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Analysis of Service System using Simulation

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ABSTRACT

Simulation is a method for evaluating model behavior in various situations that allow decision making. This simulation requires the development of a model that represents the system. Therefore, the simulation will act as a system operation. After carrying out model simulations, the real impact of each alternative and action will be identified. Discrete simulation models the operation of a system as a series of discrete events in time. Each event occurs at a specific time and marks a change in state in the system. Due to changes in the system, this simulation will prevent failures without disrupting the actual system. The results of verification and validation obtained 3 replications with an average replication time in real time, namely 19.33 minutes and in ProModel software, namely 9.65 minutes. Based on the confidence interval, the output results obtained in the ProModel simulation are with the interval [5.888 ≤ μ1 – μ2 ≤ 13.478], because the value 0 is not within the range μ1 – μ2 so it can be said that the data obtained is invalid. This means that there is a difference between the time in the real system and the simulation output results with the Promodel software. Because the results obtained are not yet valid, the simulation output cannot be applied to real service system processes at Coffee X. Suggestions for further research are to be more careful in inputting data and re-checking it, so that the simulation output obtained will be valid so that it can be applied to real situations.

Keywords: *Discreate Simulation, Service System, Simulation*.

A. INTRODUCTION

A coffee shop is a place that provides various types of coffee and non-alcoholic drinks by providing a relaxed atmosphere, attractive interior design, comfortable place and friendly service. The word cafe comes from the French word Cafe, which means coffee. In this day and age, cafes are not only found in star-rated hotels and supermarkets with various names, but cafes are found and scattered in many shop houses at a distance of 0 meters from the main road. Cafes don't just offer drinks or food, currently coffee shops are experiencing a shift in meaning which also provides a comfortable atmosphere with complete facilities so that it is the right place to relax and relieve fatigue. Apart from that, coffee shops are often used as meeting places with business partners.

As times progress and develop, the growth of coffee shops is also in line with this. The growth in the number of coffee shops in Indonesia is increasing, which means that entrepreneurs, especially in the F&B sector, must act appropriately in their marketing. Entrepreneurs must understand the needs and desires of consumers, and be able to fulfill them more effectively and efficiently than their competitors. One important factor is customer satisfaction. Customer satisfaction has a linear relationship with the continuity of a coffee shop. The success of an entrepreneur in understanding consumer desires can be seen from the increasing number of consumers who come back after the first arrival (behavioral intentions). Behavioral intentions are the stated possibility of returning to purchase a product or service that has been received by consumers (Julyazti et al., 2023).

Customer satisfaction refers to consumer evaluation of a service that has been provided. If customer satisfaction has a high value, then the customer's tendency to return to a particular coffee shop will also be higher. Customer satisfaction is a direct predictor of repurchase intention for customers. According to Yoon (2010), customer satisfaction is described as a customer's feeling of rebuilding a product repeatedly. The most important thing and parallel to customer satisfaction is the service provided by all elements in the coffee shop.

This research will discuss and analyze the service conditions provided by coffee shop employees called Coffee X through simulations using Promodel software. Coffee X, the coffee shop we studied is located at Jalan Rungkut Madya No. 213D or more briefly in front of gate 2 of the East Java "Veteran" National Development University. The aim of the simulation study of service conditions at this coffee shop is to improve service to consumers so that consumers and customers can get much better service. With much better service, Coffee X will be able to be more competitive and even outperform competitors who are currently positioned above Coffee X.

B. LITERATURE

D.1. Simulation

Simulation is a method for evaluating model behavior in various situations that allow decision making. This simulation requires the development of a model that represents the system. Therefore, the simulation will act as a system operation. After carrying out model simulations, the real impact of each alternative and action will be identified. Simulation is very important to avoid system failure due to the impact of changes. This can be checked without disrupting the actual working of the system through new changes, procedures, information flow in the system. Simulation is an experiment on a model that represents real life. Through simulation we can learn how the system operates. Predictions can be made if the variables change. It is also a tool for investigating system performance virtually (Mohamad & Filza, 2019).

Simulation comes from the word simulate which means to pretend or act as if. As a teaching method, simulation can be interpreted as a way of presenting learning experiences using artificial situations to understand certain concepts, principles or skills. According to the English-Indonesian dictionary, simulation means imitation or imitating work, while simulate means imitating, pretending or acting as if. Thus, simulation is imitation or action that imitates an event as if it were an actual event. Based on several previous definitions of simulation, simulation can be interpreted as artificial behavior that depicts actual conditions in order to gain an understanding of the nature of a concept. So that when applied to a simulated process, for example the process of connecting cables to a circuit, the process is simulated to resemble an actual process that cannot be done in reality (Jaya et al., 2015). Simulation is a methodology for carrying out experiments using a model of a real system. Simulation is a way to produce conditions from situations with models for testing or training studies, etc. The idea behind simulation is to mathematically imitate a situation in the real world, then to study the operating characteristics, and use a computer with appropriate software to draw conclusions and take action decisions based on the simulation results (Tannady, 2020).

