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Decision Making in Manufacturing Processes using Simulation as a Tool

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ABSTRACT
Simulation is a applied technology which is especially useful to study the dynamic systems. Such a system includes imaginary system as well as existing manufacturing systems. Simulation software provides flexibility in studying these systems. So simulation has become a prime tool in decision making process. This paper discusses the use of simulation software in studying existing manufacturing process and in finding the result of changes applied in the process. The changes which cannot be studied by trial and error method can be studied systematically by using process simulation software. Also this paper elaborate how small observational changes in manufacturing process impact much on productivity improvement. This is explained by using a case study of process line from automobile components manufacturing unit.
Keywords- *Simulation, Manufacturing Process, Decision Making,*

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INTRODUCTION

Simulation is a applied technology which is especially useful to study the dynamic systems. Simulation means to mimic or imitate. It involves such activities as defining, designing, and constructing a model or representation; defining the experiments to be conducted; collecting and analyzing the data to drive the model; and analyzing and interpreting the results obtained from the experiments [1]. It can become substitute vehicle for experiment and behavior prediction [2]. One of the largest application areas for the simulation modeling is that of manufacturing system, with the first uses dating back to at least the earlier 1960's [3]. Simulation is often observed as the most popular of the classical Operational Research (OR) techniques [2]. That is it has become a tool for decision making for various users.

A fundamental challenge with simulation modeling of manufacturing systems is to produce models that can be understood by the problem owners [4]. So simplicity for understanding will lead to the proper decision making. Any manufacturing unit can give efficient performance, if it applies best manufacturing practice. Decision related to these manufacturing practices have to be made, for example; which best practice will have a major impact on the company productivity, how a process can be re-engineered to be more profitable, or how a practice will change the value added for the employee. These issues are difficult to analyze and their impact in the business is difficult to assess. For such a purpose a proper methodology is used for evaluation of manufacturing practices which leads to the improvement [5]. Computer modeling and simulation will help to take decision regarding various practices and selecting best practice. This article will show how simulation helps in deciding small changes in manufacturing process that can affect largely on overall productivity. A case study is taken from automobile component manufacturing unit in which there is batch formation. The objective of this simulation is to decide optimum batch size which will lead towards higher productivity also without affecting the existing process and operators functioning. For studying the manufacturing system, simulation software Arena is used. It is Discrete Event Simulation (DES) software.

SIMULATION A BETTER DECISION MAKING TOOL

Manufacturing industry is one of the most common fields of application of simulation. The study of the use of simulation in UK manufacturing defined simulation as: "the dynamic representation of a manufacturing facility by a computer model, so that the impacts of changes can be evaluated to suggest the decision making process" [2]. It should be noted that simulation does not, of itself, generate a solution but provides information enabling a user to determine a solution. The interrelation between manufacturing systems and processes are becoming more complex and the amount of data for decision making is growing [5]. For these simulation becomes reliable tool to analyze data and support your decisions.

Discrete Event Simulation (DES) has mainly been used as a production system concepts, layout and control logic. Recent development has enhanced DES models for the use in the day-to-day operational production planning of manufacturing facilities. These "as built" models provides manufacturers with the ability to evaluate the capacity of the system for new orders, unforeseen events such as equipment downtime, and changes in operations. After a simulation model has been built, experiments are performed by changing the input parameters and predicting the response. Experiments are normally carried out by asking "what-if" questions and using the model to predict the likely outcome. A simulation based Decision Support System (DSS) can be used to augment the task of planner and schedules to run production more efficiently [6].

For the proper decision making the user need a visually effective user interface. Visual analysis provides visual and interactive tools for analytical reasoning and decision making from data. The use of simulation with an easy-to-use graphical user interface provides tools and the methods for the manufacturing scenario evaluation, scheduling optimization, and production planning even for non expert [6].

MANUFACTURING PROCESS

This includes a manufacturing line from automobile component manufacturing unit where the different types of components like brake disc, brake drum etc. are manufactured. Also there is size difference within same type of components example; brake disc are manufacture in diameter of 200mm as well as 228mm. Out of which one of the line is simulated and studied for the optimization.

A. Brake Drum Manufacturing Line

The company manufactures brake drum for one of the leading vehicle manufacturing firm of India. Simulation can be done either to study process before actually process establishment or to study existing manufacturing process for optimizing various resources of the process. While simulating any process the most important part is to collect the system data for model development. The accuracy of prediction is depends on the accuracy of model developed. To develop a model time study and motion study plays a vital role. The time and motion study is done by using camera to shoot the process as well as by using stop watch. It gives two readings of time for each process. Out of which average time is consider in the model development. Table 1 shows example of data collection to develop model. Time is taken in minutes.

Table 1 Example of Data Collection

Station Name	Enter Time	Exit Time	Net Time on station	Distribution of Net Time			
				Transfer Time	Setting Time	Process Time	Wait Time
Gang Drilling	0.00	0.91	0.91	0.25	0.16	0.5	0.00
CNC Machining	0.91	5.85	4.94	0.58	0.25	3.8	0.31
Middle Conveyor	5.85	14.03	8.18	0.93	Batch formation (Qty 4)=7.25		
Chamfer Drilling	14.03	14.25	0.22	0.12	0.1		0.00
Testing 1	14.25	15.91	1.66	0.12	1.66		
Testing 2	15.91	17.61	1.7	0.5	1.7		0.00

The line is partially automatic and partially handled manually. The line comprises three operators which are indicated as OPER1, OPER2, and OPER3. Table 2 shows the role of the operator in the manufacturing line.

Table 2 Role of the Operator

Operator	Process Handled
OPER1	Loading of Input Conveyor
	Chamfering
OPER2	Diameter Testing
	Parallelism Testing
OPER3	Balancing
	Engraving

By using the above information the simulation model is developed in simulation software Arena.

