Investigation Of The Effects On Dispatch Performance Of A System By Utilizing A Simulation Model

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Abstract : The production control strategy is related to the production system engineering which is more concerned with the flow of parts in the system rather than the operation technology. The production control strategy deals with the information flow which in turn helps in maintaining the material flow as well as optimum utilization of monetary resources of the company. And as we know in real life scenario companies are mainly focused on utilizing the available resources optimally and satisfying the customer demand. which in turn helps in gaining profit for the organization. This study has been undertaken for understanding the production control strategy involved and to investigate the effects on dispatch by varying various factors. A simulation model is prepared and utilized for the purpose of understanding the production control strategy as well as for comparing the effects on dispatch of the system. The effects on performance of dispatch are compared with the present system. The results have shown a considerable amount of improvement in the dispatch due to the applied changes in the model.

Index Terms **- Production Control Strategy, Simulation Model, Effects on Dispatch**

I. INTRODUCTION

As we all are fully aware with the current growth in the market scenario, and this has lead industries to set their eye on the market in order to grasp the opportunity to gain the advantage over it. Due to this, there has been an increase in competition between the manufacturing industries. So for the industry to maintain their position in the today's rapidly growing environment these industries have to increase their efficiency and profitability. Thus, the industries have to utilize their resources in a more efficient and effective manner. Hence in order to do so, production control strategies are utilized by the industries. The production control strategy is related to the production system engineering field. The main purpose of the production control strategy is to manage the information flow. The production control strategy is used to regulate and control the flow of material and information in the production system[1]. In a manufacturing system, the efficient acquisition and transmission of information are crucial to production control implementation[2]. And so, the accurate flow of information is important for better controlling. The accuracy of information flow can result in affecting the system in such a way that either there will be a smooth production or there will be an interruption in the production.

II. LITERATURE REVIEW

Based on the flow of parts, information and release of orders we can divide production control strategy into three different types namely push type, pull type, and push-pull or hybrid type[1]. The push type approach can also be said to be a conventional a conventional approach[3]. In a push type system jobs are released on the basis of forecasted demand and raw material availability[1]. This helps in tackling the variation in demand since there's always a certain amount of inventory present in the store[3]. In a pull type system rather than using forecasted demand actual demand made by the customer is utilized[1]. We can also say that the downstream plays the major role in deciding the ordering quantity[5]. But we can often see that the application of push type strategy is more as compared to pull due to its early emergence industrial sector[4]. Although both of them have their own merits and demerits[4]. Then comes the hybrid or push-pull strategy, this strategy basically incorporates merits of push or pull or both of the systems[1]. The hybrid system can also be classified into the two categories the first one is vertically integrated and the second one is horizontally integrated[5]. The vertically integrated systems consist of two levels, an upper-level push-type production control system and a lower level pull-type production control system[5]. A lot of research nowadays is more focused on hybrid strategy. The strategies that fall under push, pull, and hybrid is MRP, JIT, and POLCA respectively. Apart from the strategies customer satisfaction also plays a major role in the obtaining a competitive advantage over other industries. We can also say that the customer satisfaction act as a parameter for evaluating an industrial scenario. In order to satisfy the customer, the company has to meet the customer's demand. Which means providing a good quality product on the designated time to the customer. Some studies are also done in order to determine the factors for evaluating the performance of an industrial system[6]. There are many factors such as delivery reliability, cost, environment, quality etc[7]. These factors are often known as performance indicators or more specific key performance indicators. The key performance indicator helps in improving the decision making[8]. Also, there is a lot of studies in which simulation models are utilized for demonstrating various kind of process and systems. The

simulation model provides the insight into the performance of the described system[9]. The simulation model utilizes various sets of data and allows the user to observe an operation through simulation without actually performing that operation[10]. This paper focuses more on simulation modeling and understanding of the production control strategy. A simulation model is prepared as further explained in the methodology. Based on the results for dispatch adherence the performance of the system is measured for different cases.

III. RESEARCH OBJECTIVE

1. The overall objective was to study and understand the utilization of the production control strategy. The specific objective for the paper are as follows:
2. To study and understand about the various production control strategies.
3. To develop and investigate the simulation model of the present scenario so as to understand the situation and surrounding of the system.
4. To perform a comparative analysis on the virtual replication model of the industrial scenario by utilizing various cases in order to understand and analyze the effects caused due to variation in the system .

