JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A REVIEW PAPER ON APPLICATION OF WITNESS SIMULATION SOFTWARE IN INDUSTRY 4.0 FOR LAYOUT OPTIMIZATION

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Abstract : Simulation is an important technology for developing planning and testing models to improve decision-making, design and operation of complex and intelligent manufacturing systems. It can also help companies evaluate risks, costs, operational constraints, impact on operational performance and the road map for Industry 4.0. Modeling methods and simulation techniques are often powerful tools to analyse the best industrial plant structure. In fact, these methods allow you to explore the most important properties or parameters in a relationship. The contribution deals with the design of the layout solution of production premises with regard to equipment downtime and spatial use. Arrangement of equipment refers to the course of activity of physical facilities, for example, machines, equipment, devices, etc., in such a way that the progress of the material is as fast as possible with the lowest possible costs and with minimum demands on the care of the product from the reception of raw material to the transportation of the final result. A fundamental part of any association, the layout of the plant requires legitimate thinking and vision so that there are no problems in the work cycle. So, simulating the plant layout is the first step to create such plants so that we have an overview of most of the factors like cycle time, space, machinery requirements, etc..

Key Words- Industry 4.0, Simulation, WITNESS Simulation

1. INTRODUCTION

In today's competitive market, the survival of any industry depends largely on response time, production costs and manufacturing flexibility. A manufacturing company must have an efficient production system to accomplish its task. The plan should consist of people, equipment, and processes designed to integrate the resources and processes that drive the company's operations [3]. Well-designed resources will be useful for asset management during efficiency and productivity, reducing production cycle time and resource delivery time. Plant layout is a very critical part of running an efficient and cost-effective business. All work areas, production lines, material stores, etc. should be designed to perform at the highest speed and correspondingly shortest cycle time. When designing a plant layout, it is necessary to take into account all functions within the enterprise. The proposal must include not only the needs of the current business, but should also include provisions for future expansion. This is included to avoid frequent and costly design changes as demand increases. For any effective plant layout, various factors like direct and indirect costs incurred, space utilization, operator efficiency, arrangement of various equipment's, material handling etc. are considered. This has been one of the top priorities in manufacturing industry and any other industry. Facility layout design deals with the optimal design of any plant, assembly line, etc., based on the shortcomings of the current layout. Designing such an arrangement requires various information such as process cycle time, distance travelled, plant area, number of machines, operator efficiency, takt time, process time, etc., which are either calculated or obtained from internal data. [26]. Witness simulation is another way to show how development will deliver benefits as it is done at low cost and with minimal disruption to existing production activities [10, 11]. The Witness simulation site is a product of the British Lanner Group [12] and is one of the world's most successful production simulations. A good plant structure will have a small flow of material that will increase production [13] [14]. By imitation, benefits that are more important than real-life testing are provided in terms of cost, time and repetition where variability, disruption, and complexity exist. It is necessary to make institutional planning and planning before any factory is set up to ensure a sustainable process and reduce losses [15 - 17].

2. Industry 4.0

"Industry 4.0 is an acronym for the fourth industrial revolution defined as a new level of planning and management of the entire product life cycle chain, which aims to have a growing demand for individual customers. The main goal of Industry 4.0 is to satisfy the needs of every customer in areas such as order management, research and development, production authorization, deliveries to processing and recycling of products [3]. The need of Industry 4.0 is to transform the conventional technology and self-learning of the devices to improve their overall performance and environmental management correction by the environment [8]. Industry 4.0 aims to build an open, intelligent production platform for industrial network information application [9]. Real-

time data tracking, tracking product status and positions, and capturing production control instructions are key requirements of Industry 4.0 [10].

3. Simulation in Industry 4.0

Organizations, supply chain, equipment, tools and information systems are required in a product where various processes and behaviors are modeled. For example, as with manufacturing simulation, modeling is required to support operations outside of the manufacturing area. It is very important to assess the performance of the product design, support the development and validation of product process data and their impact on the performance of the company as a whole. Alternative planning, analyzing the order and flow of objects in production facilities and lines, performing energy planning analysis, determining production and processing needs, training production and support personnel in systems and processes are essential to the development and validation of simulation models. The important steps for the simulation are given below [27].

