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REVIEW ON FORMULATION OF APPROXIMATE, GENERALIZED FIELD DATABASED MODEL AND ITS SIMULATION, OPTIMIZATION, RELIABILITY EVALUATION FOR SOME OPERATIONS OF MANUFACTURING ENTERPRISE

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ABSTRACT

The present reviw is aimed at establishing mathematical relationship between the responses and inputs at some operation and formulating the field databased mathematical model for manufacturing of PVC pipe. The object is to optimize the inputs required for satisfying the various responses. Like that the present work proposes to establish relationship for some operation of PVC pipe manufacturing industry and to formulate a model by collecting the at some operation process data. With the help of model and collected data one can find a method to improve the productivity of the industry. Briefly the study includes:

Study of PVC pipe manufacturing process.
Study machine used for operation.
Material & movement of material.
The total processing time required.
Process parameters or working conditions.
Study the Responses / output at workstation.
Establish the relationship between the responses & inputs at some workstation.
Suggest the places / operations where the use of man or machine or material can be optimized.

KEYWORDS: 2-6 Keywords are required (10pt Times New Roman, Justified).

INTRODUCTION

During the 1990's manufacturing industries all over the world have started to enter in to hitherto unknown era of intense competition stiffer than before. During the same period rapid and unprecedented changes in the industrial policy of globalization and opening of the economy has opened up new opportunities along with new challenges to Indian industry. With the entering of MNC's in the Indian market [4]*, it is becoming all the more urgent and important for them to learn newer and advance tools and techniques of improving their product quality and operational performance effectiveness in order to continue to exist. The management of production and operations is of vital importance for any business. There is an increasing recognition that [9], no matter how good a firm is marketing business strategy, financial management or even human resource management or even product design, but if it fails to be effective at the production level then it will not be able to compete successfully, understanding the flow of materials through the manufacturing process with related and complex interaction is therefore a vital significance. The production process can be effectively planned, designed and controlled only with improving the understanding of those intricate and complex interactions taking place in the production process [7]**.** This can be accomplished more effectively by using the advanced tools and newer techniques like mathematical modeling, simulation, optimization, artificial neural network and such others. Mathematical modeling is a process that iteratively involves movement of real world elements to elements of the mathematics world [1].The first step of mathematical modeling is understanding the real world situation by specifying what is needed and by simplifying the problem. The second step is manipulation of the problem by identifying variables and relationships in the problem and by mathematizing the problem in building a model. The third step is prediction of the behavior of the real problem by using the constructed model in interpreting the solution to the problem. The fourth step is verification of the solution, by evaluating solution, validating and communicating results [1]. Mathematical modeling is the use of mathematics to

1. Describe real-world phenomena

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2. Investigate important questions about the observed world
3. Explain real-world phenomena
4. Test ideas
5. Make predictions about the real world Process

Manufacturing industries are under pressure to keep their customers delighted. These days that usually means increasing quality levels and decreasing prices. To get those prices down, industries must reduce their manufacturing costs. This takes the form of reducing our cycle times and Work-In-Process (WIP) levels, increasing their process efficiencies and yields, and decreasing their scrap rates and direct labor content. This is what continuous improvement**.** A very effective tool in this ongoing battle of continuous improvement of manufacturing operations is simulation. Here are some of the interpretations for what, exactly, is simulation means given by the industry: "A process involving the imitation of a real world system, through the application of models. These models may be simple, analytical assumptions, or complex, computer based systems."[5] "Simulation involves the modeling of a process or system in such a way that the model mimics the response of the actual system to events that take place over time."[4] "The process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behavior of a system and or evaluating various strategies for the operation of the system." [5]. Simulation is broadly used term from the engineering point of view. According to Webster's international dictionary "to simulate" means "To feign, to attain the essence without reality". However the simplest meaning of simulation is "imitation". These dictionary meaning do not bring out a clear picture of the word "simulation" for engineering applications. With some trepidation simulation can be defined as follows "Simulation is the process of designing a model of real system and conducting experiments with it, for the purpose of understanding the behavior of the system. Simulation is the process of formulating a model of a physical system representing actual processes and analyzing the same. Usually the model is a mathematical one representing the actual processes through a set of algebraic, differential or integral equations and the analysis is made using a computer" The increasing demand on engineers to lower production costs to withstand competition has prompted engineers to look for rigorous methods of decision making such as optimization methods to produce products both economically and efficiently [2]. Optimization techniques having reached a degree of maturity over the past several years are being used in wide spectrum of industries, including aerospace, automotive, chemical, electrical and manufacturing industries. Optimization is the act of obtaining the best results under given circumstances. In design, construction, and maintenance of any engineering system, engineers have to take many technological and managerial decisions at several stages. The ultimate goal of all such decisions is either to minimize the effort required or to maximize the desired benefit desired in any practical situation can be expressed as a function of certain decision variables. Optimization can be defined as the process of finding the conditions that give the maximum or minimum value of a function. It is the body of mathematics that deals with the properties of maxima and minima, and how to find maxima and minima numerically [21]. Reliability evaluation is related to the probability that the process will meet all the requirements during the product life [21]. It is a statistical estimate of the probability of success. It is the statistical evaluation to the real situation.

