Simulation of vise production process using Flexsim Software

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Abstract. In the industrial the process of clamping on an object is an important process carried out to facilitate the work when the process of cutting, sculpting, welding and etc. A vise is a clamping tool to clamp a workpiece milled. Using the vise, the workpiece clamped tightly to facilitate the work and the results of a process is maximum. The components contained in a vise have their own functions. This research is about simulating vise production process. The purpose of this study is to model the vise production process using Flexsim software and compare the simulation results data with the vise production target data to find out whether the simulation describes the actual condition of the vise production process. The results obtained in the manufacture of vise production lines using Flexsim software produce an output of 22 units for 1 shift / day or 7 working hours. The vise production line simulation model produces 25 vise production target data, 22 simulation results data and 12% deviation occurs, so the simulation describes the actual condition of the vise production process.

1. Introduction
In the industrial the process of clamping on an object is an important process carried out to facilitate the work when the process of cutting, sculpting, welding and etc [1]. A vise is a clamping tool to clamp a workpiece milled. Using the vise, the workpiece clamped tightly to facilitate the work and the results of a process is maximum. The components contained in a vise have their own function [2]. The vise product have 8 parts. Consists of base, right clamp body, right clamp jaw, left clamp body, left clamp jaw, fixed body, screw and handle. The machines used in the manufacture of vise parts are grinding machine, lathe, milling machine, drilling machine, scrap machine and tap and dies.

The system is an organization interacts with each other, interdependent and integrated in a unity of variables or components [3]. The system has several characteristics or characteristics consist of components system, boundaries system, the environment system, the interface system, input system, output system, processing system and goals system [4]. Models are representations of objects or ideas in a simplified form. The model can be an object imitation, system or actual event only contains important information studied [5]. A simulation model is used to understand system behavior to support decision making and problem solving. Simulation models are mainly used to understand behavior when the system changes are considered [6]. System modeling is a first step to create a software engineering of a simulation system. If the model formulation is carried out, the next step will be an evaluation of the system model including: accuracy, availability of variables estimation, interpretation, and validation [7]. Simulation is an imitation of a dynamic system using a computer model used to evaluate and improve system performance [8]. Simulation predict the system behavior observed by using data from observations result at a certain time [9].

Flexsim is a powerful analytical tool to help engineers and planners to make the right decisions in the design and system operation [10]. Simulation using Flexsim software which is a type of simulation program provides an overview of the desired distance, time and production goals [11]. Flexsim makes it possible to carry out simulations in almost all aspects, from production to logistics, material handling, warehouse planning to mining, health services, customer service and more, with access to libraries contain a large objects quantity [12]. Simulation modeling usually follows the basic steps: survey
system, data collection, building of models system, building of simulation models, model validation, simulations and running, output and analysis of simulation result [13]. Probability distribution test is carried out using ExpertFit software which is provide some suitable probability distribution recommendations [14]. Using this tool, we get the best probability distribution of all distributions in Flexsim 19 quickly and precisely [15].

The purpose of this study is to model a system simulation to help identify problems and evaluate alternative solutions in a short time and help reduce bottlenecks during the vise production process. The model built is a simulation model for vise production using Flexsim software. In this model the relationship of each element is described by the vise production and built based on the production line made before.

2. Methodology
The research conducted by several steps, include:

2.1. Data collection
The data collection consists of data on the materials quantity, machine, and operator and the production process time.

2.2. Distribution of observational data
Distribution of observational data is needed in the vise production process. The data used is the production time data from the routing sheet.

2.3. Modeling
The model is needed to represent objects on the production floor so that simulation can be done.

2.4. Simulation
The simulation is performed using the flexsim software after all necessary data and models completed to obtain the simulation results.

2.5. Comparison between production target data and simulation result
Data on the vise quantity produced by simulation using flexsim software compared to the actual production target data.

3. Result and Discussion
3.1. Distribution of observational data
Distribution of machine observational data in the process of vise production is needed to make a simulation of the vise production process. The data used is the data contained in the routing sheet. The routing sheet data is compiled by Microsoft Excel and then input in the Expertfit software which determines the data distribution.

Table 1. Distribution of observational data

| No | Machine | Distribution type      |
|----|---------|------------------------|
| 1  | Grinding| Johnson Bounded        |
| 2  | Drilling| Johnson Bounded        |
| 3  | Drilling| Johnson Bounded        |
| 4  | Scrap   | Weibull                |
| 5  | Scrap   | Log-Laplace            |
| 6  | Drilling| Johnson Bounded        |
| 7  | Drilling| Johnson Bounded        |
| 8  | Milling | Lognormal              |
To determine the distribution of observational data, ExpertFit software is used by inputting the time operation of the machine used in the vise production process and then processed by using RANDBETWEEN with the time operation added by 10 seconds, 10 times for each part of the vise. The results of the distribution type in one part vise (Base Part) can be seen in Table 1.