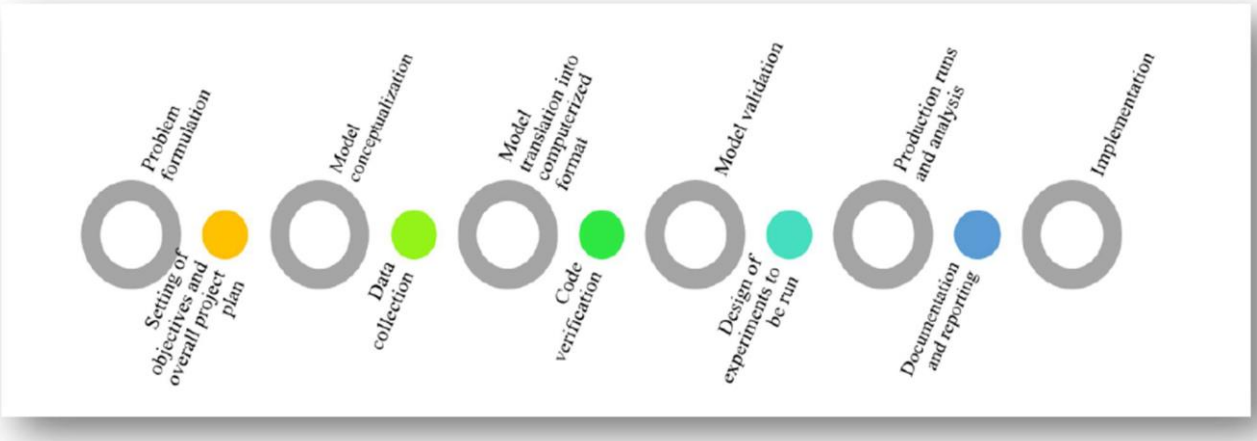

Figure 1. Simulation and modeling for design and operation of manufacturing [27]

4. Witness Simulation

Simulation modeling processes: The process of creating and analyzing a digital prototype of a real physical model. WITNESS is a simulation software package from Lanner Group. It is the culmination of more than ten years of computer simulation development experience. This experience led us to develop a visual, interactive and interpretive approach to simulation without the need for compilation. WITNESS is used to simulate entire production runs at any time period. This allows the people designing the equipment to gain insight into how production lines might actually work. This is a good way to anticipate and solve any problems and inefficiencies that might occur if the production lines were built in their current configuration. WITNESS makes visible all production bottlenecks, over-utilized resources, too small or large storage areas and any potential problems with respect to part processing work. WITNESS simulation software helps in creating a simulation model, which is nothing more than a dynamic representation of a certain part of the real word, which is sufficient for the visualization using this model to be an accurate enough predictor of reality. WITNESS is a comprehensive simulator of discrete events and continuous processes. It is intended for modeling the dynamics of complex systems. It is an established simulation tool used by thousands of organizations worldwide to analyse and validate business processes, achieve desired process performance, or support continuous process improvement activities. WITNESS provides a graphical interface for creating simulation models. It enables the representation of a real-world process in a dynamic animated computer model and enables automation of simulation experiments, optimization of material flow across equipment, and generation of animated models [28].

