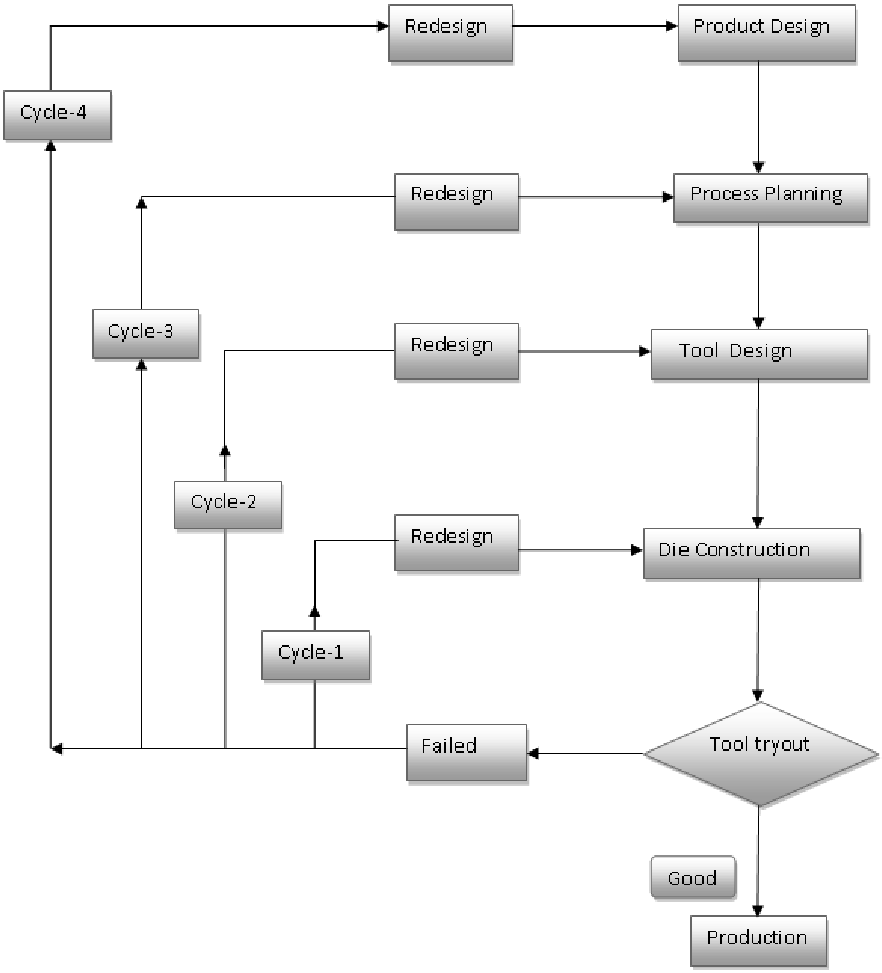


Fig -1: Die Design and Process Planning By Conventional Methods

The conventional product design and development practices carrying out product design, manufacturing process development, and quality and testing activities in a sequential manner. If the die trial goes well and the component satisfies the specifications, the die will be put into production however, if the die tryout fails and the component shows some splits and wrinkles, the die set will need to be revised. Even if the problem is not resolved, new die design and process planning must be considered. In other cases, the development team returns to the design stage to make changes to the product specifications, leading to a rise in the expenses of design and development. The design department finishes the design assignment and sends it to planning, who then sends it to production, and so on. Changes can only be made by going backwards in the process. When designing, manufacturing, or assembling a product, engineers usually need to make modifications. While these changes will be made to the design, they will be integrated into the final product. An increased expense and a delay in the product's release are the result of this. Components are currently manufactured on traditional machines in the present system. The component drawings are in 2D format. Conventional machines are being used to make complicated component shapes. The use of CAD/CAM and simulation technology is not present. Process planning not implementing properly. There is no quality control at each stage of the process. Quality is verified only after final production, the component rejection rate is high. Drawings, quality assurance plans and process planning documents are not kept in a centralized area. Searching of documents consumes a significant amount of time. Revised drawings and documents should be provided to all sections in a timely manner. This system excludes concurrent engineering, and there is a lack of coordination and communication between various sections. Any ideas or improvements cannot be conveyed at the start and feedback is provided later, resulting in time wastage, rework, and so on. After receiving the final component drawing, process planning begins, followed by tool development, die construction, and tri-out. This is how a specific product's die is traditionally designed. The die is sent for manufacturing if all goes well. If the tryout fails parts that don't work, the development team must resort to die reworking. If the problem persists after die reworking, new die design or new process planning are necessary. In some circumstances, the component design must be modified as well. It all happens as a result of a problem found at the end of development.

