

Review on Manufacturing Predictive simulation: Use of WITNESS SIMULATION SOFTWARE

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Abstract—Simulation is a necessary set of technological tools and methods for successful implementation of digital manufacturing by way of predictive simulation, since it allows for experimentation and validation of the product, process and system design and configuration. Especially in today's quick changing manufacturing environment, which is affected due to factors like globalization, product customization, government rules enforcements and changing demand of the customer resulting in changing market trends, the value of simulation is evident. It allows learning and testing the manufacturing environment virtually. The paper here, details out the simulation and its applications and benefits. It includes discussion on how simulation is a way to digitalization and its benefits to Indian society in the field of science and technology.

Keywords— Manufacturing, Predictive simulation, WITNESS, Digitalization.



I. INTRODUCTION

For an industry to sustain in today's fast growing and changing market situation and attain the competitive advantage in global market scenario, they have to implement new strategies, which give them advantages such as flexibility, quick responsive, cost efficiency, quality, reliability and service. To achieve this, industry needs to implement the changes in the existing system. Implementing the changes is difficult task for any organization. Simulation helps out in such cases as it allows designers to imagine new systems and also enables them to both quantify and observe the behavior in advance. This simulation is a new digitalized approach of predicting the behavior of system or product or process well in advance before application and helps in tracing out the errors if any.

Manual work and automation are the complementary elements in the modern production systems. The increasing customization and shortening product life cycle have led to smaller batch sizes and more varying products. The intelligence and adaptability of human workers make them the most flexible part of the production process. However, production must be optimized with respect to human well being and environmental sustainability.

Simulation software is based on the process of modeling a real phenomenon with a set of mathematical formulas. It is, essentially, a program that allows the user to observe an operation through simulation without actually performing that operation. Simulation software is

used widely to design equipment so that the final product will be as close to design specs as possible without expensive in process modification. When the penalty for improper operation is costly, such as airplane pilots, nuclear power plant operators, or chemical plant operators, a mock-up of the actual control panel is connected to a real-time simulation of the physical response, giving valuable training experience without fear of a disastrous outcome.

II. VISUAL INTER ACTIVE SIMULATION

The role of simulation is to evaluate practical alternatives available either in support of major strategic initiatives which might involve a large financial outlay, or in support of the continuous search for better performance at operational and tactical levels. Examples of such evaluations include changes to the product mix, increases or decreases in volumes, improvements in throughput, shorter lead times and improved customer response times. Simulation provides the user with a greater breadth and depth of information on which to base decisions: it is not an optimizing tool. It is capable of handling the complexity of large systems, even a whole factory. In addition, the simulation approach supports sensitivity analysis by allowing rapid changes to the model logic and data.

"Visual Interactive Simulation is one which has features for graphical creation of simulation models, dynamic display of the simulated system and user interaction with the running program. Interaction implies that the simulation halts and requests information from the user or the user stops the simulation at will and interacts with the running program."

WITNESS is Lanner Group's simulation software package. It is the culmination of more than a decade's development experience with computer based simulation.

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III. WITNESS SIMULATION SOFTWARE: A WAY TO DIGITALIZED MANUFACTURING[3]

WITNESS is used to simulate full production runs, over an arbitrary time period. This allows people designing a facility to get a preview of how the production lines might operate in actual. This is a good way to predict and solve any problems and inefficiencies that may present in them if the production lines were built in the current configuration. WITNESS makes obvious any production bottlenecks, overly-idle resources, storage areas that are too small or large and any potential issues with respect to labour attending to the processing of parts.

The WITNESS Simulation Software helps in building a simulation model which is nothing but the dynamic representation of somepart of the realworld sufficient to ensure that visualization using this model is adequately accurate predictor of the reality. WITNESS is a comprehensive discrete event and continuous process simulator. It is designed to model the dynamics of complex systems. It is an established simulation tool used by thousands of organizations worldwide for analysis and validation of business process, to achieve a desired process performance or to support continuous process improvement activities. WITNESS provides a graphical interface to build simulation models. It enables to represent a real world process in a dynamic animated computer model and allows automating simulation experiments, optimizing material flow across the facility, and generating animated models. A simulation model can incorporate all the variability's of real life experience which may come in actual (variable reliability, process times, resource efficiency etc.).The WITNESS simulation package is capable of modeling a variety of discrete (e.g.,part-based) and continuous (e.g., fluids and high-volume fast-moving goods) elements. Depending on the type of element, each can be in any of a number of "states". These states can be idle (waiting), busy (processing), blocked, in-setup, brokendown, waiting labour (cycle/setup/repair) etc. Complex routing and control logic is achieved with numerous input and output rules as well as special actions using functions. The format for using actions is similar to that of a simple programming language. Piecharts, time-series and histograms provide a meaningful, easily-read format for data from a simulation model run. Reports allow user to examine the performance of elements in the model and provide him with relevant information about their interaction, details and status. Reports can help to identify areas where the model's operation can be improved.