Today, more than 6,500 WITNESS systems are in use worldwide in organizations ranging from automotive to pharmaceutical, aerospace to electronics, hospitals to banks, airports to defense and more. WITNESS Manufacturing Performance Edition is a version of WITNESS specifically designed for manufacturing applications. It is ideally suited for various production and warehouse layout and logistics modeling scenarios. [5] Witness is discrete manufacturing process modeling, simulation and optimization software for flow research and supply chain analysis, equipment design, production planning and operations management. [19]

Figure 2. Witness Logo

4.1 Features of Witness:

It is a fast, productive predictive simulation desktop software for professional modelling and application development. Some features are as follows:[5]

- Discrete Event and Continuous Modelling
- 2D and 3D Modelling Environment
- Interfaces for Data Driven Modelling
- Simple, Powerful Logic Coding
- Embedded Business Intelligence

4.2 Applications

Applications of Witness software can be found in Production Flow Process-
- Facility Planning,
- Process Optimization,
- CIM/FMS Setup,
- Assembly Lines Design,
- Complete Plant Setups,
- Production Throughput,
- Bottlenecks Management,
- Inventory Control,
- Six Sigma Planning,
- Resource Utilization,
- Production Scheduling,
- Layout Planning,
- Statistics in Production Flow Environment etc.

This software is widely used in automotive, aerospace, defence, food and drug processing, health care and consumer products industries.[5]

4.3 Benefits

Witness has better resolved rules, where it is possible to set, for example, a change in the length of the blank at the entrance and exit. It is modular, has many output options and display options. [5 & 19]

1. Quickly create powerful models that represent your business
2. Experiment and optimize with the integrated WITNESS experimentation framework
3. Flexible connectivity with enterprise and local data sources
4. Develop predictive simulation applications for use by non-modelers
5. Highly rated resources for customer support and simulation projects
6. Joining data tables can be done to CSV files and Excel ranges
7. Predictive maintenance of Industry 4.0 machines can be modeled including functions:

- Breakdown Interval Remain
- Stoppage Interval Remain
- Trigger Breakdown
- Trigger Stoppage

4.4 Witness Work Flow

a) Goal setting: This is the first and most important phase of any simulation project. The goal of any simulation project should be to make better business decisions. You, as a simulation modeler, need to understand this business decision because it will likely have important implications for the content of your simulation model.
b) Model scope and level of detail: The scope of a simulation model refers to where it starts and where it ends. It is important to limit the scope of the model as much as possible. When it comes to the level of detail contained in a model, the golden rule is to model the minimum necessary to achieve the goal of the model. [5]
c) Data collection: Information for a model is likely to fall into one of three categories,
- Available – the data is readily available and in a suitable form that the model can use immediately.

• Not available but can be collected - the data is either in the wrong format or has not been previously sorted. You may need to do a small work study to collect this type of data (for example, manual timing of certain processes).
• Not available or collectible – data is not currently available and not easy to collect (for example, for a model of a new greenfield factory with new machinery). If data is not available or collectible, you must use estimates.

d) Model structuring: An important last step before creating a simulation model is its structuring. This will identify the most difficult areas to model and highlight any other data requirements that may have been overlooked until now, such as the transfer time of parts between processes.

e) Building the model: It is recommended to build the model step by step and thoroughly test each stage before building the next stage. Doing this makes it easier to find problems in the model than if you had to search the entire model. This ability to build a model incrementally, testing each section as you go, is a powerful aid to productivity and generates
confidence in the validity of your model.

f) Running the model: After defining, displaying and detailing the elements of your model, we can immediately run it and then modify it by adding, changing or removing elements. You can then run the model again to assess the impact of these changes. [19]

g) Report generation: After building and running a model, you can use WITNESS reports to help you choose between alternative modeling scenarios.

h) Model testing: Simulation model testing consists of verification and validation. The verification and validation phases of a simulation study are usually iterative in that they involve revisiting some of the phases already described. For example, the model may require the addition of some processes that have not yet been modeled, thereby increasing the scope of the model.

i) Experimentation: When you are confident that the model resembles the behaviour of the real situation, you can explore a number of "what if" scenarios. The scenarios were to be defined within the original objectives of the simulation study. [19]

j) Presentation of results and implementation: How to present results depends on the size of the simulation project and the culture of your organization. An animated model provides an effective communication tool to support business decisions, especially if you have enhanced its graphical representation.

