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Modelling And Simulation Of The Driving Licence Application Queue Using Promodel Software At The Karawang Police Headquarters

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ABSTRACT

This study models and simulates the queue system for C driver's licence applications at the Karawang Police Station using ProModel to identify bottlenecks and evaluate improvement scenarios. As a baseline, the total actual time for applicants averaged 129.69 minutes, exceeding the standard of 120 minutes, with a daily output of 54 applicants (6 hours of operation). Two scenarios were proposed: (S1) adding registration units; (S2) adding 3 information units. The simulation results showed that S2 was the most effective: throughput increased from 54 to 139 applicants/day (+85), the aggregate '%full process' percentage decreased from 15.49% to 2.12% (−13.37 points), and the average total waiting time decreased from 79.44 minutes to 68.8 minutes (-13.3%). The mean difference test (t-test, 95% CI) confirmed a significant improvement in waiting time and output. In practical terms, these results recommend a reorganisation of capacity at the clarification stage and arrival scheduling to reduce queues, thereby increasing citizen satisfaction and resource efficiency.

Keywords: *Bottleneck; Discrete Event Simulation; ProModel; SIM C; Queueing.*

Introduction

The Driver's Licence Administration Unit (SATPAS) handles a multi-stage process (registration, data entry, briefing, photo and fingerprinting, theory and practical tests, form filling, printing, payment). Imbalances in capacity and variability in arrivals cause queues, prolong service times and reduce citizen satisfaction. Discrete event simulation (DES) and queueing theory have been widely used to improve the performance of public/semi-public services (e.g., clinics/outpatient care, licensing, service counters) through scenario evaluation without disrupting actual operations [1], [2], [3], [4]. At the Karawang Police Station, the standard duration for a SIM C process is set at 120 minutes, but the actual average is 129.69 minutes with an output of 54/day during 6 hours of operation. Observations show a bottleneck at the clarification stage (limited room capacity, preceding several downstream processes) and an imbalance in capacity between stations, which triggers queues and 'blocked' entities downstream. As a result, the gap between the standard time (120 minutes) and the actual time (≈130 minutes) persisted; daily output was stuck at 54 applicants. Initial quantification of model metrics reinforced indications that capacity mismatch was the main source of inefficiency. Therefore, this study aimed to model and validate the SIM C queueing system using a pro-model, identify bottlenecks and evaluate capacity improvement scenarios, and present quantitative evidence (waiting time, utilisation, throughput, CI) for operational recommendations.

As can be seen in **Table 1**, the data regarding the recapitulation of Sim C production in the last 6 months is as follows:

Table 1. Recapitulation Data on the Issuance of Driving Licences in the Last 6 Months

Summary data on the issuance of C driving licences in the last 6 months		
Month	**SIM C**	**Average per day**
July	1.934	64
August	2.073	69
September	1.716	57
October	1.292	43

November	839	28
December	1.406	47
July	1.934	64
Amount	**9.260**	**308**
Mean	**1.543**	**51**

The duration specified for completing the entire process of obtaining a C driving licence, as determined by the Karawang Police SATPAS, is 120 minutes. However, in reality, the average total duration for obtaining a SIM C licence is 130 minutes. If each stage of the SIM application process requires applicants to wait in line, this will result in significant waiting times. This will have an impact on the motivation of other applicants who wish to obtain a new SIM licence due to the inefficiency of the service provided.

Table 2. Mean Total Actual Time

Standard time (minutes)	Average total waiting time (minutes)	Average total processing time (minutes)	Average total actual time (minutes)
120	79,44	50,25	129,69

To examine the issue of queues in the production of SIM C, it is necessary to use a simulation tool. Simulation is a representation of the components of arithmetic and logical processes in a model of a real system, which in the analysis process uses computer software with the aim of overcoming or simplifying problems that occur in the system [5], [6], [7], [8]. Improvements to the queueing system for SIM C production were made using a discrete event simulation approach. Discrete event simulation is a process of complex system behaviour from a well-defined event of a real system and has an orderly sequence based on changes in discrete or integer time [1], [9]. In this study, the simulation process used is discrete event simulation. This study uses ProModel software as a tool to create a system simulation model.