3.2. Modelling
The design model is the vise simulation production model are fixed resources, task executors, networks, and dashboards. Fixed resources are stationary objects in 3D models. Fixed resources used in this study are source, queue, processor, sink, combiner, multiprocessor, and rack. Task Executor is a move object in 3D models. Task Executors used in this research are task executer, operator, and transporter. Network is used to determine the line of task executor when the simulation is run. Without a network, the task executor will run but does not observe another objects in the line. The following is an example of a network. Dashboard on Flexsim is used to perform the graphics. The data of the graph result is updated as the simulation progresses. Dashboards used in the simulation process for vise production are Staytime Table, Throughput per Hour Bar, and State Pie. The use of the staytime table queue in the simulation shows what is the average time, the longest time, and the shortest runway time, left clamp body, right clamp body, left clamp jaw, right clamp jaw, fixed body, screw, handle, nut A1, A2, A3, A4, B1, B2, B3, B4 and screw rings are in the queue before being used in production machines. The final appearance of the staytime table queue dashboard can be seen in Table 2.

| Object          | Average Staytime | Min Staytime | Max Staytime |
|-----------------|------------------|--------------|--------------|
| Base            | 11760.99         | 5.13         | 24925.38     |
| Queue 3         | 13654.65         | 3127.47      | 24823.84     |
| Queue 2         | 14052.71         | 3371.89      | 24784.36     |
| Queue 1         | 14348.98         | 3593.41      | 25095.26     |
| Left Brace Body | 12322.33         | 7.19         | 24349.11     |
| Player Body     | 11638.70         | 12.34        | 24966.32     |
| Left Clamp Jaw  | 11899.91         | 14.44        | 25022.72     |
| Right Clamp Jaw | 12157.54         | 135.64       | 24969.30     |
| Right Brace Body| 132.02           | 132.02       | 132.02       |
| Lava Body       | 12691.33         | 17.43        | 25025.72     |
| Handle          | 13193.95         | 138.63       | 25089.96     |

The use of throughput per hour assembly in the simulation shows how many products are produced from assembly 1, assembly 2, assembly 3, and assembly 4 per hour. On the dashboard throughput per hour assembly, at the end of the simulation it can be seen that in 1 hour of work, assembly 1, assembly 2, assembly 3, and assembly 4 finish of 3,14 parts. The final display of dashboard throughput per hour assembly can be seen in Figure 1.
The use of state pie material handling in simulations shows how many percentage of material handling times are idle, travel empty, travel loaded, offset travel empty, and offset travel loaded. The final display of the dashboard state pie material handling can be seen in Figure 2.

![State Pie Material Handling](image)

**Figure 2.** State pie material handling.

3.3. **Simulation**

The simulation process of vise production is done by using Flexsim software. The final display of the simulation can be seen in Figure 3.

The use of rack describes the product warehouse which is the place where the vise produced are collected. Sink describes the exit door of the factory when the vise collected and distributed. The simulation is run after the fixed resource, task executor, network, and dashboard are finished. The simulation run results are the simulation data in the form of output results after the simulation is run for 1 shift (7 hours). The output produced during one shift or 7 working hours is 22 units.
From the production target data obtained information related to vise production data as follows:

a. Vise Production Data per year = 15700.

b. Working days = 312.

c. $Shift = 2 \text{ times / day (1 shift = 7 hour)}$

Vise production data/shift

$$\text{Vise production data/shift} = \frac{\text{Vise production data per year}}{\text{Working days}} \times \frac{1}{2}$$  \hspace{1cm} (1)

$$= \frac{15700}{312} \times \frac{1}{2}$$

$$= 25.16 \approx 25$$

3.4. **Comparison Between Production Target Data and Simulation Result**

Comparisons are made to compare production target data with the simulation data and see the deviations data occur. The results of the comparison can be seen in Table 3.

| Production target data | Simulation data | Deviation |
|------------------------|----------------|-----------|
| 25                     | 22             | 12%       |

The results obtained based on comparison of production target data and simulation data shows that there is a deviation of 12% so that the simulation describes the actual condition of the vise production process.
4. Conclusion
Simulations are carried out to identify problems on the production floor, before repairs are made. The simulation can be said to be valid if it describes the actual conditions of an industry and the deviation between the simulation and the actual results can still be tolerated. The simulation done using Flexsim software in this study describes the actual condition of the vise production process because it only produce a deviation of 12%.

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References
[1] Efrizal and Hidayat A 2018 Jurnal Teknik Mesin 8.
[2] Harwanto I, et.al 2015 Jurnal Teknik Desain dan Matematika 2.
[3] Prasojo L.D 2013 Sistem Informasi Manajemen Pendidikan (Yogyakarta: UNY Press).
[4] Anggraeni E.Y 2017 Pengantar Sistem Informasi (Yogyakarta : CV. Andi Offset).
[5] Arif M 2017 Pemodelan Sistem, (Yogyakarta: Deepublish)
[6] Beaverstock M, et.al 2017 Applied Simulation Modelling and Analytics using Flexsim (USA: Canyon Park Technology Center)
[7] Khotimah B.K 2015 Teori Simulasi dan Pemodelan: Konsep, Aplikasi, dan Terapan (Ponorogo: WADE GROUP)
[8] Susilo J, et.al 2013 Jurnal Teknik POMITS 3(2)
[9] Hutahiean H D 2018 Journal of Informatic Pelita Nusantara 3(1).
[10] Kumar B S 2015 International Journal of Computational Engineering Research 5 (1).
[11] Tarigan U, et.al 2019 JSTI 21(1)
[12] Burduk A, et. Al 2019 Intelligent Systems in Production Engineering and Maintenance (New York: Springer Science+Business Media).
[13] Zhu X, et.al 2014 Journal of Applied Research and Technology 12
[14] Andre I, et.al 2016 Spektrum Industri 14(2).
[15] Rizqi Z. U 2020 IENACO