Figure 3. Witness Layout Example

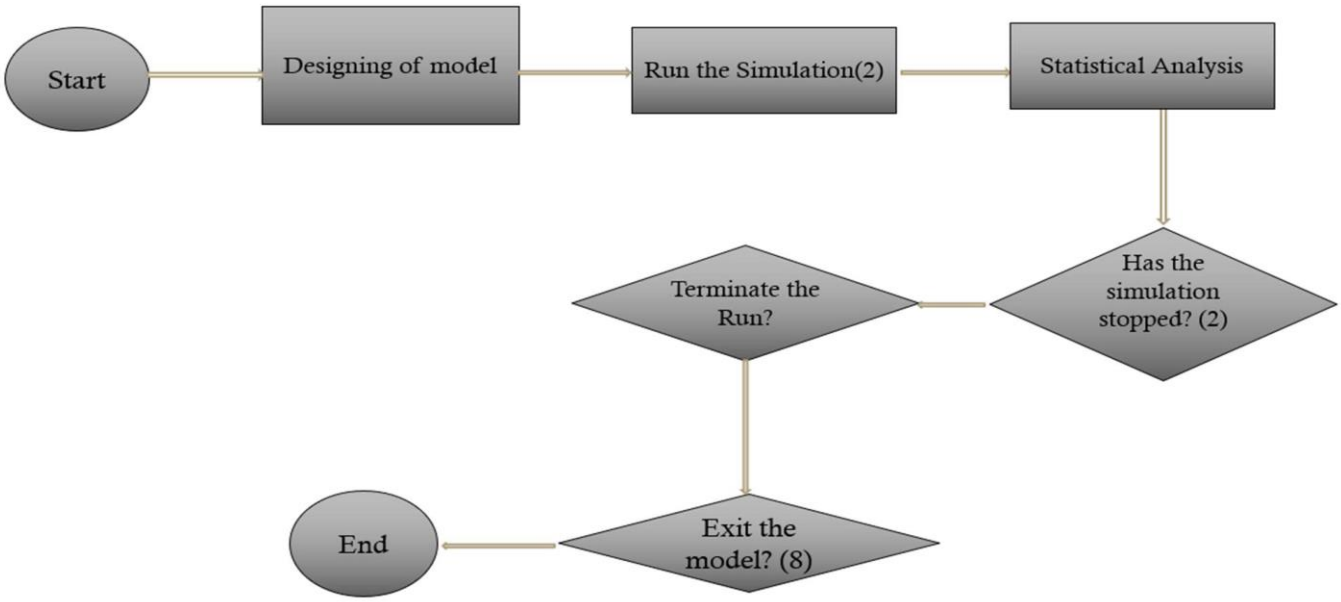

Figure 4. Flow Chart of the Witness Software

4.5 Sample Model (Hypothetical Model)

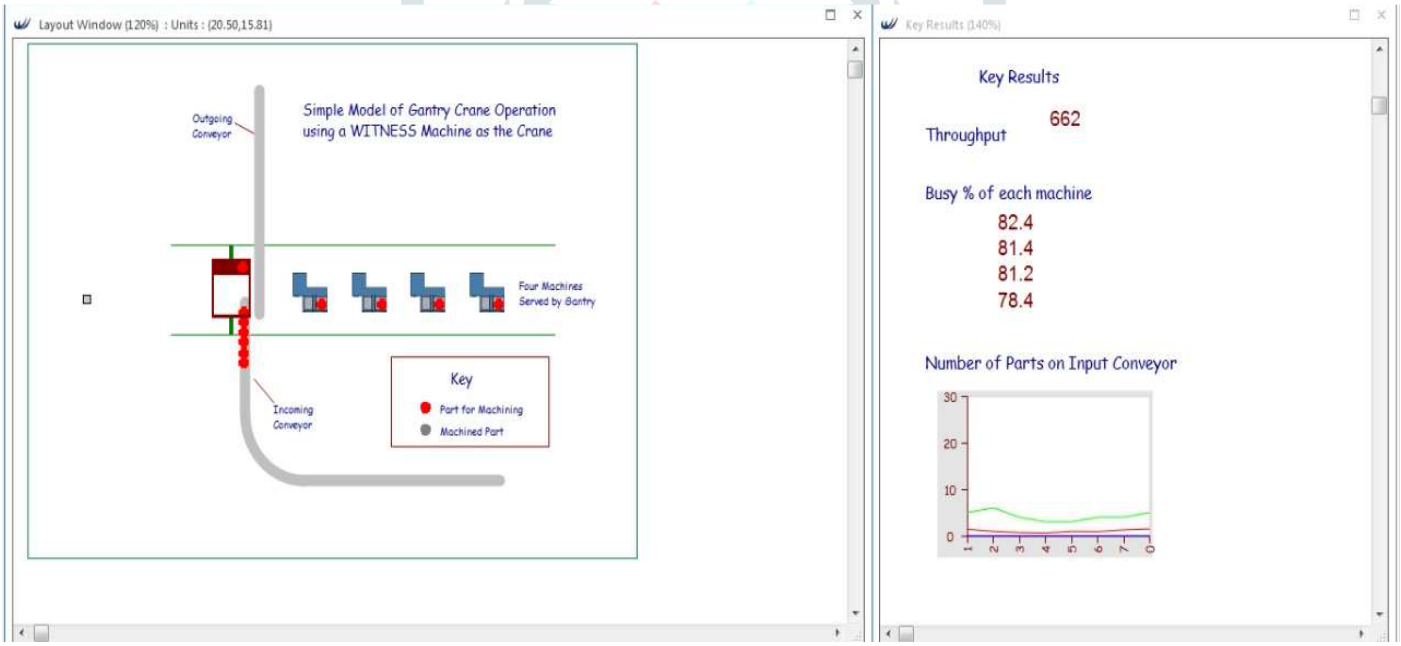

Figure 5. A simple facility layout hypothetical Model in Witness Simulation Software

5. Identified Research Gaps

- Implementation of appropriate representation, both physical and management solutions.
- Lack of complex system modeling and simulation.
- Lack of standardization.
- After Studying Several Research papers we found that Proper Accuracy is missing in existing simulation software's.

6. Problem Identification

 This Research work has been proposed in respect of a medium scale industry based in Bengaluru. This Industry basically manufactures Mattresses, Sofas, Bed sheets, Blankets and Pillows etc.

 Plant layout is the physical arrangement of equipment and facilities within a plant. i.e., the grouping of equipment and operations in the factory for the greatest degree of efficiency. Optimizing the layout of the plant can improve productivity safety and quality of the products. Unnecessary efforts of material handling can be avoided when the plant layout is optimized. This is valid for:

 Distances through which the material has to move.

 Distances equipment has to move.

 Types of handling equipment needed.

 Distances operator has to move.