AIM, OBJECT AND SCOPE

The present review is aimed at establishing relationship between the responses at every workstation, inputs at every workstation of some manufacturing operations and creating the field databased model and simulate it for some operations of manufacturing PVC plastic pipes. The object is to optimize the input variables required for satisfying the various responses. Like that the present work proposes to establish relationship for every workstation in the PVC Plastic pipe manufacturing industry. This modeling and simulation work enables entrepreneur to get system wide view obtained by deliberately making local changes in manufacturing system and also can predict its impact on performance on particular workstation. Thus it is very helpful to make overall manufacturing unit cost worthy and efficient. Learning about field databased modeling and simulation is an important step from a theoretical mathematical training to an application-oriented mathematical expertise, and makes the candidate fit for mastering the challenges of our modern industrial and technological culture. Field databased modeling and simulation is an art of translating problems from an application area into tractable mathematical formulations whose theoretical and numerical analysis provides insight, answers, and guidance useful for the originating application. This work is indispensable in many applications and gives precision and direction for problem solution. This work enables a thorough understanding of the system modeling and prepares the way for better design or control of a system allowing the efficient use of modern computing capabilities.A brief survey of Small and Medium Enterprises (SMEs) suggested that systematic modeling of some operations of manufacturing shop will be useful method for improving the productivity, product quality and operational performance effectiveness. It helps to increase throughput

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(part produced per unit time) by increasing utilization of machines or worker, Also increases profitability reducing capital requirement and operating cost.

REVIEW OF THE LITERATURE

In as much as at end of 60's practical and useful simulation methodologies were commonly considered impracticable. Now in the first decade of twenty first century it is difficult to find a practical problem, which cannot be solved at least near – optimally by existing codes [3]. There has been a painstaking and in-depth analysis of modeling and simulation to understand their role in predicting and therefore improving the performance of real life problems. A detailed discussion about historic development is given by Law A M, Kelton W D [3]. The technique of performance modeling of automated manufacturing system [6] indicate the vital role played by analytical modeling in gaining better insight to the design and operational intricacies of flexible manufacturing systems. Models for layout optimization and group technology are illustrated by [18], where exhaustive surveys are given on many advance topics in manufacturing. The topic of model building in mathematical programming is covered in many text of operations research; a notable reference with many practical examples is given Williams H P [19]. With the development of digital computers many problems, otherwise unmanageable by their size and complexity, are now possible to be tackled with ease, accuracy and required speed in decision making [11, 12, & 14]. The discrete event dynamic system assumes that time is continuous, so that the events may occur at any instant still, the system state changes only in corresponding to such events [10 & 15]. The system dynamics and control system approach are emerging as more effective approach to designing dynamic evaluation models of large scale systems like the complete industrial object, rather than individual functional problems like scheduling or inventory control [8]. Lee J C, Khaksar [10] have demonstrated a computer solution to the evaluation of AGV systems. Evaluative models either of experimental or analytical type are based on more or less approximate mathematical representations of systems. Experimental model are basically simulation model at capturing the working of a system within a computer program [12 & 13]. In the area of performance evaluation of a manufacturing system Shapiro J F [16] in his book "Mathematical programming, structure and algorithms" has outlined a detailed discussion on the nature and scope of evaluative type modeling problems and related computer algorithms to obtain their optimal or near optimal solutions. Sterman J and S Sushil [17] have outlined the importance of systems approach to business dynamics and modeling and simulation of complex managerial and informational problems. From a handful of computers and user, today the internet has grown to thousands of regional network that can connect millions of user. It is therefore essential to search through internet or knowing about information related to simulation and modeling. Many popular search engines like Alta Vista, MSN, Info seek, Lycos etc. offer large amount of information related to software's on simulation and modeling. Some of these software's are available; however using these software's for the specific needs of small and medium scale industries is not possible due to high cost of their usable version.