D.2. Discrete Simulation

Discrete simulation models the operation of a system as a series of discrete events in time. Each event occurs at a specific time and marks a change in state in the system. Due to changes in the system, this simulation will prevent failures without disrupting the actual system. Discrete simulation is commonly used in manufacturing systems. However, the rapid increase occurred in the services sector. Discrete Simulation provides intuitive and flexible tools for solving complex systems using computer-based modeling. In addition, discrete simulation can also be identified as a flexible modeling method that has the ability to represent complex behavior within, and interactions between individuals, populations and their environment. Among simulation methods, only discrete simulation provides a sequence of events in separate times (Mohamad & Filza, 2019).

Discrete simulations, also referred to as time-to-event models, are ideal for complex problems, such as health problems. Discrete simulation is a computer-based operations research technique that models different systems as networks of queues and activities to assess, predict, and optimize proposed or existing systems, where changes occur at different times over time. Discrete simulation emerged from the world of manufacturing, where Tocher developed the first language in the late 1950s to build models to simulate steel mills in England. Discrete simulation can capture system behavior and interconnection effects, which result from the combination of many random processes, coupled with the structure of the system. In contrast, developing discrete simulation models can be time-consuming and expensive, and relies heavily on good quality data to inform system behavior. Therefore, users must balance the benefits and challenges of using a simulation approach. The key concepts in discrete simulation are events, entities, attributes, and resources. Building discrete simulation models requires large amounts of quantitative numerical data. Discrete simulations also require a series of logical statements expressed in computable form to describe how an entity changes its state (Vazquez et al., 2021).

D.3. System

The system has a long historical tradition in various scientific disciplines. The basic concepts and methodology of this approach have been repeatedly adopted and modified and further developed by new scientific communities. Over time the popularity of this approach has resulted in a proliferation of derivative concepts, which, coupled with the popular and less restrictive use of these concepts, is a phenomenon in itself. In innovation studies, the concept of innovation systems has been widely used, often with different qualifications such as national innovation systems or sectoral innovation systems (Grandstrand, O & Holgersson, M., 2020). A system is a collection of objects that are joined in an interaction or related to regular

interdependence. System modeling begins with a system that requires further investigation which is usually referred to as a supervised system. This can be an investigation of a real-world problem or a consideration for a future system. A conceptual model is then developed and validated, followed by implementation of the computer model. In the verification stage, the computer model is checked to ensure that the conceptual model is well represented and the implementation is error-free. Experimental scenarios are developed and verified, followed by experiments. After the process ensures operational validation, the simulation results can be implemented (Mustafee, 2018).

System has a methodological meaning which is known as the general meaning of a systems approach. Basically, this approach is the application of scientific methods in an effort to solve problems, or applying the habit of thinking or assuming that there are many causes for something to happen, in viewing or dealing with interconnectedness. The systems approach seeks to understand the complexity in most things, so as to avoid viewing them as something very simple or even wrong (Begem et al., 2019). A system is a collection of elements in the form of data, a network of interacting procedures, human resources, technology, both hardware and software, which are interconnected as one unit to achieve the same specific goals or objectives (Julianti et al, 2019). According to Ladjamudin, a system is a collection of components or elements or subsystems. In general, a system is a collection of elements that interact to achieve a certain goal. In other words, the system can also support data management, by forming a flow of information that is used for decision making (Otanius, 2022).

Quoted by Drs. Zaki Baridwan, a system is a framework of interconnected procedures that are arranged according to a comprehensive scheme, to carry out an activity or main function of an organization (Iskandar, 2019). A system is a network of interconnected procedures, gathered together to carry out certain targets (Anggraeni et al., 2020). The system consists of three elements, namely input, process and output. Input is the driving or power-giving component where the system is operated, while output is the result of the operation. In a simple sense, output means that which is the goal or operational target of a system, while process is an activity that can transform input into output (Frisdayanti, 2019).

D.4. Queuing

A queuing system is a collection of customers, services and rules that regulate customer arrival and processing queue service problems. The queuing system is characterized by five components, namely customer arrival patterns, service time patterns, number of services, facility capacity to accommodate customers and the rules in which customers are served. There are four basic queue structure models that are common to all queues, namely single channel-single phase, single channel-multi phase, multi channel-single phase, and multi channel-multi phase. The Multiple Channel Single Phase model is a service system that serves with one queue line and several services, an example of this model is the queue at a bank teller (Muzaki, 2020). Meanwhile, according to Render and Haizer (2005), a queue is people or goods in line who are waiting to be served. The science of queuing forms known as queuing theory is an important part of operations and also a very valuable tool for operations management (Pellondou et al, 2021).