IV. CASES

The cases demonstrate the various inputs in the model. Three cases are considered the first two are the part of inventory level which can help in satisfying the customer order and the third is the inclusion of several machines in order to support the system in times of heavy workload. The cases are described below:

Case-1: This is a case of inventory level in this a 10% of finished goods inventory is considered for each of the products so as to improve the dispatch adherence of the system. Since there the system takes times to complete the product and the main objective is to satisfy the customer a certain amount of finished goods inventory is necessary to fulfill the order on time. Also, we cannot deny the fact that there can be a number of problems (i.e. breakdown, late delivery of raw material etc.) that can hinder the dispatch performance of the industry. So, in order to avoid these problems, this case is considered.

Case-2: This is also a case of inventory level in the execution of model is same the case-1 the only difference is instead of considering a 10% amount 15% finished goods inventory are used so that the dispatch adherence can be further improved.

Case-3: In this case, several numbers of machines are considered to support the system during the heavy workload. In order to do so the machines with the highest busy time or say the high workload is provided with support machines for the faster completion of the work presented to the particular machine.

V. METHODOLOGY

Purpose: The purpose of utilizing the methodology is to fulfill the goal of the paper. The methodology helps to show the working of a production control strategy in a real-time environment. It also provides a general view of the real-time scenario of the industry environment. It can be said that rather than studying definition and comparison this will help in understanding the practical nature of a system as well as its effects. The method will provide a quantitative data which will concern the working of the machines and effects on the job due to processing.

Description: A simulation model is made in order to study the industry environment utilizing a production control strategy (i.e. MRP). A simulation model tool (i.e. Witness simulation software) is used for making the model. The tool helps to prepare a replica model of the present scenario. To make a model a set of information is required such as cycle time, setup time, the flow of the jobs etc. Then after replicating all the factors involved in the industry environment, a simulation run is performed for a month period of time. The tool then provides a set of stats related to working and elements involved in the system. The set of information is then refined for the use of performing the study on the system. Then after replicating the system different type of variation are provided to the system and a simulation run is performed again representing the cases involved in the study of the system. These cases are then utilized to perform a comparative analysis with the current system.

Tool Utilized: Witness Simulation Software is used as the tool for performing the simulation. The witness utilizes the various set of elements, codes, and utility tool for replicating the model. Each element contains various dialogue boxes which can be used for the input of data as well as for coding the system. The input data for elements are the simple set of information such as the type of machine, the capacity of the machine, cycle time, setup time etc which contains the numeric value. Then comes the coding formulas which are used for coding of the elements involved in the system so that the system can perform as per the requirement. The coding data is used so that the elements can perform a complex operation. Coding is also used for generating the desired data from the elements which can generally not be obtained from the simulation. A separate set of coding is provided to obtain the desired results. After performing a simulation run the software provide a set of data involving each and every element inside the system. The data obtained is in the form of various stats and graphs considering the elements. The stats involve each and every effect of the system which in turn helps in the study of the current system as well as effects caused due to variations in the system.

Steps: There are various number of steps involved in the completion of the work. These steps are performed so that each of the specific objective can be obtained in a definite manner. The steps are as follows:

- Study the literature related to production control strategy and simulation modelling.
- Acquire the required data for modelling the industrial scenario.
- Build the simulation model.
- Inspect the simulation model for issues.
- If a problem occurs then rework on the model.
- Run the simulation model for the required time.
- Obtain necessary stats and refine them as per requirement.
- Generate results and prepare required graphs for study.
- Perform a comparative analysis of results.
- Finally, draw the conclusion utilizing the stats and results.