3. Proposed System:

After reviewing the existing system, some loop holes were identified, such as not implementing process planning properly, a lack of communication or working in isolation, operation on conventional machines etc. Drawbacks of this problem are wastage in material due to excess error or damaging of work piece while machining, increased lead time, poor quality, wastage of time in searching old files etc. So to overcome these problems and eliminate the loop holes a new system proposed where the systematic approach is introduced. A simple user interface is provided to upload and download the files where all files will be collected in one place in a systematic manner, concurrent system is implemented, improved process planning, advanced machines (CNC/VMC) usage for obtaining higher production rate, reduce lead time and to achieve better quality.

Initially the die components are manufactured on lathe machines in which these components are not getting required dimensional & geometrical parameters. Sheet metal components manufactured on these dies get rejected. Instead of using conventional machines and manual programming, the projected system will employ CNC/VMC machines, CAD-CAM to increase productivity and quality. Dies components will be drawn on PRO-E software and Del-Cam software used for manufacturing. CAD assists in obtaining analytical results on time. This will allow the designer to analyze multiple design alternatives, which would not be possible otherwise. Implementing advanced software can also help determine the best design solutions. This will result in significant unit cost savings, manufacturing data creation and enhanced information access. The ability to create programs using CAM software packages is a significant advancement. The drudgery of writing huge programmes was alleviated using this strategy. Errors are decreased, and waste is prevented as a result. Implementing proper process planning will minimize production time and increase product quality. Make a list of standard market components and decide whether to make or buy.

As shown in schematic diagram fig. beginning product development with simulation techniques to get early feedback and make necessary corrections and changes at the lowest possible cost. With this method, defects can be mitigated or perhaps eliminated before to the actual die manufacturing step. If any changes or redesigns are needed, they can be made quickly and with minimum feedback time, leading in a smoother die test and shorter lead times and lower development costs if they are truly needed.

