International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 12 | Dec 2019 www.irjet.net p-ISSN: 2395-0072

Review Paper on Manufacturing System Performance Improvement by Modeling and Simulation

Mr. Kanse Ashish Balasaheb[1]

[1]M.Tech (Mech-Production) Student, Department of Mechanical Engineering, KIT's Collage of Engineering, Kolhapur

---

Abstract: *This review paper focuses on the design and development of different activities that emphasizes the application of simulation capabilities as a tool to aid the continuous improvement process in manufacturing. Such paper concentrates on the analysis of standard approaches to modelling production systems. Simulation is a powerful tool to enable companies save their time and cost. It is not only used to measure the plant performance but can be used to understand the behaviour of current system, evaluate various types of operational strategies or enable users to experience the operation without disturbing the system. By using the simulation method, lots of advantages can be obtained such as reducing time on rearranging the factory layout, saving costs, increase profit, increase productivity, reduce idle time, reduce lead time, and so on.*

Key words: Simulation and Modeling Software, Plant layouts, Production processes, Model of layout.

1. Introduction:

Simulation is a descriptive technique in which a model of a process is developed and then experiments are conducted on the model to evaluate its behavior under various conditions. It is a process of designing a model of a real system and conducting experiments with the model for the purpose of understanding the behavior of the system or evaluating various strategies for the operation of the system. Simulation does not only apply in the industrial sector, but it can be applied in many other sectors such as service sectors, educational, movies, games, training and many more. Once the model has been validated and the actual model is established, study was carried out on the current shop-floor layout to seek the opportunities for performance improvement. By using the simulation method, users enable to get experience from the operation of the target equipment without possibility of destroying the equipment or disturbing the system. It can be used to shorten design cycles, reduce costs, and enhance knowledge.

Productivity is generally defined as the ratio of an output to the unit of all of the resources used to produce this output. Productivity usually has different meaning commonly associated with departmental effectiveness in industry from production. Production concerning output over a given time period. Improving productivity with respect to labor, capital, material, machine etc. and to do with people from different frames of an organization. However, plant layout improvement, could be one of the tools to response to increasing industrial productivities

There are many programs designated to simulate production processes like FlexSim, AnyLogic, Arena, Process simulate and Simio are often used for determining Industrial and Systems Engineering solutions for various service and production systems. **Features of Simulation Software:**

Desirable features of simulation software include,

- User-friendliness;
- Needs to be easily understood by users;
- Allowing modules to build from sub-modules;
- Allowing users to write and incorporate their own routines;
- Include material-flow capability;
- Capability of producing standard output statistics such as cycle times, utilization, and wait times;
- Graphical display of the product flow through the system with animation;

Advantages and Disadvantages of Simulation software's:

The advantages of using a simulation software solution include,

- Independent from the real system therefore it doesn't impact the daily work flow;
- Helping to understand the details of the simulated real system;
- Generates a set of numbers for different possible scenarios that can be used for industrial engineering solutions;
- Providing a replication of the system more realistically compared to mathematical modeling;
- Transient period analysis is possible while such an analysis is may not be possible using mathematical techniques;

The **disadvantages** include,

- Reliability may not be possible;
- Structuring a simulation model can take a lot of time;

- Simulation results can be less accurate compared to mathematical models' analysis due to the random number generation nature;
- Unstandardized approach to solve problems.

2. Literature Review:

1: Luis Gonzaga Trabasso et al (2016), presented paper on A Proposal Simulation Method towards Continuous Improvement in Discrete Manufacturing **[1].** This paper presents the work seeks to systematic analysis for layout modifications carried out during kaizen events in discrete manufacturing companies. Discrete manufacturing companies need often a flexible manufacturing system that can develop quality and time-to market according to product demand fluctuations.

A lot of companies have chosen to apply changes in their shop floor by means of Kaizen events which are characterized, in part, by direct experimentation and trial and error cycles.This analysis can be done by means of collaborative tools for manufacturing environment simulation, since these tools are attached to the practices applied by the corporation. In this context, the main contribution of this paper is on the systematic merging of a traditional discrete event simulation method with the kaizen event method.

2: N.H. Saad et al (2005), presented paper on manufacturing plant performance analysis using simulation technique **[2].**In this paper we look in to the management process of a discrete event simulation project. The objective employs the general principle recommended in the PMBOK to integrate with simulation methods for improving the project execution performance. To achieve this goal we developed a management plan of the steps involved in the project management model using the knowledge areas proposed by PMBOK. The goal of this paper is not to conduct a simulation model with modelling, verification, and validation phases, indeed some aspects around a simulation project are been considered.

03: Mateusz Kikolski et al (2016), presented paper on Identification of production bottlenecks with the use of Plant Simulation software **[3].** Improving the functioning of workstations that delay the production is a crucial issue. However, it should be noted that before taking action aimed at improving the operation of workstations defined as bottlenecks, it becomes crucial to identify their precise location. Identifying a bottleneck in the system is the first stage of managing constraints according to the Theory of Constraints. It involves localising the system's limitations. The following are other stages of managing constraints that can also be used in the analysis of computer-assisted simulation models:

• Making a decision on the manner of using a bottleneck;

• Subordinating all other operations to the decisions made in stage two;

• Eliminating the system's bottleneck;

• Returning to stage one and preventing the limiting effect of inertia.