Research Method

This research was conducted at the Karawang Police Headquarters from January 2023 to April 2023. The research design used was descriptive quantitative with simulation-based experimental studies (Discrete Event Simulation) with replication and statistical testing. This study aimed to model and evaluate the effectiveness of the C driver's licence issuance process at the Karawang Police Headquarters using ProModel software. The research stages included several stages, starting with a comprehensive literature review followed by observation of the problem in the field. The next stage was data collection and analysis to facilitate problem solving. Next, the results of the simulation scenario were evaluated using ProModel software. The research concluded with the formulation of findings and the preparation of a report. Data collection in this study was carried out by taking data from the process of making a C driver's licence at the Karawang Police Station, which included the process flow and the time required to make a C driver's licence. Data collection related to the issues to be studied was obtained through direct observation of the process of making a C driver's licence at the Karawang Police Station. After the data was collected, it was analysed and processed to determine simulation parameters such as:

1. Simulation time: 6 hours/day, 5 days/week (adjusted to operations).
2. Warm-up period: 10 minutes, required to stabilise queue conditions before output data is recorded.
3. Number of replications: 30 replications/scenario, sufficient to produce a stable 95% confidence interval (CI).
4. Arrivals: Lognormal LogN (μ=1.06 minutes, σ=0.32, based on goodness-of-fit (KS/AD) results showing the best fit to the actual arrival pattern.
5. Service time per station: for service time per station, see **Table 3 & Table 4**).
6. The entity in this study is the applicant for a C driving licence.
7. The location or station consists of 9 processes, starting from registration, data input, enlightenment, fingerprinting, theory test, practical test, form filling, printing, and payment.

This analysis includes observations of system elements or components, time adjustment calculations in real systems, and data input into simulation models to improve the effectiveness of the C driver's licence production process at the Karawang Police Station. Furthermore, this data is analysed by developing scenarios in the simulation model using software to obtain an overview of the increased effectiveness of workstation usage in the C driver's licence issuance process. The flowchart for this study is as follows:

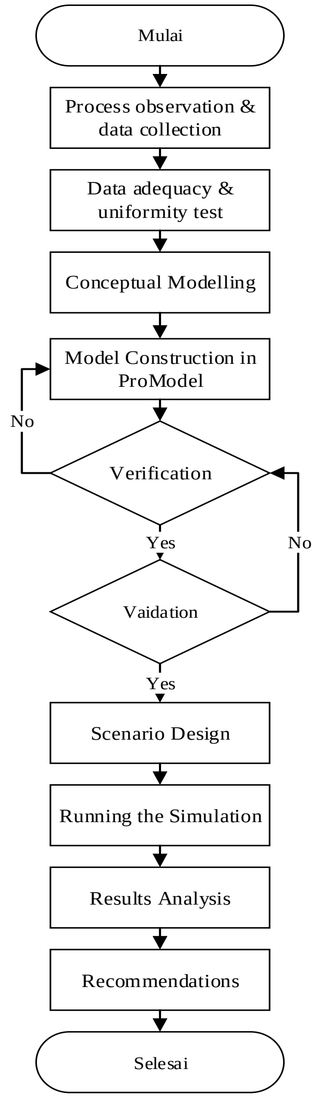


Figure 1. Research Flowchart

Figure 1 shows the flow chart for this study, with the following explanations:

a. Process observation & data collection

At this stage, the process of obtaining a SIM C licence at the Karawang Police Station was observed in order to identify the workflow and potential obstacles that might arise. At this stage, data collection was also carried out on all necessary data, starting from the time of arrival of the applicant and the service time at each work station or at each process of the C driver's licence issuance service.

b. Data adequacy & uniformity test

The data collected in the previous stage was analysed to ensure its quality and validity in the data adequacy and uniformity test analysis. The data adequacy test is carried out to assess whether the data used meets the required level of accuracy, while the data consistency test is carried out to ensure that the data is stable and there is no extreme variability.

