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# A Case Study on Data Mining Application in Manufacturing Industries

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**Abstract:** ***This paper highlights the importance of data mining technique in manufacturing system design. A case study is presented in this paper in which the manufacturing system was re-designed through data mining of data generated corresponding to the traditional method. The performance and properties of the product was analysed virtually using CAD softwares AutoCAD and PTC Creo. The improved design reduced the operating time as well as cost and hence better productivity is achieved through this research work.***
**Keywords:** Manufacturing System, Computer aided Design, Data Mining, System Design, Automation

## 1. INTRODUCTION

Data mining is a useful tool to find out the ignored and hidden information of any process. Also, it can process huge amount of data. The data mining from large marketing database can be successfully applied in a number of advanced fields. Applications of data mining include cyber security [1,2], smart cities monitoring[3], forecasting future customer requirements [4], sample identification [5], manufacturing sector [6], medical sector [7 - 9], risk assessment [10]. The data mining also known as data or knowledge discovery is multidisciplinary in nature as it includes statistics, image processing, machine learning, mathematical optimization and information retrieval. The researchers and practitioners all around the world are successfully applying data mining technology on data from different areas such as banking, finance, retail, marketing, insurance, fraud detection, science, engineering, etc., to discover any hidden relationships or patterns.

In this paper we discuss the developments and instructions on improvisation of manufacturing system design based on data mining. Section 2 talks about data mining for manufacturing system design. Section 3 presents a case study demonstrating the data mining approach to improve the productivity of a manufacturing unit. Section 4 gives the conclusion of research work carried out.

## 2. DATA MINING IN MANUFACTURING SYSTEM DESIGN

The computer design is a high risk and value-added technology as the satisfaction of customer requirements is critical issue for the computer designers and manufacturers. Data mining technique may displace the traditional methods like visualization and statistics that are not preferred for the analysis of any manufacturing system.

Data mining is important stage of Knowledge Database Discovery (KDD) process [11]. KDD process used for manufacturing includes

1. Understanding the manufacturing domain
2. Collecting the targeted data
3. Data cleaning, pre-processing and transformation
4. Data integration
5. Choosing the functions of data mining
6. Choosing the appropriate data mining algorithm
7. Data mining
8. Interpretation and Visualization
9. Implementation of discovered knowledge
10. Knowledge storage, reuse and integration into the manufacturing system. The process of data mining is shown in Figure 1.

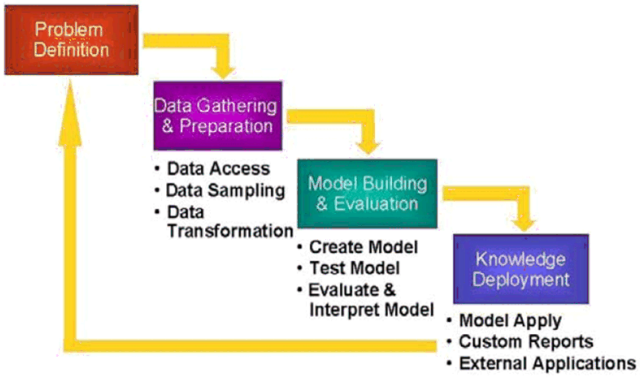


**Figure1.** Data mining process

Data mining allows users to analyze data from different dimensions or angles, categorize it, and summarize the relationships identified. The integration of data mining with computer aided design and analysis helps in improvising the existing manufacturing system. The drawings of a product contain the useful information.

Data Extraction tool is used to build automated bills of material, drawing title sheets, coordinate tables. Hence the useful data can be easily extracted to Microsoft Excel files using Data Extraction tool. The success factors of data mining are as follow:

- Datasets available
- Data preprocess
- Information content
- Correlation vs. casuality
- Privacy
- Corporations
- Tools and software selection

In a larger context, successful implementation of data mining in manufacturing leads to better engineering design, decision support system, shop floor control and layout, fault detection, quality improvement, maintenance and customer relationship management.

## 3. CASE STUDY

Case study was done in Bhati and Company situated in Jodhpur, Rajasthan: manufacture of single barrel, double barrel, 12 bore shot gun and 12 bore shot gun cartridges. Traditional process includes purchasing of raw material (seamless tube), machining on lathe machine, bend removal, boring for specified inner diameter, internal grinding, vertical honing, polishing followed by welding and brazing of barrel ends. It was observed that complete manufacturing process was manual. If any problem arises during manufacturing or testing, the company relied heavily on suppliers. Furthermore, any modification takes a large amount of time which results in increasing the overall operating cost of the manufacturing unit.

We observed that there is a need of the standardization of the complete manufacturing process which could reduce the overall cost as well as time. Due to lack of the standard procedure for planning, design and production the manufacturing unit takes any preventive or corrective action as per customer feedback only. Hence, we decided to use data mining for standardizing the manufacturing process which reduces manufacturing time and cost to the company.