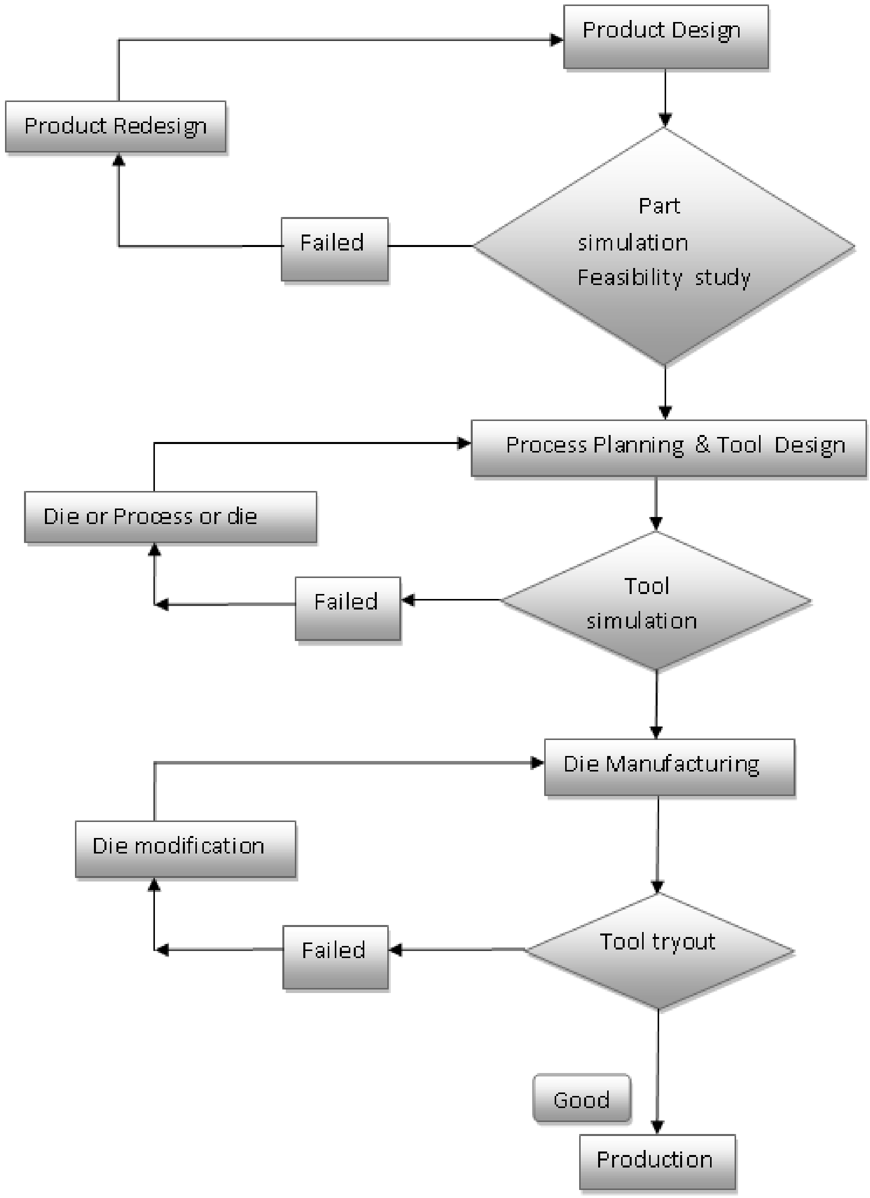


Fig -2: Workflow Based on Simulation

4. Simulation (NC Verification)

NC tool path simulation includes the ability to superimpose the cutter path on a geometric part. The location of the cutter on the CAD system is displayed in color rather than black and white. The CAD/CAM system also proposes that the geometry as a shaded image is in one set of colors, while the tool path is in a different set of colors. Cutting pathways are shown by solid lines, while rapid air motions are represented by dotted lines. As a result, CNC manufacturing process simulation using a CAD/CAM system is more powerful and clear.

During the tool path generating process, there are many chances for error. Plans can be misunderstood, the CAM software cannot generate the tool path programme correctly, and the post-processor cannot output the NC machine tool instructions effectively, and the NC coder can make errors either manually or by utilizing the CAM software incorrectly. Because of the possibility of CAM system fault, the NC tool path should be confirmed earlier than machining. If new programmes are not fully tested, they can result in tool crashes, smashed fixtures/holders, broken tools, wasted productive machining time, and even injury. Non-computer tool path verification methods are classified into two types. In First, case the programmer can physically ensure the programme. This strategy is largely ineffective for any but the most basic tasks. Physical validation is time-consuming, error-prone, and unsuitable for today's more advanced processes.