c. Conceptual Modelling

The results of the observations made are then translated into a conceptual process flow diagram, illustrating the relationships between processes or stations and sequencing each activity. This stage is important because it helps bridge the gap between the real system and the simulation model.

d. Model Construction in ProModel

Based on the conceptual model that has been conceptualised, the simulation model is constructed using ProModel software. From start to finish, each station is configured according to the results of observation, data collection and analysis.

e. Verification

The verification stage of the model is carried out to ensure that the model that is built or created can operate in accordance with the planned system logic without any logic errors, deadlocks or model inconsistencies.

f. Validation

Validation at this stage is carried out to ensure that the model that has been created and has passed the previous stages is in accordance with the real system, or that the simulation results are the same as the actual data. The model is considered valid if there are no significant differences.

g. Scenario Design

Once the model has been validated, improvement scenarios are developed or designed based on the obstacles or bottlenecks identified, with the aim of evaluating alternative solutions that have the potential to improve the efficiency of the SIM C production system at the Karawang Police Headquarters.

h. Running the Simulation

This stage involves running the model that has been built, with each scenario being run through simulation.

i. Results Analysis

This stage involves analysing the results of each scenario simulation based on key metrics, including waiting time, total completion time, utility (% full), blocked conditions, and throughput. The results are then compared with the initial conditions to determine whether there has been a change in capacity. The optimal scenario is the one that can be selected because it reduces processing time and increases the actual output.

j. Recommendations

This stage involves running the model that has been built, with each scenario being run through simulation.

Results and Discussion

In this study, the identification of objectives and objects focused on analysis to collect the data needed to improve the efficiency of SIM C production time at the Karawang Police Station. The objective was to reduce the SIM C production process time and improve slow processing times in several areas. The expected end result was to reduce the gap between standard time and actual time, which differed significantly in each production. The following is the SIM C production process at the Karawang Police Station.

Table 1. Processing Time Per Section

No.	***Processing***	Processing time (minutes)
1	Registration	3,06
2	Data entry	4,06
3	Briefing	5,17
4	Photo and fingerprint taking	3,17
5	Theory test	11,64
6	Practical test	10,17
7	Form filling	5,14
8	Licence printing	3,12
9	Payment	3,14

In addition to the processing time per section, there is also a queue time. The following is the queue time for the C driver's licence application process at the Karawang Police Station.

Table 2. Processing Moving Time (Queue)

No	***Processing***	Processing time (minutes)
1	Registration	10,11
2	Data entry	6,17
3	Briefing	0

4	Photo and fingerprint taking	6,19
5	Theory test	5,08
6	Practical test	5,12
7	Form filling	4,8
8	Licence printing	15,30
9	Payment	12,35

Data Adequacy Test

Data adequacy testing is a process to determine the sufficient amount of sample data in a study [10], [11], [12], [13]. In the context of measuring queue time data adequacy, testing is carried out using samples of queue times for printing driving licences, which have the longest duration, and queue times for filling out forms, which have the shortest duration.

$$N = \left[\frac{k/s\,\sqrt{N(\sum {x_i}^2) - (\sum {x_i}^2)^2}}{\sum x_i}\right]^2 \quad (1)$$

In which :

k : Confidence level

s : Precision level

N : Number of data points

x_i : The i-th measurement data

Conclusion: $If\ N' < N$, then the data is sufficient.

A total of 50 calculations were used in the data sufficiency test for the SIM C production process. To improve the validity of the existing data, it is important to test the sufficiency and consistency of the data first with a 95% confidence level and 10% precision level. This aims to obtain a k/s value of 2/0.1..