Based on the critical analysis of the available literature the following gaps in research have been identified

1. Relationships between the responses and input variables at every workstations and formulating the field databased model for some operations of manufacturing enterprise is not established anywhere.
2. Optimization of the various input variables required for satisfying the responses of some operations in manufacturing enterprises has not been identified.
3. The use of sensitivity analysis, Artificial Neural based Simulation and reliability performance of the mathematical field databased model has not been found anywhere.
4. In the context of Mathematical modeling so many models in the other field of engineering are available but nothing is found regarding formulation of field databased model of some operation of manufacturing industry, its optimality and testification.

PROPOSED METHODOLOGY

The proposed methodology for Formulation of approximate generalized field databased model for some operations of manufacturing of plastic pipes is given below. Data will be collected to study the activities carried out while manufacturing of PVC plastic pipes

1. To Record the inputs required & outputs at every workstation.
2. To Study the data collected.
3. To Develop a generalized field databased model with the help of data collected for proper utilization of man, material & time.
4. To simulate, and optimize the processes in manufacturing industries.
5. To test the model for its reliability and sensitivity analysis.
6. To simulate the developed model by Artificial Neural Network (ANN) simulation.

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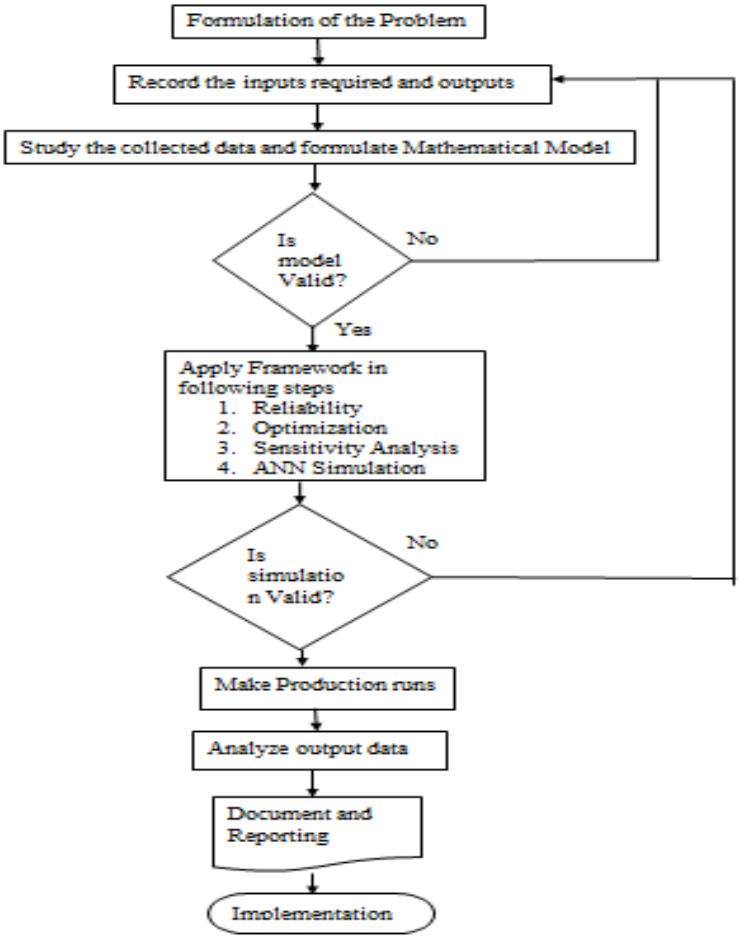
7. To implement the developed model.
8. To make perspective recommendations to improve the working conditions and enhancing the production rate.

Typical phases in this proposed methodology is shown in following figure.



RESEARCH PLAN

The plan of the work can be briefly be stated in the following steps.

Step 1: Collect and process real system data.

Field data related with working of the manufacturing enterprise will be collected to study the activities carried out while manufacturing. The data for input variables and responses at every workstation will be recorded and study of this field data will be carried out.