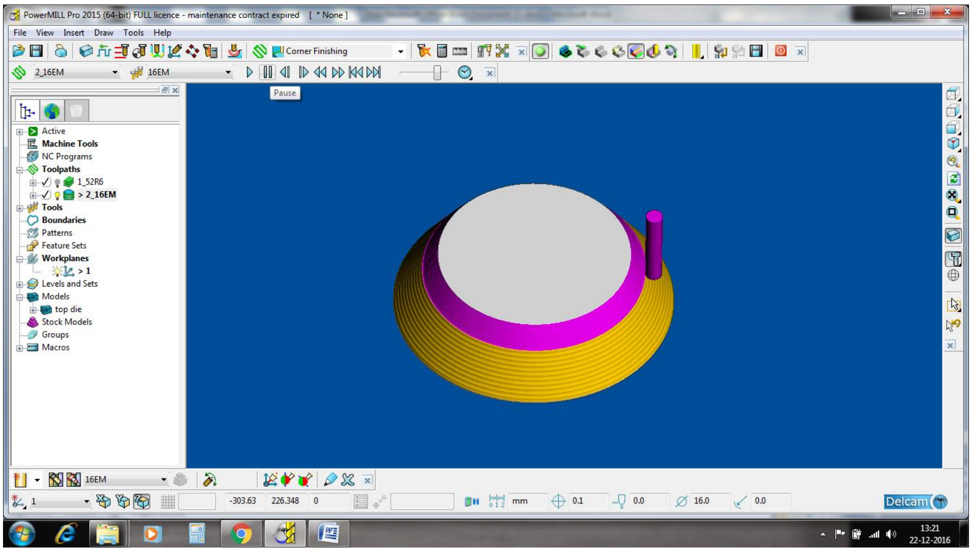


Fig -3: Finish Machining Operation

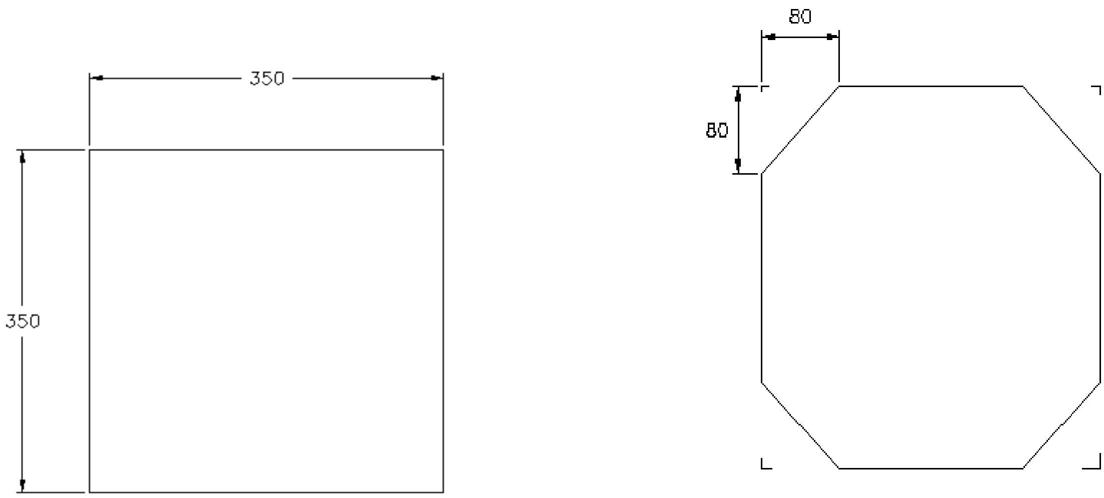
The conventional part prove-out method consumes a lot of time and money, therefore verifying part programmes ahead of time saves a lot of time and money. Costly machine tool capital, equipment, and worker time are not necessary since faults are found before the component programme is submitted to the shop floor.

The software can detect inaccuracies in programming, speedy motion contact, gouges, surplus material, and possible machine tool accidents. The software can also be used by manufacturers to improve feed rates and reduce machining times.

5. Process Improvement.

In the existing system process improvement done to improve the product quality and to reduce rejection. Large size holes on the component has drawn in three operation starting from smaller hole to finish size. These three operation holes improve the quality and avoids the rejection of components.

Initially square blank of 350 X 350 was selected. During deep drawing operation product gets wrinkling, splitting etc. Modification of blank size done by trimming four sides 80 x80 mm . After this modification wrinkles, splitting issues resolved.



Plain blank sheet

Sheet sides trimming

for easy & wrinkle free drawing

Fig -4: Blank sheet preparation

Initially lubricating oil is applied on the component but wrinkle, scratches still appears then plastic paper applied on the component. The combination of plastic paper & lubricating oil resolves these issues.

Fig -5: Plastic sheet on Punch

Fig -6: Applying oil on punch

6. Error elimination in existing system by implementing proposed system

6.1. 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.

6.2 Improved process planning

By observing the required essential process & making categories a proper synchronization is made between all processes. Improved process planning will eliminate unnecessary process and reduces the rejection rate.

6.3 Elimination of conventional machining

Complicated shapes machining profile and geometrical parameters are difficult to achieve on conventional machines. Also sheet metal components manufactured on these dies has errors. So the die components are manufactured on advanced CNC\VMC machines.

Eliminating the conventional machining component rejection rate and time required for machining is less. Productivity improved by using advanced machines.

7. Results and Discussion

Development time and cost required for sheet metal die manufacturing by conventional and CIM technique is compared result are as below.