7. Existing Layout

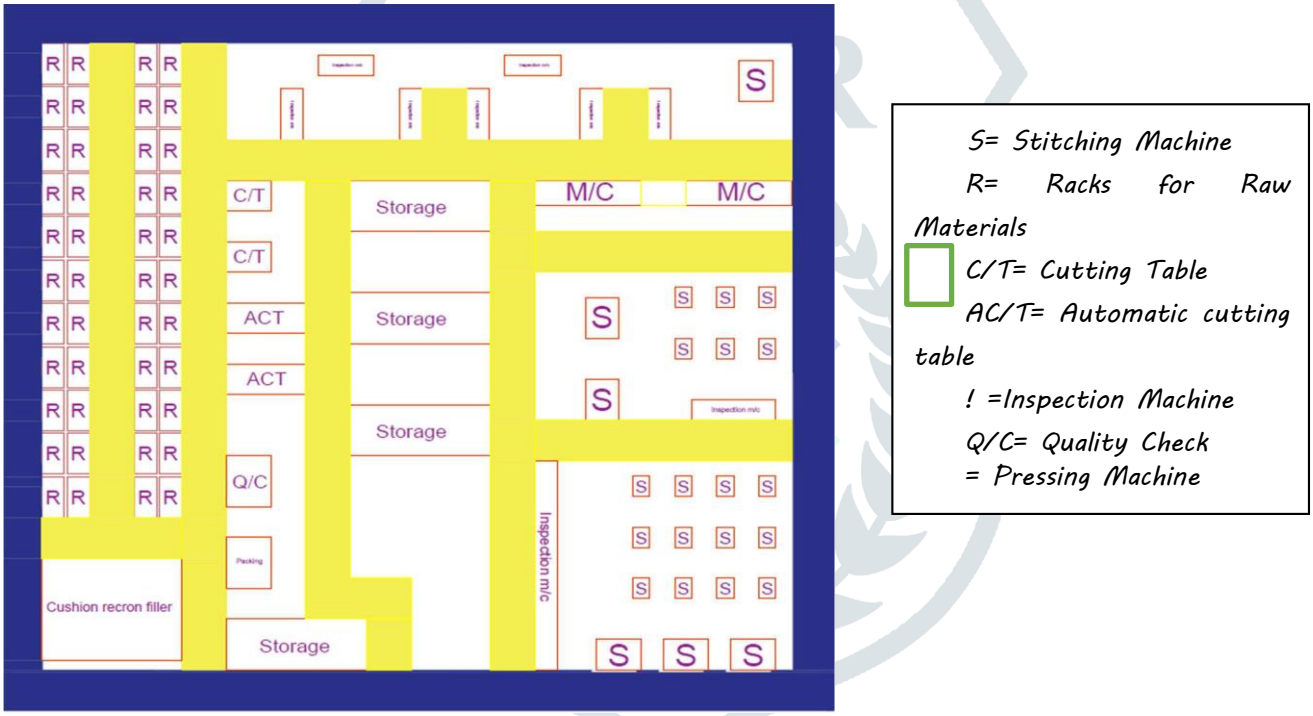

Figure 6. Existing Layout of Plant

7. Objectives of the Research

 Study of Industry 4.0 and its components.
 To Study WITNESS Simulation Software.
 To Identify application of WITNESS Simulation Software in layout Optimization.

8. Proposed Methodology

This Research work that has to be done in respect of a medium scale industry based in Bengaluru. This Industry basically manufactures Mattresses, Sofas, Bed sheets, Blankets and Pillows etc. The first task which this research accomplished was to acquire the current layout. This was done using Auto Cad software. The layout that I am proposing in this research work was meant for improving
the current layout.