The queuing system is a process of customers or goods entering a queue that will then be needed. service as it should be. Queues were developed by a mathematician from Denmark named A.K. ERLANG. The waiting phenomenon is a direct result of randomness in the operation of service facilities. The arrival of customers in advance cannot be known, because if it is known the operation of the facility can be scheduled in such a way as to eliminate the need to wait. The aim of queuing is to minimize the total direct costs in providing service facilities as well as indirect costs. A system that has an optimal number of service facilities means that it requires a high capital investment, but if the number is less than optimal, the result will be delayed service (Arianto et al., 2022).

A queue is a group of consumers/customers waiting to receive a service. The process in a queue starts when consumers come to receive service and waits in a line if all services are busy. In the queuing process of choosing priority, consumers also see the existence of different service disciplines. Queues will occur if the need for a service exceeds the available capacity of that service. A long queue will have an impact on several things such as social costs and loss of customers. The main actors in the queue are the customer (customer) and service (server) which will produce a time period to complete a service. The queue structure will be formed into channels (single or multiple) and phases (single or multiple). Channels indicate the number of service facilities provided as well as the path to enter a service. Meanwhile, phase is the number of service stations that must be passed until the service is declared complete (Putra dkk, 2022).

Queuing theory is a mathematical study of queues or waiting lines for customers who require services from existing systems. An organization must try to provide services so that customers do not queue for too long. There is usually a fee for organizations to add service facilities. Fast service will retain customers and increase company profits in the long term. Queuing theory is a mathematical study that refers to conditions related to all aspects of people/goods waiting for service. Queuing theory was first introduced by the Danish mathematician Agner Krarup Erlang, in 1917. Queuing theory is used to analyze the performance/characteristics of existing queuing systems using a queuing model. The queuing model is used to present various kinds of queuing systems that exist in real systems (Listiyani et al, 2019). Queuing is one of the problems that is often faced by every public service, such as what happened at Bank BNI Pondok Candra Surabaya. Some customers canceled transactions because of the long queue time and chose to make transactions at other banks in the hope of getting more satisfactory service. Therefore, the application of queuing theory is very important in order to improve the quality of service for customers so that long queues do not occur and determine the number of tellers that must be opened in order to increase customer satisfaction with the bank (Putri, 2020).

The basic components of a queue that need to be considered in a queuing system are arrival, service, and queuing. Arrival can be said to be an input process. The input process consists of the source of arrival or calling population and the method of arrival or arrival pattern, which usually occurs as a random process. Customer arrival patterns can be seen from the time between the arrival of two consecutive customers (interarrival time). The pattern of customer arrivals in the queue can be deterministic (certain) or stochastic (random). The arrival pattern is deterministic if the arrival pattern is fixed/does not change and can be determined between arrival times and produces a fixed queue length. Services or service mechanisms may consist of one or more service facilities. The essence of a queuing process lies in the queuing itself (Cahyo, 2022).

The queuing model is a mathematical representation of the queuing or waiting process in a service system. This model includes various variables and parameters that influence customer flow and overall queuing system performance. In the context of health services such as health centers or hospitals, queuing models are used to understand and optimize how customers queue, waiting times, the number of counters or servers needed, and how to allocate resources to provide the best service. By using a queuing model, health service managers can understand queue dynamics, identify bottleneck or congestion points, and plan strategies to increase service efficiency and reduce customer waiting times. This model also helps in making decisions regarding resource allocation, service scheduling, and capacity planning to anticipate fluctuations in service demand (Alimuddin & Ahsan, 2022).

D.5. Service

Service is any action or activity that can be offered by one party to another party, which is basically intangible and does not result in any ownership (Herzegovina and Taufiqurrohman,

2022). The dimensions of service quality are physical evidence (tangibles), reliability, responsiveness, assurance and empathy (Hidayanti and Handayani, 2019). The need for services exceeds the capabilities of the service or service facilities, so that facility users who arrive cannot immediately get services due to busy services which will cause queues (Putra et al., 2022). The queuing system is the result of the development of queuing theory, which regulates services according to arrival to achieve effective and efficient performance, as a solution to queuing problems. Queuing discipline is one of the customer regulators in the queuing system, which is divided into 5, namely (Pratiwi et al., 2019):

a. First Come First Served (FCFS) or First In First Out (FIFO) which means, the customer arrives first and is served first.
b. Last Come First Served (LCFS) or Last In First Out (LIFO) which means, those who arrive last will receive service first.
c. Shortest Operation Times (SOT) is a queuing system where customers who require the shortest service time get service first.
d. Service In Random Order (SIRO) is a service system where customers may be served randomly, no matter who arrives first to be served.
e. Priority Service (PS), namely the priority service given to customers who have a higher priority will be served first, compared to those who have a lower priority, even though customers who have a lower priority arrive first, incidents like this are caused by several things, for example someone who is in an emergency or serious illness.