The traditional process of manufacturing (Figure 2) requires more time for production and testing of the products. Furthermore, highly skilled labour is required to produce good quality products. The company was importing various parts and hence relied on the supplier for timely delivery of the product. In addition to this, the manufacturer cannot itself make any modification or preventive correction in various parts due to lack of complete information and data.

**Figure2.** Traditional method of manufacturing

To start with, we discussed with the manufacture the problems they are facing related to design and performance of the product. The history of the customer feedback and complaints was studied which motivated us to generate the complete information and data to find the reasons for the associated problems. The information related to material and process was collected for various parts. Furthermore, the dimensions were measured for all the parts (Figure 3). The mass properties important for kinematic and dynamic performance of the product were calculated according to the data generated through measurement.

**Figure3.** Measurement for data generation

In next step, the drawings of all parts were made using CAD software at Jodhpur CAD/CAM Technologies based on the data generated through measurements (Figure 4).

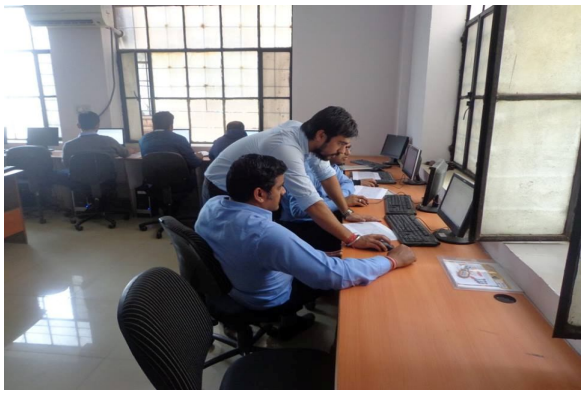

**Figure4.** Preparation of drawings from generated data

Keeping in mind the problems and requirements of the product, different versions of parts were prepared virtually using CAD (Figure 5). The major advantage associated with the CAD modeling is that parts were prepared virtually which reduced time and cost of actual production. Through data mining, various alternatives can be modeled and suitability can be checked as per customer needs regarding cost and weight of the final product.

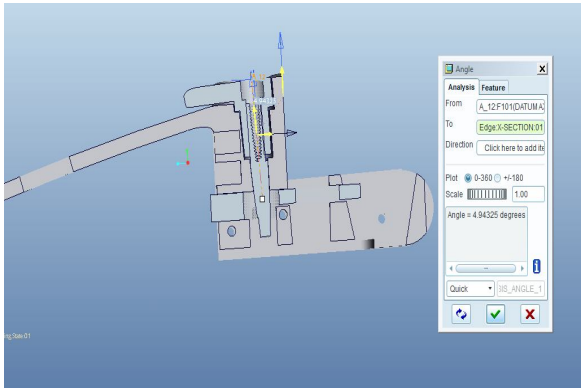

**Figure5.** CAD model corresponding to generated data

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Consequently, the parts can be tested virtually for any failures which guide us to take preventive or corrective actions during design and manufacturing of the parts (Figure 6, 7).

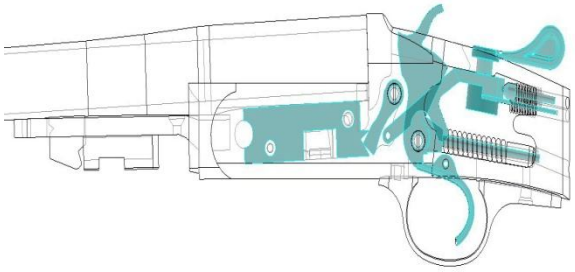

**Figure6.** Simulation for verifying motion properties

**Figure7.** Simulation for verifying mass properties

Finally, prototype of product was made corresponding to the new design to verifying the conformity of various standards (Figure 8).

**Figure8.** Prototype of final product

Thus, integration of data mining with computer aided design helped the manufacturer in estimating labour cost, manufacturing overhead, cost modeling and production scheduling.

## 4. CONCLUSIONS

The machine learning and computational intelligence tools provide excellent potential for better control of manufacturing systems especially in complex manufacturing environments where detection of the causes of problems is difficult as highlighted in case study done in this paper.

The integration of data mining and computer aided design helped us to redesign the complete manufacturing process which motivated the company to modernize the plant. The major advantage of data mining is that the required data for analysis can be collected during the normal operations of the manufacturing process being studied and it is therefore generally not necessary to introduce dedicated processes for data collection

The results of this study can provide an effective procedure of identifying the limitation of the existing system and redesigning it to increase the productivity and customer satisfaction. Implementing new techniques for designing manufacturing process for various other industries will be examined in further study.

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