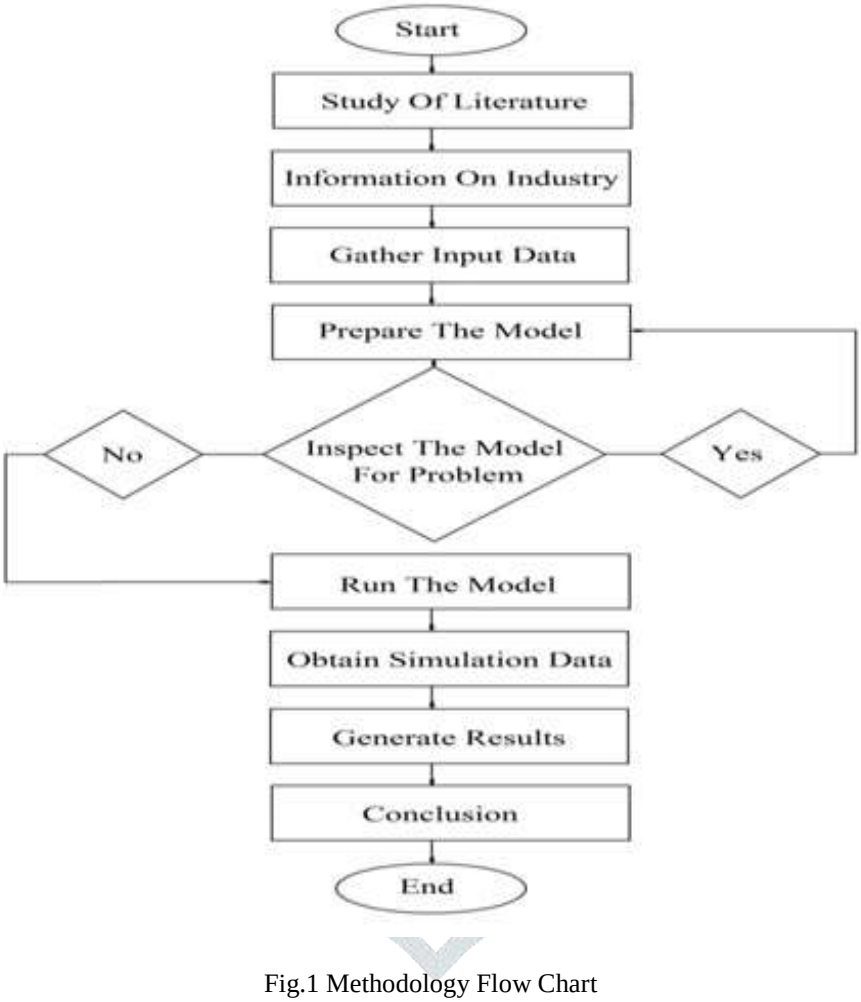

Fig.1 Methodology Flow Chart

VI. MODEL

In the simulation model, we are considering an industrial environment consisting of twenty-four different machines (M1, M2…....., M24) in it. These machines are used to process twenty-two different jobs (JN1,....JN11, JG1….., JG11) having a pre-specified flow in the system. These twenty-two jobs are then assembled into two different products namely product 1 and product 2. Both product 1 and product 2 consists of 11 different jobs. Each of the flow is separate from each other for each of the 22 jobs. There are separate buffers for each of the products processing through the machines. The jobs move according to the flow through the designated buffers in order to reduce the confusion of flow and machine sequence. In the model, it is assumed that the raw material is available at the start of the simulation. All the machines are batch machines with different batch sizes. The size of the batch can be similar for all the jobs or maybe different for all the jobs passing through the machines it may differ according to the input in the machine. While the machine inputs the jobs it divides the jobs into the ratio as per the provided programming. Programming is also used for maintaining the batch size. The sequence of processing the job is general. The machine searches the input buffers and according to the availability of products, it processes the jobs. As the jobs are finished processing through the machines the jobs are then sent to an input buffer of another machine. When the jobs are finished through all the designated processes the processed jobs then move to the final buffers. There are 22 separate final buffers (i.e. NA1,.....NA11,

GA1,.....GA11) for all the jobs. After the jobs enter the final buffer they then move to the assembly machines (i.e. Assembly_1 and Assembly_2), the product 1 and product 2 are then sent to their designated store buffers. These products are then shipped according to the order. There is a whole separate arrangement provided in the simulation model for order generation. A month schedule is considered for the order generation and the simulation time is also the same.