1. Data Adequacy Test for Theory Examination and Registration Process Time

$$N' = \left[\frac{2/0{,}1\,\sqrt{50(3{,}12^2 + 3{,}02^2 + \cdots + 3{,}06^2) - (3{,}12 + 3{,}02 + \cdots + 3{,}06)^2}}{561{,}82}\right]^2$$

$$N' = \left[\frac{2/0{,}1\,\sqrt{50(6313{,}26) - (315641{,}71)}}{561{,}82}\right]^2 = 0{,}36$$

From the calculations performed, a value of N' of 0.36 was obtained for the theory test process time. The amount of data used in the test was 50 calculations ($N = 50$). Therefore, based on these results, the data is considered sufficient because $N' < N$, so the data can be used in research.

$$N' = \left[\frac{2/0{,}1\,\sqrt{50(3{,}12^2 + 3{,}02^2 + \cdots + 3{,}06^2) - (3{,}12 + 3{,}02 + \cdots + 3{,}06)^2}}{152{,}91}\right]^2$$

$$N' = \left[\frac{2/0{,}1\,\sqrt{50(467{,}68) - (23381{,}47)}}{152{,}91}\right]^2 = 0{,}20$$

From the calculations performed, a value of N' of 0.20 was obtained for the registration process time. The amount of data used in the test was 50 calculations ($N = 50$). Therefore, based on these results, the data is considered sufficient because $N' < N$, so the data can be used in the study.

2. Testing the Adequacy of Data on Queuing Times for Printing & Form Filling

$$N' = \left[\frac{2/0{,}1\,\sqrt{50(15{,}33^2 + 15{,}34^2 + \cdots + 15{,}27^2) - (15{,}33 + 15{,}34 + \cdots + 15{,}27)^2}}{765{,}08}\right]^2$$

$$N' = \left[\frac{2/0{,}1\,\sqrt{50(11707{,}08) - (585347{,}41)}}{765{,}08}\right]^2 = 0{,}0045$$

From the calculations performed, a value of N' of 0.0045 was obtained for the driving licence printing queue time. The amount of data used in the test was 50 calculations ($N = 50$). Therefore, based on these results, the data is considered sufficient because $N' < N$, so the data can be used in research.

$$N' = \left[\frac{2/0{,}1\,\sqrt{50\left(4{,}51^2 + 4{,}43^2 + \cdots + 4{,}35^2\right) - (4{,}51 + 4{,}43 + \cdots + 4{,}35)^2}}{218{,}76}\right]^2$$

$$N' = \left[\frac{2/0{,}1\sqrt{50((957{,}27)-(47855{,}94)}}{218{,}76}\right]^2 = 0{,}25$$

From the calculations performed, a value of N' of 0.25 was obtained for the form filling queue time. The amount of data used in the test was 50 calculations ($N = 50$). Therefore, based on these results, the data is considered sufficient because $N' < N$, so the data can be used in research.

Data Homogeneity Test

After going through the data adequacy testing stage, the next step is to select valid data for research purposes. In addition, data uniformity testing is also carried out to ensure that the data used meets the specified control limits [12], [14], [15], [16]. The data uniformity testing process uses the following equation.

$$Bk = \bar{\bar{x}} \pm \sigma z_a / 2\sigma x \tag{2}$$

In which :

Bk : Control limit

x : Mean of samples in each subgroup

σ : Standard deviation

z : Z-value corresponding to the confidence level

It is known that the standard deviation (σ) for the theory test process time is 0.09, for the registration process time is 0.03, and the confidence level (k) used is 95%%.

1. Testing the Uniformity of Data on the Timing of Theory Exams & Registration

$$\bar{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0{,}09}{\sqrt{5}} = 0{,}04$$

Thus:

$$BKA = 11{,}24 + 2(0{,}04) = 11{,}32$$
$$BKB = 11{,}24 - 2(0{,}04) = 11{,}15$$

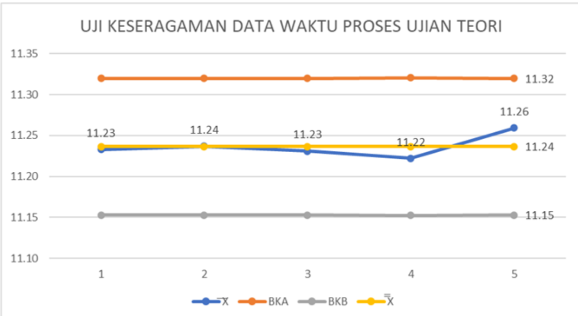


Figure 2. Graph of the Uniformity Test of the Theoretical Examination Time Data

$$\bar{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0{,}03}{\sqrt{5}} = 0{,}01$$