05: Dominika leks et al (2014), presented paper on application of FlexSim for modeling and simulation of the production process **[5].**There are many programs designated to simulate production processes. One of them, presented in this paper, is FlexSim. FlexSim simulation program is used primarily for modelling, simulation and visualization of business processes. Importantly, it can help to solve inventory and work in progress(WIP) problems, to optimize the production line, to determine business performance, to manage bottlenecks, to test new planning practices, to justify productivity and capital expenditure. FlexSim allows to realize and animate3D models and to create models directly using C ++.

06: Akshay D. Wankhade et al (2017), presented paper on Productivity Improvement by Optimum Utilization of Plant Layout: A Case Study **[6].** The paper is intended to study, understand the problems/issue faced by this small industry and its implementation study on small plants among those one to improve its efficiency and reliability. This research aims to improve the plant layout of milk industries to eliminate obstructions in material flow and thus obtain maximum productivity. The different optimized plant layout models has to be designed and their simulation using available software will result out the increase productive plant. Actually optimization is complicated due to many related factors such as workflow, machine positions, and the relationship between machines and work. These mentioned factors result in plant layout improvement planning. Hence, the primary step for plant layout improvement should be started with identifying the problems of the current plant layout in order to maximize the productivities at the minimized investment but, it is important that products which have good quality products and meet customers' demand.

07: Jianliang Peng (2007), presented paper on Simulation and Optimization of Production Logistics System Layout based on Flexsim **[7].**Production of modern logistics system simulation through the simulation aims to understand various statistics and dynamic performance which the material transport and stored dynamic processes. If using of simulation software, it can help staffs to effectively complete optimizing the layout design in the system layout and commissioning the system can save time and resources. Flexsim is developed commercial discrete-event system simulation software by Flexsim Software Production

Company in the United States, which combines three-dimensional computer image processing technology, simulation technology, artificial intelligence technology, and data processing technology as a whole.

08: Vijay Bhaskar et al (2017), presented paper on Modeling and Analysis of a Manufacturing Plant Using Discrete Event Simulation **[8].**Simulation is the representative model for real situations. It is represent the reality to observe, what would happen under real operating situations. Thus, such representation to reality, which may be either in physical form or in a mathematical equations form, may be called simulation.

09: E.Tokgoz et al (2017), presented paper on Industrial Engineering and Simulation Experience Using Flexsim Software **[09].**Industrial engineering is a branch of engineering which deals with the optimization of complex processes, systems or organizations. Industrial engineers work to eliminate waste of time, money, materials, man-hours, machine time, energy and other resources that do not generate value. Simulation software such as FlexSim, AnyLogic, and Simio are often used for determining Industrial and Systems Engineering solutions for various service and production systems. Simulation solutions are also often obtained for various engineering problems.

10: Liu Haidong et al (2004), presented paper on Workshop Facility Layout Optimization Design Based on SLP and Flexsim **[10].**This paper comprehensively utilizes SLP and Flexsim simulation software to perform optimization design for the workshop facilities, and reaches the goal of improving the production efficiency, making the logistics smooth, shortening the carrying distance, and efficiently applying the space.

3. Simulation software for manufacturing applications:

Most organizations that simulate manufacturing or material-handling systems use a commercial simulation software product, rather than a general-purpose programming language. Furthermore, the two most common criteria for selecting simulation software are modelling flexibility and ease of use. A simulation language is a software package that is general in nature and where model development is done by "programming." Traditionally, programming meant the development of a simulation model by writing code, but in recent years there has been a strong movement toward simulation languages that employ a graphical model-building approach. The major advantage of a good simulation language is modeling flexibility, whereas the major disadvantage is that programming expertise is required.This type of software has two main characteristics:

- Orientation is toward manufacturing
- Little or no programming is required to build a model (relative to simulation languages)

For example, manufacturing simulators have such fundamental modelling constructs as machines, parts, and conveyors. Since in the real world conveyors can come in a myriad of forms, there is a good chance that none of the built-in conveyor options is completely correct. Furthermore, because of the fundamental nature of the conveyor modelling construct, it may not be possible to change their logic in a substantive manner. The distinction between simulation languages and simulators has become less clear in recent years. Languages have gone to graphical user interfaces to increase ease of use and simulators have added some programming capabilities to increase modelling flexibility. However, we can still say that a simulation language is general in nature and uses programming to develop a model. Simulators, on the other hand, are application specific and, perhaps, at most 20% of the model is developed using some form of programming.