D.6. Promodel

Promodel stands for Production Modeler application released by the Promodel company. This application functions to simulate and model various types of manufacturing and service systems. Promodel is software for simulating a system and analyzing a production system. Promodel has flexibility, presenting the most appropriate combination in modeling all conditions (Gumelar and Darajatun, 2021). Promodel is a simulation tool designed to quickly but accurately model manufacturing systems of all types, especially supply chain systems. Promodel can model simulations for various models and with different conditions (Mahessya et al., 2019). ProModel is a discrete system simulation software that is quite easy to understand for both people who understand and do not understand simulation. Some modules commonly used in simulation are (Astanti et al., 2020):

1. Location, This is the place where the process occurs in the system.
2. Entity, Object that is processed in the system.
3. Arrival, Defines the arrival of an entity into the system.
4. Path Network, Defines the path or route traversed by the entity.
5. Processing, This is the main module in ProModel to define every operation of the entity that comes into the location.

In ProModel, manufacturing system workstations are organized as processing locations where entities such as parts are processed based on “processing logic”. Other things that can be included in the ProModel are material handling units, operators, mobility paths, and supports (Peter et al., 2021). ProModel provides the right combination of usability, flexibility, and simple system modeling to make it look more realistic. Things that need to be considered in modeling the entire system are how the system operates, material flow, operating logic, work resources, and work trajectories. In ProModel, during the simulation, animations of ongoing activities will be observed and the results will be displayed in the form of tables and graphs which facilitate analysis (Haekal, 2021).

D.7. Activity Cycle Diagram

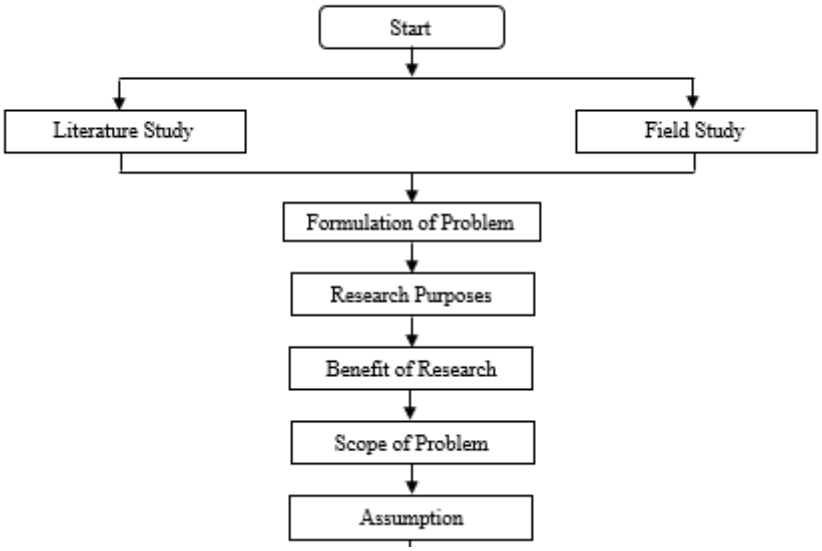
Activity Cycle Diagram or Activity Cycle Diagram (DSA) is a technique for describing interactions between objects in a system. This technique uses graphs and symbols to explain a

series of activities in a real system. In DSA, the life cycle of an entity in a system is represented by an activity cycle that alternates between active and passive states. The passive state is called queue and is shown by a circle, while the active state is called activity and is shown by a rectangle. One example of an activity is the product preparation process, where the product is prepared according to the order letter from the sales department (Imansuri, 2022).

Activity diagrams describe the workflow or activities of a system or business process or menu in the software. This is related to efforts to create a good mathematical model of the system. Furthermore, from the conceptual model fresh thoughts will emerge which are the basic model in deriving the mathematical model. The conceptual model is usually made in a simple form, but is able to present the structure of the system's existence. There are various forms of this conceptual model, one of which is commonly used is a diagram (Tabrani, et al., 2021).

C. METHOD

The method used to collect data samples in this research is by observation or direct observation. The population of this study was Coffee X staff who worked on the days and hours of the observation, namely 2 people. The service queue selected as the research sample was 15 customers who would later be analyzed using Promodel software following Figure 1 below.