B. Model Development and Its Analysis for Optimization

The model is developed in process simulation software Arena which is Discrete Event Simulation (DES) software. Figure 1 shows the model developed for the above manufacturing line. This model consists of 6 submodels which are named as Station 1, station 2, etc. Here during observation, it is found that the functioning of OPER1 is irregular and subjected to changes according to the situation and it is needed to study the OPER1's functioning. As OPER1 take care of loading of input conveyor as well as chamfering operation on component. Loading station and chamfering stations are separated by about 100 meters. There are about 8 components which can be loaded on automatic input conveyor. So OPER1 load the conveyor first and then turn to chamfering station and then do the chamfering operation. By that time there is batch formation before the chamfering. So it is needed to keep that batch as small as possible. And this becomes the prime objective of simulation. By keeping the batch low and taking it for chamfering will help in reducing the cycle time. Usually OPER1 takes components for chamfering after batch of 4 components forms. So instead of 4 component batch different combination of batch sizes are tried and their outputs are checked for the optimization. The care is taken to keep the process flow uninterrupted and loading is before loading conveyor gets empty.

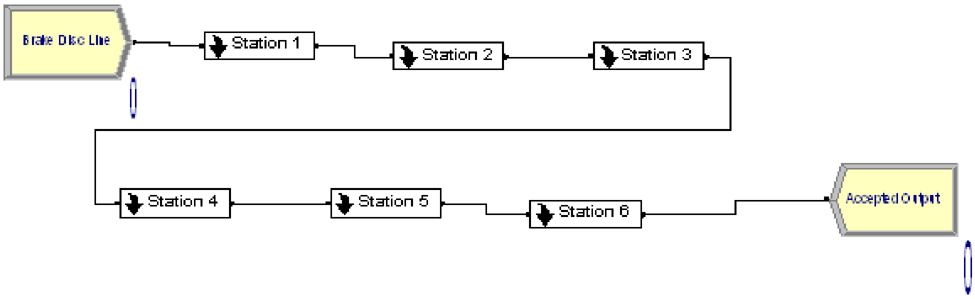

Figure 1 Arena Model for Brake Drum Line

RESULT AND DISCUSSION

Table 3 shows the condition of the loading conveyor and batch formed before chamfering operation with the time. It is needed to keep the line running continuously and engage the OPER1 fully so that idle time is reduces and also cycle time is reduced.

The usual practice was to take components for the chamfering after the batch size becomes 4 or more. Some times because of that input conveyor gets empty and loading in the line gets affected. So by keeping batch size of 2, OPER1 can chamfer them first and then go for loading. Because of this practice there is saving in time. Previously in 3 hours span 100 components were manufactured. By implementing the above change of keeping batch size of 2, there is saving of 5.04 minutes. For 12 hours shift, time saved will be 20.16 and the number of components produced in this time will be 12.

Table 3 condition on Input Conveyor and Batch Formation with Time

Time in Minutes	Number of Components on Input Conveyor	Number of Components Between Input conveyor and Batch	Number of Components in Batch Before Chamfering
0.00	8	0	0
0.00	7	1	0
1.75	6	2	0
3.5	5	3	0
6.99	4	3	1
8.74	**3**	**3**	**2**
10.49	2	3	3
12.03	**1**	**3**	**4**

That means previously 400 components were manufactured in 12 hours shift. By implementing above solution the net saving of time will be 20 minutes (neglecting fraction values) in 12 hours shift. So the increase in production in 12 hours is 12. Therefore increase in production of brake drum line,

$$\% \text{ Increase In Production} = \frac{\text{Final Production} - \text{Initial Production}}{\text{Initial Production}} \times 100$$

$$\% \text{ Increase In Production} = \frac{412 - 400}{400} \times 100$$

$$\% \text{ Increase In Production} = 3$$

So there is increase in the production by 3% and reduction in the idle time of OPER 1.

CONCLUSION

The importance of simulation in studying the manufacturing process is growing day-by-day, as it is not only cost effective but also provides good prediction about the changes in system with the system parameters. It has become a prime tool in decision making process. As shown in the case study there is increase in the production of the brake drum manufacturing line. Also this approach is useful to the reduction of the idle time of the OPER. Small observational changes can affect a lot on overall performance of the system. As discussed in the case study simulation helps to study the system systematically. And find out the scope for the improvement of the process.

REFERENCES

1. Stefan Bjorklund, Naresh Yamani, Thomes Lloyd,(2004). "Simulation Software for Real Time Forecasting as an Operational Support," Second World Conference on POM and 15th Annual POM Conference, Cancun, Mexico.
2. B. W. Hollocks,(1995)."The Impact of Simulation in Manufacturing Decision Making," Control Engineering Practice, Elsevier Science Ltd, Vol.3, pp. 105-112.
3. Averill M. Law, Michael G. McComas, (1999)."Simulation of Manufacturing Systems," Proceedings of the 1999 Winter Simulation Conference, pp. 56-59.
4. D. J. Van Der Zee,(2006). "Modeling Decision Making and Control in Manufacturing Simulation," International Journal on Production Economics, pp. 155-167.
5. Arturo Molina, Veruzcka Medina,(2003). "Application of Enterprise Models and Simulation Tools for the Evaluation of the Impact of Best Manufacturing Practices Implementation," Annual Review in Control, Pregamon, pp. 221-228.
6. Juhani Heilala, Jari Montonen, Paula Jarvinen and Sauli Kivikunnas ," Decision Support Using Simulation for Customer-Driven Manufacturing System Design and Operations Planning," ISBN: 978-953-307-069-8.

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