4. Developing valid and credible simulation models:

A simulation model is a surrogate for actually experimenting with a manufacturing system, which is often infeasible or not cost-effective. Thus, it is important for a simulation analyst to determine whether the simulation model is an accurate representation of the system being studied, i.e., whether the model is valid. The following are some important ideas/techniques for deciding the appropriate level of model detail for validating a simulation model, and for developing a model with high credibility:

- State definitively the issues to be addressed and the performance measures for evaluating a system design at the beginning of the study.
- Collect information on the system layout and operating procedures based on conversations with the "expert" for each part of the system.
- Delineate all information and data summaries in an "assumptions document," which becomes the major documentation for the model.
- Interact with the manager on a regular basis to make sure that the correct problem is being solved and to increase model credibility.
- Perform a structured walk-through (before any programming is performed) of the conceptual simulation model as embodied in the assumptions document before an audience of all key project personnel.
- Use sensitivity analyses to determine important model factors, which have to be modelled carefully.
- Simulate the existing manufacturing system and compare model performance measures to the comparable measures from the actual system.

5. Statistical issues in simulating manufacturing systems:

Since random samples from input probability distributions "drive" a simulation model of a manufacturing system through time, basic simulation output data (e.g., times in system of parts) or an estimated performance measure computed from them (e.g., average time in system from the entire simulation run) are also random. Therefore, it is important to model system randomness correctly and also to design and analyze simulation experiments in a proper manner. These topics are briefly discussed in this section.

Modelling System Randomness:

The following are some sources of randomness in simulated manufacturing systems:

- Arrivals of orders, parts, or raw materials
- Processing, assembly, or inspection times
- Machine times to failure · Machine repair times
- Loading/unloading times
- Setup times

In general, each source of system randomness needs to be modelled by an appropriate probability distribution, not what is perceived to be the mean value.

Design and Analysis of Simulation Experiments:

Because of the random nature of simulation input, a simulation run produces a statistical estimate of the (true) performance measure not the measure itself. In order for an estimate to be statistically precise and free of bias, the analyst must specify for each system design of interest appropriate choices for the following:

- Length of each simulation run
- Number of independent simulation runs
- Length of the warm up period, if one is appropriate

We recommend always making at least three to five independent runs for each system design, and using the average of the estimated performance measures from the individual runs as the overall estimate of the performance measure. This overall estimate should be more statistically precise than the estimated performance measure from one run. For most simulation studies of manufacturing systems, we are interested in the long-run behaviour of the system, i.e., its behaviour when operating in a "normal" manner. On the other hand, simulations of these kinds of systems generally begin with the system in an empty and idle state. This results in the output data from the beginning of the simulation run not being representative of the desired "normal" behaviour of the system. Therefore, simulations are often run for a certain amount of time, the warm-up period, before the output data are actually used to estimate the desired performance measure. Use of the warm-up-period data would bias the estimated performance measure.

6. Simulation analysis of a manufacturing system:

In the actual analysis of a manufacturing system we will address the following issues:

- Evaluating different machine resource levels.
- Sizing of work-in-process buffers.
- Determining the impact of random machine downtimes.

7. Conclusion:

Our paper tried to look for the management process of a discrete event simulation project. As results of this paper, the specifications from this simulation project were considered, so the joint research areas were proposed, taking principles of project management and applying it to simulation project. The Flexsim program is a powerful analysis tool that helps engineers and planners to make more sophisticated decisions on the design and operation of the system. The aim of this paper was to present the problems of modeling and simulation as well as to describe the basic tools used in this process.

References:

1. Victor Emmanuel de Oliveira Gomesa,b, Luis Gonzaga Trabassoa, A Proposal Simulation Method towards Continuous Improvement in Discrete Manufacturing, 49th CIRP Conference on Manufacturing Systems (CIRP-CMS 2016)

2. N.H. Saad, M.A.A. Farouk, Z. Mohamed and A.R.M. Sahab, manufacturing plant performance analysis using simulation technique, 2nd International Conference on Mechatronics, Kuala Lumpur, Malaysia.

3. Jose Arnaldo Barra Montevechi, Amarnath Banerjee, Federal University of Itajubá, a study on the management of a discrete event simulation project in a manufacturing company, 2016 Winter Simulation Conference.

4. Mateusz Kikolski, Identification of production bottlenecks with the use of Plant Simulation software, ISMSME 2016 pages: 103-112.

5. Dominika LEKS, Aleksander gwiazda, application of FlexSim for modelling and simulation of the production process, 2006.

6. Akshay D. Wankhade1, Dr. Achal S. Shahare2, Productivity Improvement by Optimum Utilization of Plant Layout: A Case Study, Volume: 04 Issue: 06,2017.

7. Jianliang Peng, Simulation and Optimization of Production Logistics System Layout based on Flexsim,2007.

8. Radha Krishna R., Siva Krishna S, Vijay Bhaskar A, Sriram G, Vamsi P, TVSRK Prasad, Modeling and Analysis of a Manufacturing Plant Using Discrete Event Simulation, Int. Journal of Engineering Research and Application, 2248-9622, Vol. 7, Issue 2, (Part -3) February 2017, pp.49-54.

9. E.Tokoz, Industrial Engineering and Simulation Experience Using Flexsim Software, Computers in Education Journal, Volume 8, Issue 4, December 2017.

10. Liu Haidong,Workshop Facility Layout Optimization Design Based on SLP and Flexsim,2005.

11. Averill M. Law,Michael G. McComas, simulation of manufacturing systems, 1997 Winter Simulation Conference, U.S.A.