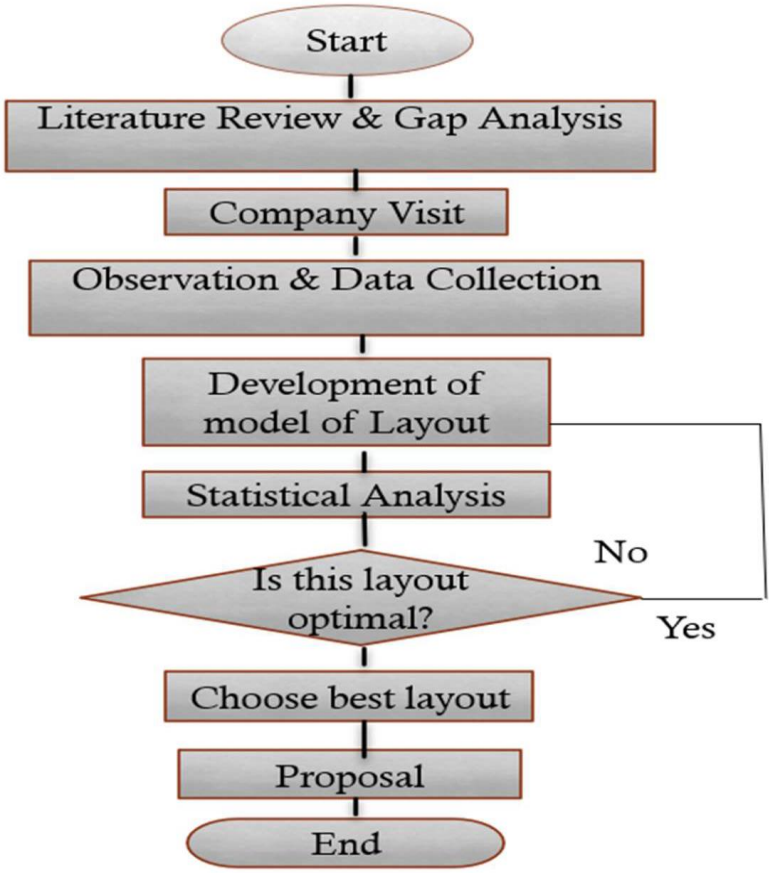

Figure 7. Proposed Research Methodology Flow Chart

9. Discussion & Conclusion

The main objective of this paper was to discuss how manufacturing simulation is digitization and how it affects the Indian society. So, we had our view on production simulation, its applications and benefits in industry. The objective of this research is to analyse the existing layout and also design a new plant layout using Witness software. We will simulate the layout using software, then efficiency of the machine will increase and productivity will also be increased. The obtained study will show an improvement, an increase in work efficiency, by reducing the distance between the machines. Knowledge of the production system can be used to improve the factory system to achieve better performance and consequently increase productivity and reduce waste to gain more profit. Finally, we can say that simulation is a way of digitization to get a virtual view of the future in advance.

10. ACKNOWLEDGMENT

"A REVIEW PAPER ON APPLICATION OF WITNESS SIMULATION SOFTWARE IN INDUSTRY 4.0 FOR LAYOUT OPTIMIZATION" has been an amazing research subject that leads one to discover new heights in the field of industrial engineering. We would like to express our thanks and deep gratitude to our esteemed guide Associate Professor Ms. Neha Patkar Department of Industrial and Manufacturing Engineering SGSITS, Indore for her technical advice, encouragement and constructive criticism which motivated us to strive more for excellence.

REFERENCES

[1]. Andradóttir, S., Healy, K. J., Withers, D. H., Nelson, B. L., Markt, P. L., & Mayer, M. H. (1997). Proceedings of the 1997 Winter Simulation Conference. Winter Simulation Conference Proceedings, 711–717.

[2]. Briano, E., Caballini, C., Mosca, R., & Revetria, R. (2010). Using WITNESSTM simulation software as a validation tool for an industrial plant layout. International Conference on System Science and Simulation in Engineering - Proceedings, June 2014, 201–206.

[3]. de Paula Ferreira, W., Armellini, F., & De Santa-Eulalia, L. A. (2020). Simulation in industry 4.0: A state-of-the-art review. Computers and Industrial Engineering, 149. https://doi.org/10.1016/j.cie.2020.106868.

[4]. Iqbal, G.M. and Hashmi, M.S.J., (2001), "Design and analysis of a virtual factory layout", Journal of Materials Processing Technology, 118: 403-410.

[5]. Mehta, N., & Khalkar, S. (2020). Facility Layout Design and Optimization using Simulation and Time Study. 1020–1029.

[6]. Mechanical, M. E. (2016). Facility Layout Optimization Using Simulation: a Case Study of a Steel Utensils Industry. International Journal of Advance Engineering and Research Development, 3(03), 507–513. https://doi.org/10.21090/ijaerd.030384.

[7]. Magoulas G.D., Eldabi T., Paul R.J. 2002. Adaptive Stochastic Search Methods for Parameter Adaptation of Simulation Models. In Proceedings of 2002 First International IEEE Symposium "Intelligent Systems", pp 23-27, September 2002

[8] R. D. Vaidya, P. N. Shende, N. A. Ansari, S. M. Sorte, 2013, Analysis Plant Layout for Effective.