Thus :

$$BKA = 3{,}06 + 2(0{,}01) = 3{,}09$$
$$BKB = 3{,}06 - 2(0{,}01) = 3{,}03$$

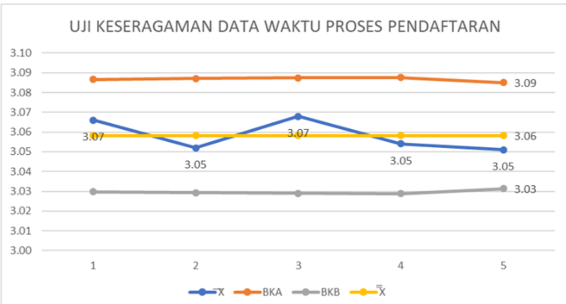


Figure 3. Graph of the Uniformity Test of Registration Time Data

2. Testing the Uniformity of Data on Printing Queue Times and Form Filling

$$\bar{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0,05}{\sqrt{5}} = 0,02$$

Thus :

$$BKA = 15,30 + 2(0,02) = 15,35$$
$$BKB = 15,30 - 2(0,02) = 15,25$$

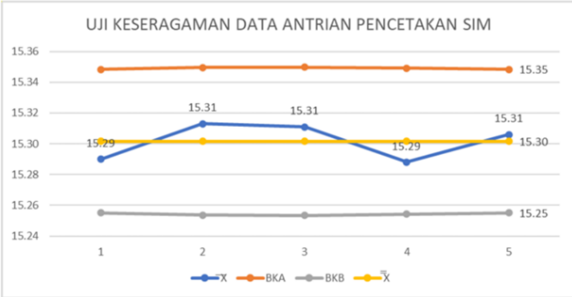


Figure 4. Graph of the Uniformity Test of Drivers's Licence Printing Queue Data

$$\bar{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{0,05}{\sqrt{5}} = 0,02$$

Thus :

$$BKA = 4,38 + 2(0,02) = 4,42$$
$$BKB = 4,38 - 2(0,02) = 4,33$$

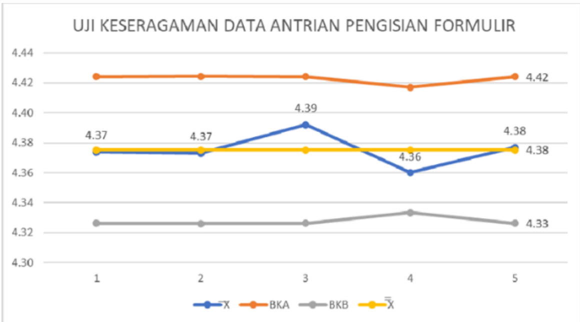


Figure 5. Graph of Queue Time Data Uniformity Test for Form Filling

4.1 Conceptual Model

The conceptual model is a stage in simulation-based research related to the creation of a diagram or flowchart framework in the form of a flow that describes an event or activity within the system[3], [4], [7], [17]. The events or activities in this study are the flow of the process of making a C driver's licence at the Karawang Police Station. The following is a conceptual model of the flow of the process of making a C driver's licence at the Karawang Police Station.

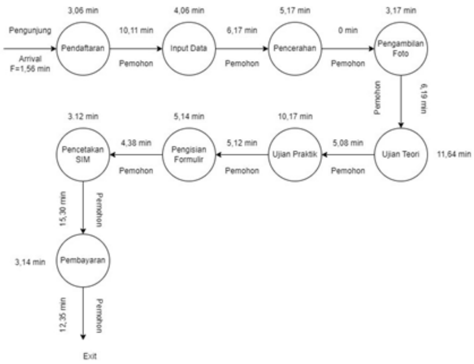


Figure 6. Conceptual Model of the Driver's Licence Application Process at the Karawang Police Station

The conceptual model of the SIM C production process flow at the Karawang Police Station was created based on the process time and the SIM C production line sections that had been analysed previously. The stages of creating this conceptual model aim to facilitate the specification of the simulation model that will be carried out in the next stage.