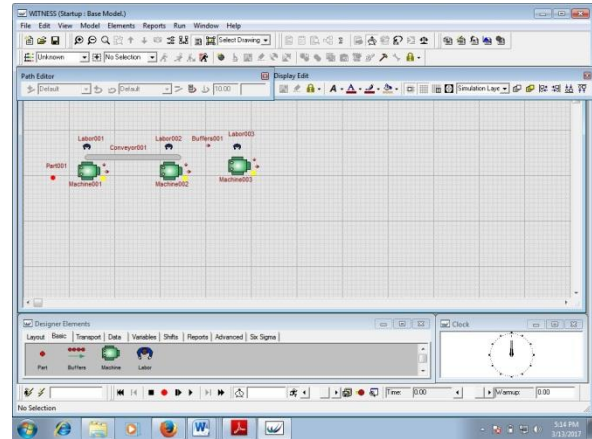


Fig.1. WITNESS Simulation Software Interface

The benefits of using WITNESS Simulations Software can be listed down in two basic categories namely,

- 1) Quantitative benefits
- 2) Qualitative benefits

The quantitative benefits include use of WITNESS enabling evaluation of how to reduce lead time, increase capacity, reduce work in process, reduce operating cost, improve efficiency, capital justification, optimal use of the space etc. the figure 2 below shows these benefits.

On the other hand the Qualitative benefits include use of witness simulation software to support decision making and action taking in reducing risk, testing assumptions, cause and effect analysis, communication and understanding within team, solution to right question etc. The figure 3 below depicts these benefits.

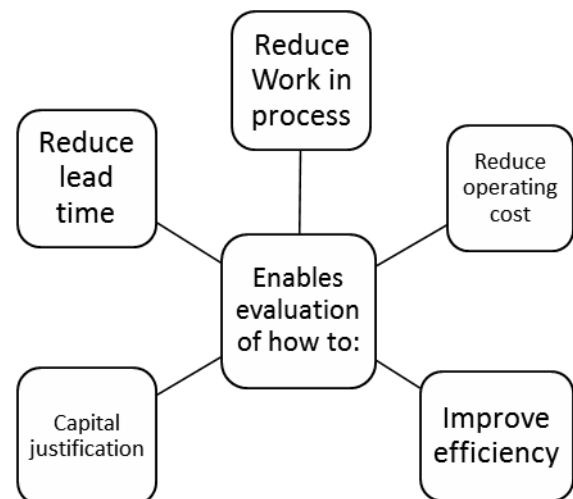


Fig.2. Quantitative benefits of simulation

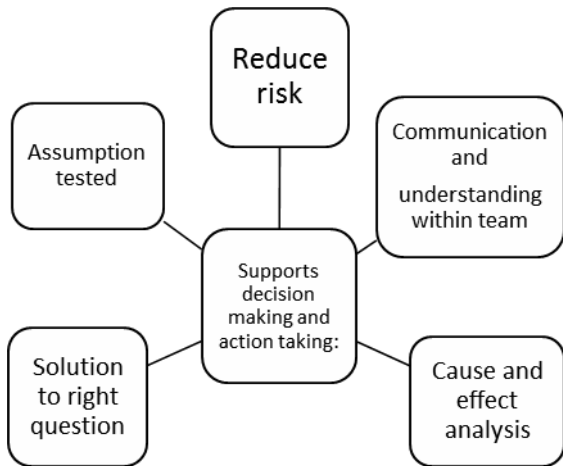


Fig.3. Qualitative benefits of simulation

IV. DIGITALIZATION IN MANUFACTURING SIMULATION AND ITS IMPACT ON INDIAN SOCIETY:

In this chapter we will discuss on how manufacturing simulation is connected to digitalization and what is its impact on Indian society?[3]