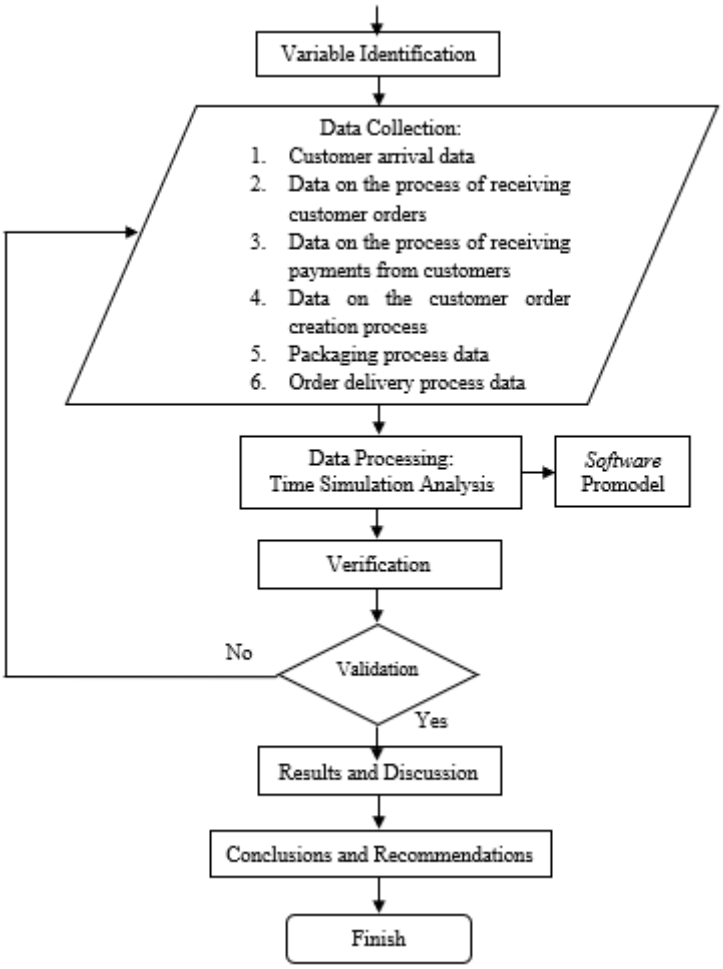


Figure 1. Flowchart

D. RESULT AND DISCUSION

D.1. Conceptual Model

Promodel software is a software that can be used to model various manufacturing and service systems. In Promodel, during the simulation, animations of ongoing activities can be observed and the results will be displayed in the form of tables or graphs which make it easier for analysis. The data that has been collected will be processed using Promodel software and the resulting output will be used to overcome the service waiting time that occurs so as to obtain a level of time efficiency in service.

The conceptual model is the formation of a representative model of the real system that becomes a reference in building promodel simulations through the depiction of Activity Cycle Diagrams (ACD). In the case study of the Coffee X service system, the real system created is an illustrative image display that explains the flow of the service process at Coffee X . The following is an Activity Cycle Diagram (ACD) on roma biscuit production, as shown below:

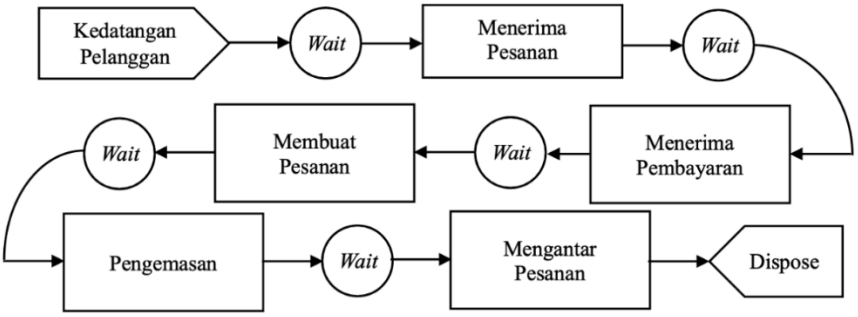


Figure 2. Conceptual Model of Coffee X Service with ACD

D.2. Simulation Model

The simulation model in this research is made based on the conceptual model that has been made and the data collected. In this stage, the design of the simulation model is carried out using Promodel software (Layout on Location) so that it can be simulated as in the following figure:

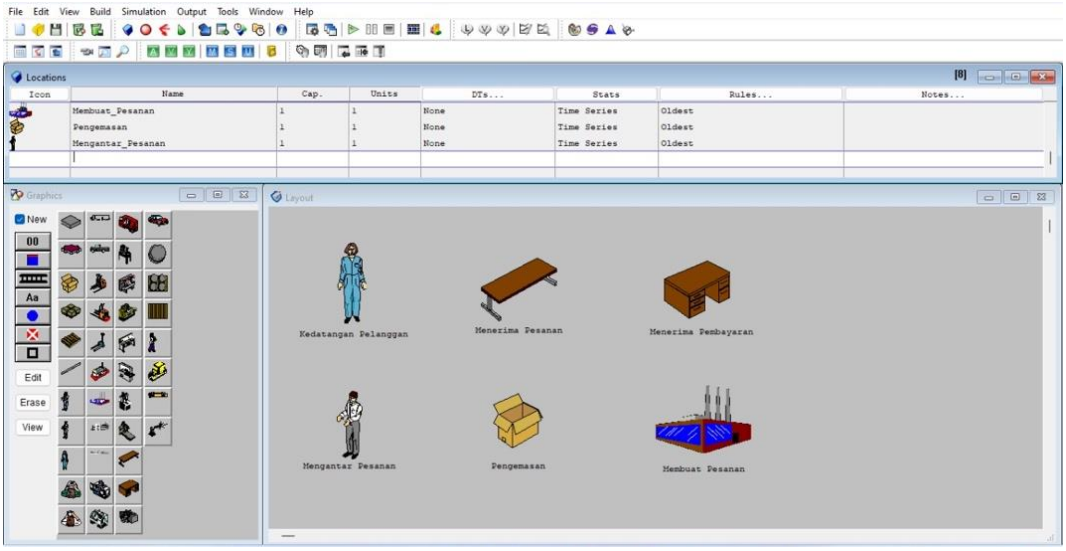


Figure 3. Simulation Model on Coffee X Service with Promodel Software

Based on the picture above, it can be seen that the service simulation model at Coffee X uses Promodel software. The first activity is the arrival of customers described with graphics Worker, the second activity is receiving orders described with graphics Table, the third activity is receiving payments described with graphics Desk, the fourth activity is making orders described with graphics Factory, the fifth activity is packaging described with graphics Box, and the sixth activity is delivering orders described with graphics Operator.

D.3. Verification and Validation

Verification is a reconfirmation process to ensure that the information, process, or method used has met the requirements and prove that testing with the method produces valid results and data. The results of running the model that has been made on the Coffee X service are shown in the figure below and it can be seen that the model is free from valid, so the model has fulfilled the verification stage as follows:

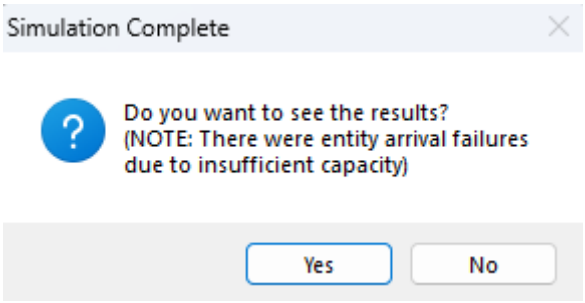


Figure 4. Error Checking Result

Validation is a process of assessing certain parameters based on a study to prove that they meet the requirements or specifications that have been determined for their use. From the model verification process, it is found that the calculation of the simulation is said to be correct, thus it can be continued with the model validation stage. The following is a model validation test with the Welch Confidence Interval method.

a. Calculating The Number of Replications

TABLE I
REPLICATION ACTIVATION IN COFFEE X

Replication	Total time (minutes)
1	7,69
2	8,08
3	7,68
4	8,12
5	7,96
6	7,86
7	8,07
8	8,29
Replication	Total time (minutes)
9	7,89
10	7,94
Average	7,958
Standard Deviation	0,190776192
Varians	0,036395556

By:

n = 10

n-1 = 9

confidence level = 95%

a = 1 - *confidence level* = 5% = 0,05

Then Za/2 is obtained from the table = 1,96

Half width $= \frac{(\text{t d . f .}\frac{a}{2}) \times S}{\sqrt{n}}$

$= \frac{2{,}26 \times 0{,}247361634}{\sqrt{10}}$

$= 0{,}176951853$

Betha $= half\ width$

$= 0{,}176951853$

n’ $= \left[\frac{\left(\frac{za}{2}\right) \times S}{\beta}\right]$

$$= \left[\frac{1{,}96 \times 0{,}247361634}{0{,}176951853}\right]$$
$$= 2{,}74 \approx 3$$

From the calculations that have been carried out, the minimum number of replications needed is 3 replications.

b. Calculating the Minimum Number of Replications Required

TABLE II
TOTAL OBSERVATION TIME

Activity	Total Observation Time (minutes)
1	18
2	19
3	21

TABLE III
SIMULATION OUTPUT RESULTS

Replication	Total time (minutes)
1	9,69
2	9,61
3	9,65

Since the number of n1 ≠ n2, the method used for testing the validation of this model is the Welch Confidence Interval method, where:

Hypothesis:

- H0 : μ1 – μ2 = 0 can be said to be valid if the value 0 is in the range μ1 – μ2.
- H1 : μ1 – μ2 ≠ 0 can be said to be invalid if the value of 0 is outside the range of μ1 – μ2.
- Each population (simulated system) is independent and normally distributed, both within the population and between populations.
- The number of samples in each population (n1) and (n2) does not have to be the same.
- The variance between population 1 and population 2 does not have to be the same.

c. Determination of Validation with Welch Confidence Interval Calculation

The following is the determination of validation with the calculation of the Welch Confidence Interval:

TABLE IV
COMPARISON OF REAL SYSTEM AND PROMODEL OUTPUT

R	*Real System* (minutes)	Promodel (minutes)
1	18	9,69
2	19	9,61
3	21	9,65
Average	19,33333333	9,65
Standard Deviation	1,527525232	0,04
Variance	2,333333333	0,0016
N	3	3
n - 1	2	2

By:

H0 : μ1 – μ2 = 0

H1 : μ1 – μ2 ≠ 0

α = 0,05

$$df = \frac{\left[\frac{S_1^2}{n_1}+\frac{S_2^2}{n_2}\right]^2}{\frac{\left[\frac{S_1^2}{n_1}\right]^2}{(n_1-1)}+\frac{\left[\frac{S_2^2}{n_2}\right]^2}{(n_2-1)}}$$

$$= \frac{\left[\frac{2,33}{3}+\frac{0,0016}{3}\right]^2}{\frac{\left[\frac{2,33}{3}\right]^2}{(3-1)}+\frac{\left[\frac{0,0016}{3}\right]^2}{(3-1)}}$$

$$= 2,002 \approx 2$$

Then, it is obtained from the t distribution table that $t_{n-1} \,.\, \alpha/2 = 4,30265$

$$hw = \frac{(\text{t d . f .}\frac{a}{2}) \text{ x } S}{\sqrt{n}}$$

$$= 4,30265 \text{ x } \sqrt{\frac{S_1^2}{n_1}+\frac{S_2^2}{n_2}}$$

$$= 4,30265 \text{ x } \sqrt{\frac{2,33}{3}+\frac{0,0016}{3}}$$

$$= 3,794583034$$

Therefore, the confidence interval is:

$P(\bar{x}_1 - \bar{x}_2) - hw \leq \mu 1 - \mu 2 \leq + (\bar{x}_1 - \bar{x}_2) + hw = 1 - \alpha$

$P[(9,683) - (3,794583034) \leq \mu 1 - \mu 2 \leq (9,683) + (3,794583034)] = 1 - \alpha$

$[(5,888) \leq \mu 1 - \mu 2 \leq (13,478)]$

Analysis:

From the calculation results it can be concluded that, H0 is rejected, because the value of 0 is not in the range of μ1 - μ2 so it can be said that the data obtained is invalid. This means that there is a difference between the time in the real system and the simulation output results with Promodel software.

D.4. Simulation Output

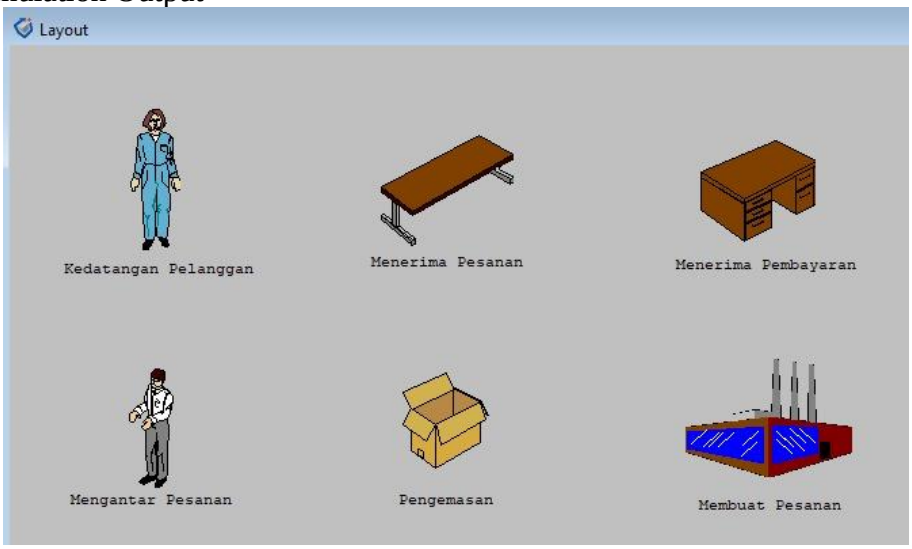
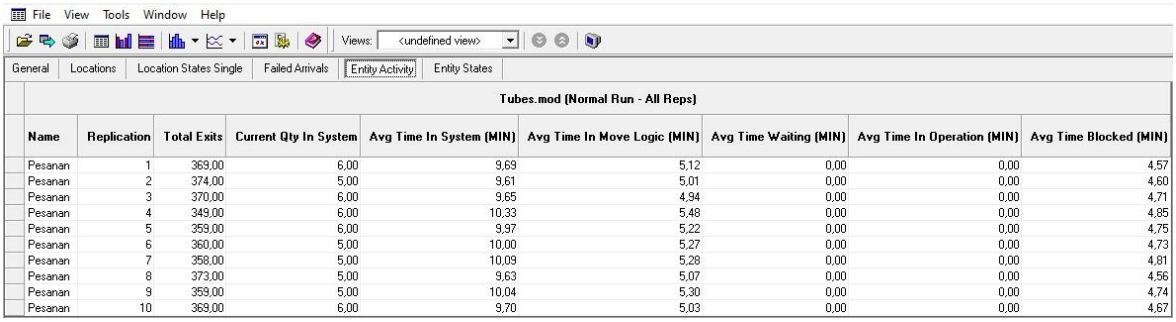