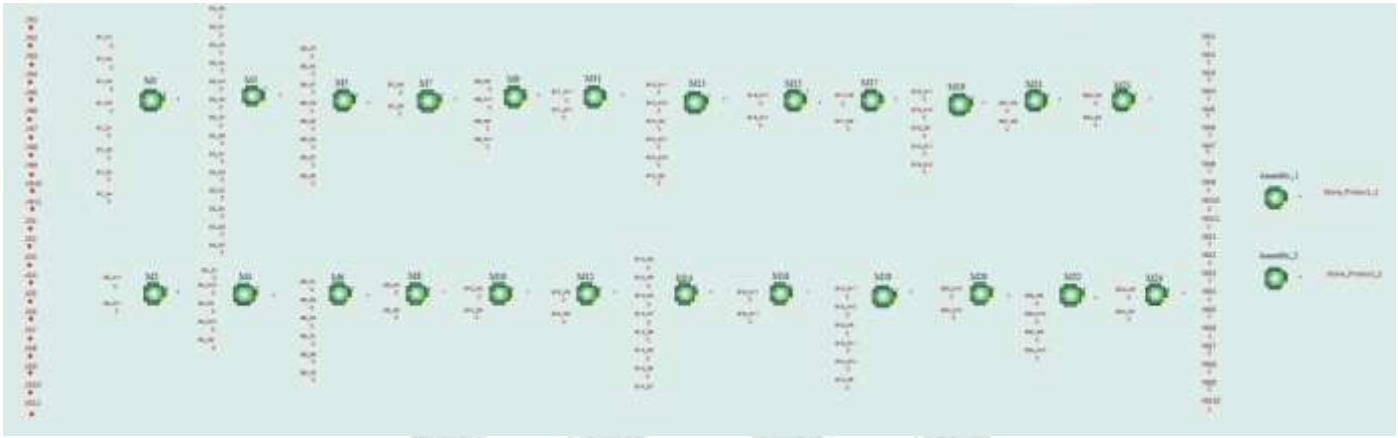

Fig.2 Simulation Model

VII. RESULTS

Figure 3 and 4 display the effects on dispatch performance of present scenario with respect to the cases. Both the figures have cases on the x-axis and dispatch adherence on the y-axis. In both the green bar representing the cases and the blue bar represent the present scenario. The figure 3 and figure 4 demonstrate the dispatch performance of product 1 and product 2 respectively. The clustered columns are utilized to show the difference in dispatch performance of the cases and the present scenario for both product 1 and product 2. The dispatch adherence for the present scenario for product 1 is 82.65% and product 2 is 58.99%. And, the dispatch adherence for case-1, case-2, and case-3 for product 1 are 106.06%, 116.56%, and 97.59% respectively. Similarly the dispatch adherence for case-1, case-2, and case-3 for product 2 are 68.39%, 77.93%, and 62.24% respectively. The results make it pretty clear that by considering either finished goods inventory or several machines both of them will increase the dispatch adherence of the present system.

Fig.3 Dispatch Graph (Product 1)

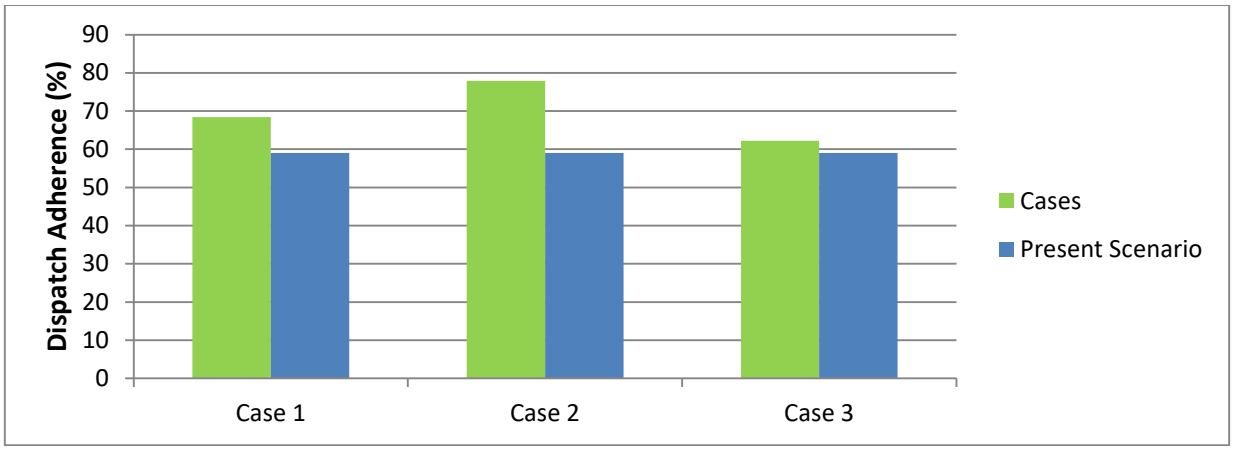

Fig.4 Dispatch Graph (Product 2)

Results for both Product1 and Product 2 have clearly shown an improvement with respect to the present scenario. The rise of Product 1 is 23.41, 33.91, and 14.94 for case 1, case 2, and case 3 respectively. As for Product 2, the rise of case 1, case 2, and case 3 are 9.4, 18.94, and 3.25 respectively.

VIII. CONCLUSION

The study was conducted considering an industrial scenario. A certain set of data was utilized in order to develop a simulation model as well as for performing a comparative analysis on the dispatch of the products. In the result, considering the dispatch performance for both the products are higher as compared to the present system. It can be said that the dispatch performance obtained by varying the model proved to be a success.

XI. FUTURE SCOPE

As the word future scope we can say there is the number of chance for the expansion of the work. Such as inclusion of various external and internal factors like the customer, supply chain, labor input, shift time, small elements (i.e. conveyor etc.), departments and their functions etc. These factors will help in making the model more precise from the real-life point of view. Further, In addition to the mentioned points, we can also use a hybrid push-pull strategy which is proven to be more effective as compared to the traditional push, pull strategy. This can provide a new perspective for the industrial scenario and could help as a references in the near future.

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