Step 2: Establish the relationship between responses and inputs

In this step relationship between responses and inputs at every workstation of the manufacturing enterprise can be established.

Step 3: Formulate the model.

Based on the above step, an approximate, generalized field databased mathematical model will be formulated with the help of recorded input variables and responses.

Step 4: Validate the model.

Validation of the formulated model is done in this step. Validation provides assurance that the formulated model is an accurate representation of some manufacturing operations of the enterprise. The model can therefore be substituted for the real manufacturing system for the purpose of its verification.

Step 5: Document model.

Document objectives, assumptions, input and output variables in detail.

Step 6: Simulate the model.

Simulation of formulated model will be carried in the next step followed by its optimization.

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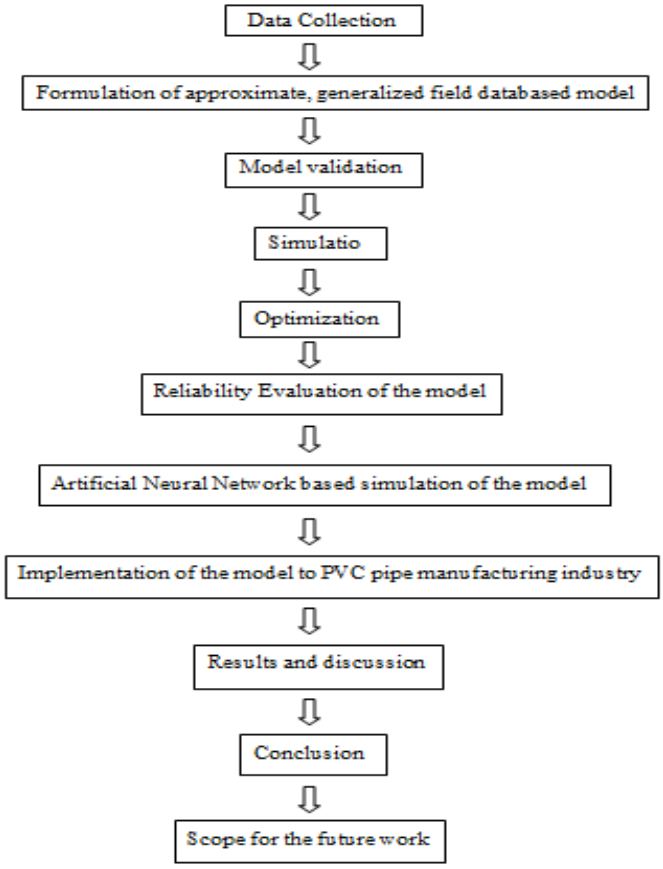
Step 7: Evaluate the reliability.
In the next step reliability evaluation of the developed model is carried out and its will be carried out.
Step 8: Perform ANN simulation.
Developed model will be then simulated by applying Artificial Neural Network and perspective recommendations can be made to improve the working conditions and enhancing the overall production rate.
Step 9: Implement the model.
The applicability of the model to manufacturing systems is demonstrated by means of a case study of PVC pipe manufacturing industry.
Step 10: Interpret and present results.
The results are interpreted, discussion based on above mentioned steps can be carried out and conclusion is made.
Step 11: Recommend the scope for the future work.
This may include further suggestions to increase the precision and accordingly the scope of the future work can be recommended.
The following figure shows the workflow for the research plan in brief.



CONCLUSION (PROBABLE)

A scene is likely to be depicted as how field databased mathematical modeling, its simulation, optimization and reliability evaluation improves some of the operations of manufacturing enterprise. If the formulated model developed by candidate is implemented successfully after its simulation, optimization then the manufacturing enterprise can enhance productivity, total operational performance, product quality and profit which lead to improved overall performance. Important outcome of this work is, it will allow to experiment without disrupting the actual manufacturing operations. With this work, one can explore how an existing manufacturing system might perform if altered and attempts to develop a more emergent and iterative procedure that better reflects the reality based on field databased modeling.

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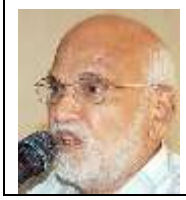	Dr.J.P.Modak is emeritus professor and Ex. Head, Mechanical Engineering VNIT, Nagpur, received his Ph.D and D.Sc. in Mechanical Engineering from Nagpur University and currently working as dean (research) at Priyadarshini College of Engineering, Nagpur.