Thus the WITNESS Simulation Software helps us in predicting the behavior of the process well in advance, analyze it and try making different configurations in it as per requirement. The changes can be made by simulating it and the corresponding change in the resulting process can be easily observed and decision can be made based on this simulation. How it is connected to digitalization is, because it is the use of computer, software, programming, and various digital aids in its application. It gives a virtual visualization of what is going to happen and how it is going to occur. To talk about the impact of this digitalization on Indian society, we can say that this digitalization is more over a king of automation and most of the automation reduces employment. But in this case, use of witness does not really reduce the manpower and goes for unemployment unlike other automations. Yes unlike others it also needs skilled man force. But talking about the impact on society in other sense, we can say that it gives quality output to the society, it reduces many costs associated in development stage or early phases of any manufacturing.

For a growing country like India it is always beneficial to make use of such digitalization aids so that the time to market will be minimum possible with better quality of product and take over the competitive advantage.

V. CONDUCTING WITNESS SIMULATION PROJECT[6]

Projects that involve simulation have several unique aspects which must be managed particularly carefully to ensure their success. The typical practical methodology that can be implemented is outlined below.

1. Establishing objectives

2. Decide the scope and level of detail for simulation model
3. Collect data
4. Structure the model
5. Building and running the model
6. Generating reports
7. Testing the model
8. Experimenting with model
9. Documenting the model
10. Presenting the results and implementing them.

This is the first and most important phase of any simulation project. The aim of any simulation project should be to make a better business decision. You, as simulation modeler, must understand this business decision as it is likely to have important implications for the content of your simulation model. The scope of a simulation model refers to where it begins and where it ends. It is important to limit the scope of the model as far as possible. With regard to the level of detail contained within a model, the golden rule is to model the minimum necessary in order to achieve the model's objective. Information for a model is likely to fall in to one of three categories;

1. Available-data is readily available and it is in an appropriate format that the model can use immediately.
2. Not available but collectable-data is either in an incorrect form at or it has not been collated before. You might need to perform a small work study in order to collect this type of data (for example, timing certain processes manually).
3. Neither available nor collectable-data is not currently available and it is not easily collectable (for example, for a model of a new factory on a green-field site with new machinery). If the data is neither available nor collectable, you must use estimates. When ever you use an estimate, you should declare it as an assumption upon which the model is based. If at all the simulation fails then it becomes easier to rectify the assumptions made to correct the false. An important final step before building the simulation model is to structure it. This will identify the most difficult are as for the model building and highlight any additional data requirements that may have been over looked up to now, such as a transfer time for parts between processes. It should identify the elements to be used from witness to model the real time process.

The WITNESS Simulation software package allows modeler to simulate the process and analyze its performance, observe the process by making various experimental changes. This helps in improving the efficiency of the process before actual commissioning of the process. This software also helps in simulating assembly lines of product and analyze the assembly process for productivity, reduction of WIP, cycle time etc. the WITNESS package allows user to use many basic elements required for simulation which are common in most of the simulation requirements. Besides this, WITNESS also allows user to customize the element based on requirement of simulation. It also allows user to define its own variables for simulation

and correlate them with the existing parameters. It also allows defining the input output rules for product flow in the process. It has a facility of using various elements in various configurations as per the requirements from the business.[4]

WITNESS has a programming flexibility using functions defined in built. It also has a facility to add attributes to the elements of simulation model to have better understanding of the model to new user.

CONCLUSION

The main objective of this paper was to discuss about how manufacturing simulation is a digitalization and how it affects Indian society. Thus we had our view on manufacturing simulation, its applications and benefits in industry.

Why it is called as predictive simulation is also discussed in this paper. How this predictive simulation helps industries to improve the productivity, reduce cost and improve quality is by giving digital virtual view of the things that will be done in future. Thus pre observance and pre analysis are the two main aspects of this manufacturing simulation. Simulation helps in making required changes in system in initial phase only to avoid any inconvenience and observe the system behavior again with changes made. Thus at last we can say that simulation is a way of digitalization to get virtual view of future in advance.

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