Figure 5. Activity Output Results at Coffee X Service



File View Tools Window Help

Views: <undefined view>

General | Locations | Location States Single | Failed Arrivals | Entity Activity | Entity States

Tubes.mod (Normal Run - All Reps)

Name	Replication	Total Exits	Current Qty In System	Avg Time In System (MIN)	Avg Time In Move Logic (MIN)	Avg Time Waiting (MIN)	Avg Time In Operation (MIN)	Avg Time Blocked (MIN)
Pesanan	1	369,00	6,00	9,69	5,12	0,00	0,00	4,57
Pesanan	2	374,00	5,00	9,61	5,01	0,00	0,00	4,60
Pesanan	3	370,00	6,00	9,65	4,94	0,00	0,00	4,71
Pesanan	4	349,00	6,00	10,33	5,48	0,00	0,00	4,85
Pesanan	5	359,00	6,00	9,97	5,22	0,00	0,00	4,75
Pesanan	6	360,00	5,00	10,00	5,27	0,00	0,00	4,73
Pesanan	7	358,00	5,00	10,09	5,28	0,00	0,00	4,81
Pesanan	8	373,00	5,00	9,63	5,07	0,00	0,00	4,56
Pesanan	9	359,00	5,00	10,04	5,30	0,00	0,00	4,74
Pesanan	10	369,00	6,00	9,70	5,03	0,00	0,00	4,67

Figure 6. Activity Output Results at Coffee X Service

D.5. Output Analysis

From the results of the Promodel output obtained, it is known that the Coffee X service activity has 6 activities including customer arrival, receiving orders, receiving payments, making orders, packaging, and delivering orders. From the results obtained, it is known that Average Time in System (minutes) appears in replication 1 for 9.69 minutes, replication 2 for 9.61 minutes, replication 3 for 9.65 minutes, replication 4 for 10.33 minutes, replication 5 for 9.97 minutes, replication 6 for 10 minutes, replication 7 for 10.09 minutes, replication 8 for 9.63 minutes, replication 9 for 10.04 minutes, and replication 10 for 9.7 minutes. From the results of verification and validation, it can be concluded that H0 is rejected, because the value of 0 is not in the range of $\mu 1 - \mu 2$ so it can be said that the data obtained is invalid. This means that there is a difference between the time in the real system and the simulation output results with Promodel.

E. CONCLUSION

Based on the output results from the Promodel software and the discussion above, it can be seen that there is a time difference that causes the service process at Coffee X to occur in the results of customer arrival, receiving orders, receiving payment, making orders, packaging, and delivering orders. The results of verification and validation obtained 3 replications with an average replication time in real time, namely 19.33 minutes and in ProModel software, namely 9.65 minutes. Based on the confidence interval, the output results obtained in the ProModel simulation are with the interval $[5.888 \leq \mu 1 - \mu 2 \leq 13.478]$, because the value 0 is not within the range $\mu 1 - \mu 2$ so it can be said that the data obtained is invalid. This means that there is a difference between the time in the real system and the simulation output results with the Promodel software. Because the results obtained are not yet valid, the simulation output cannot be applied to real service system processes at Coffee X . Suggestions for further research are to be more careful in inputting data and re-checking it, so that the simulation output obtained will be valid so that it can be applied to real situations.

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