[9]. Production, International Journal of Engineering and Advanced Technology (IJEAT), Volume-2(3), Page-500- 504.

[10]. Rodič, B. (2017). Industry 4.0 and the New Simulation Modelling Paradigm. Organizacija, 50(3), 193–207. https://doi.org/10.1515/orga-2017-0017

[11]. Michlowicz, E., & Smolińska, K. (2019). The use of the WITNESS simulator for improving flows in a complex production system. AIP Conference Proceedings, 2078(March). https://doi.org/10.1063/1.5092065

[12]. Markt, P. L., & Mayer, M. H. (1997). WITNESS simulation software. 711–717. https://doi.org/10.1145/268437.268613.

[13]. Orville Sutari, Satish Rao U, 2014, Development of Plant Layout Using Systematic Layout Planning

[14]. (SLP) to Maximize Production – A CASE STUDY. Proceedings of 07th IRF International Conference at Bengaluru, India. Page: 124-127.

[15]. Rodič, B. (2017). Industry 4.0 and the New Simulation Modelling Paradigm. Organizacija, 50(3), 193–207. https://doi.org/10.1515/orga-2017-0017

[16]. Shinde, M. K., & Nimbalkar, U. (2017). Review on Manufacturing Predictive simulation: Use of WITNESS SIMULATION SOFTWARE. International Journal of Scientific & Engineering Research, 8(4), 355–359. https://www.ijser.org/researchpaper/Review-on- Manufacturing-Predictive-simulation-Use-of-WITNESS-SIMULATION-SOFTWARE.pdf.

[17]. Smutkupt U., Wimonkasame S. 2009. Plant Layout Design with Simulation. In Proceedings of the Inter- national MultiConference of Engineers and Computer Scientists 2009 Vol II 32 IMECS 2009, March 18 - 20, Hong Kong.

[18]. Vaidya, S., Ambar, P., & Bhosle, S. (2018). Industry 4.0 - A Glimpse. Procedia Manufacturing, 20, 233 238.https://doi.org/10.1016/j.promfg.2018.02.034

[19]. Waller, A. WITNESS SIMULATION SOFTWARE in Proceedings of the 2012 Winter Simulation Conference 2012.

[20]. WITNESS Training Reference manual, Copyright 2012 Lanner Group Ltd.

[21]. Yusoof, M. Y. M., Mohamed, N. M. Z. N., Nelfiyanti, & Hadi, M. Z. I. A. (2021). The software. IOP Conference Series: Materials Science and Engineering, 1078(1), 012027. https://doi.org/10.1088/1757-899x/1078/1/012027.

[22]. Hiten Patel, S.C.S., Review on Cycle Time Reduction in Manufacturing Industries. Journal of Emerging Technologies and Innovative Research (JETIR), 2014. 1(7): p. 955-956.

[23]. Ali Naqvi, S.A., et al., Productivity improvement of a manufacturing facility using systematic layout planning. Cogent Engineering, 2016. 3(1): p. 1207296.

[24]. Tidke, A.J., Designing Facilities Layout for Small and Medium Enterprises. International Journal of Engineering Research and General Science., 2013.

[25]. F.G.Miller, T.S.D., and L.J. Mogas, Job Rotation Raises Productivity. Industrial Engineering, 1973. 5(6): p. 24-29

[26] Neel Mehta, Shreyas Khalkar, Facility Layout Design and Optimization using Simulation and Time Study. Volume: 07 Issue: 11 | Nov 2020

[27] Banks, Jerry; Carson, John S.; Nelson, Barry L, (1996), Discrete-Event System Simulation. Prentice Hall, U.S.A. Walters,

[28] Mr.Vaibhav K. Shinde, Prof. U.M. Nimbalkar, Review on Manufacturing Predictive simulation: Use of WITNESS SIMULATION SOFTWARE. International Journal of Scientific & Engineering Research, Volume 8, Issue 4, April-2017 ISSN 2229-5518.