7.1) Time Comparison

Time required using conventional methods (Hr.)	Time required using CAD/CAM/CIM technique (Hr.)	% Time saved
67.275	37.77	43.85 %

Table 1: Cycle Time Comparison

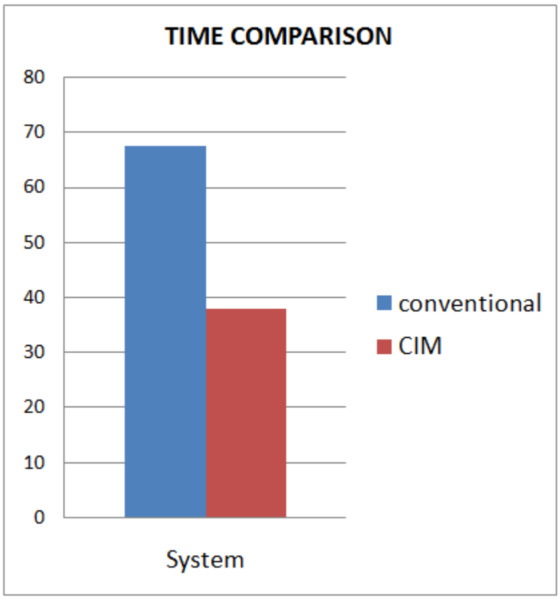


Chart -1: Time comparison between conventional and CIM Technology

7.2) COST COMPARISION

Cost required using conventional methods (Rs.)	Cost required using CAD/CAM/CIM technique (Hr.)	% Cost Saving
36050	28775	20.18 %

Table 2: Cost Comparison

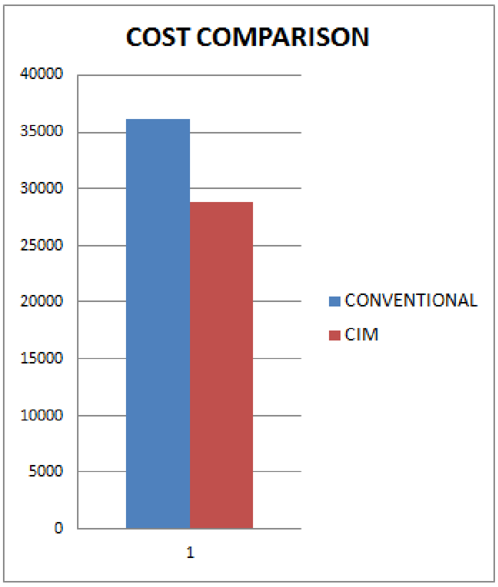


Chart -2: Cost comparison between conventional and CIM Technology

8. CONCLUSIONS

By using latest CAD/CAM/CIM technique time saved by 43.85 % and cost saving by 20.18 % from die design and development to manufacturing. The time and cost required during proposed system is less than that of conventional system. This study carries evidence of productivity & quality improvement of applying computer integrated manufacturing in a small scale die industry.

The efficient use of simulation methods at the early phases of design help in making essential modifications and improvements at the lowest possible cost before the tryout. Simulation is used to find and fix errors before they occur during actual machining.

REFERENCES

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

[2] 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.

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

[4] 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.

[5] 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

[6] S. Jablonski, B. Reinwald, T. Ruf. Integration of process planning and job shop scheduling for dynamic and adaptive manufacturing control. IEEE 1990.

[7] Cheng Wu, Yushun Fan, Deyun Xiao. Computer integrated manufacturing. Part1 Handbook of Industrial Engineering, 3rd Edition, Published by John Wiley & Sons.

[8] Kan Chen. Generation dynamics in computer-integrated manufacturing systems. Technological forecasting and social change 31, 19-26 (1987). Elsevier Science Publishing Co., Inc.

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

[10] Yogesh G. Jangale, Dr.R.R.Deshmukh. cycle time reduction from design to manufacturing by integrating cad-cam and process planning activities in small scale die manufacturing company, IJESRT ISSN:2277-9655, April 2015

[11] Sumin Wamg,Hao Zhang, Fuqiang Ma, Haihang Wan. "Concurrent Engineering-based CAD/CAM technology & Application" IEEE International Conference on industrial Technology, 1996 P.P. 320-321.

[12] A. Gunasekaran, I. Virtanen, T. Martikainen, P. Yli-Olli "The design of computer-Integrated manufacturing systems" International journal of production economics 34 (1994) PP 313-327

[13] Vinayak P.Bavchikar , P.N.Gore "productivity & quality improvements by using computer integrated manufacturing (CIM) in die manufacturing industry" IJESRT, ISSN: 2277-9655,January 2016.