Model Construction

Model construction is the process of creating a model that has been built into simulation software, with specifications for components or elements of process time and moving time, as well as the frequency of arrival of entities (applicants) adjusted to the real system [6], [18], [19]. The following are the stages in constructing a model for SIM C production at the Karawang Police Station using ProModel software..

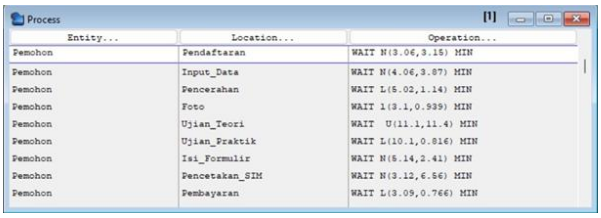
1. *Location*

   Location refers to the place where a process occurs within a system [19], In this case, the location refers to the determination of the C driver's licence production section at the Karawang Police Station, which consists of nine sections. The 9 sections (lines) for SIM C production at the Karawang Police Station are registration, data input, briefing room, photo and fingerprint taking, written test, practical test, form filling, SIM printing, and payment. Of these nine sections, the registration section has one room with a capacity of 50 people, data input has four service units, each with a capacity of one person, the lighting section has one room with a capacity of 12 people, photo and fingerprint taking has three service units, each with a capacity of one person, the theory test uses 15 computers, each used by one person, the practical test uses 3 motorcycles, each used by 1 person, form filling has 1 room with a capacity of 12 people, the driving licence printing section has 1 service unit with a capacity of 25 people, and the payment section has 1 service unit with a capacity of 25 people.
2. *Entities*

   An object to be observed from a system can be defined as an entity [3], [16], and there is only one entity involved in the process of obtaining a SIM C, namely the applicant. This entity has a process and movement speed of 150 fpm, equivalent to 150 metres per minute.
3. *Arrival*

   Arrival is the process of observing the arrival of entities from outside into the system [20]. In this context, the time of arrival of applicants to the initial stage of the system, namely registration, has been calculated. The arrival of applicants to the C driver's licence production system at the Karawang Police Station has an arrival frequency distributed as L (1.06), which means that the data on the arrival time of applicants to the system is distributed lognormally for 1.06 minutes.
4. *Processing*

   Processing refers to all processes that occur within a system, and the point of occurrence is carried out at a location or between locations [15], [20], [21], [22]. Simply put, the processing of input carried out by a tool or machine aims to produce a specific output. The process of creating a processing model in ProModel software [18] is shown in the following figure.



Process [1]

Entity...	Location...	Operation...
Pemohon	Pendaftaran	WAIT N(3.06,3.15) MIN
Pemohon	Input_Data	WAIT N(4.06,3.87) MIN
Pemohon	Pencerahan	WAIT L(5.02,1.14) MIN
Pemohon	Foto	WAIT 1(3.1,0.939) MIN
Pemohon	Ujian_Teori	WAIT U(11.1,11.4) MIN
Pemohon	Ujian_Praktik	WAIT L(10.1,0.816) MIN
Pemohon	Isi_Formulir	WAIT N(5.14,2.41) MIN
Pemohon	Pencetakan_SIM	WAIT N(3.12,6.56) MIN
Pemohon	Pembayaran	WAIT L(3.09,0.766) MIN

Figure 7. Processing for the Creation of SIM C

Verification

The verification process is carried out to ensure that there are no system errors in the simulation model that could hinder the simulation process. Verification can be done by checking every process that occurs in the model, viewing the model animation to observe its behaviour, and checking the results that occur in the system [8], [9], [11]. The following are the results of the verification of the SIM C production simulation model at the Karawang Police Station using ProModel software.

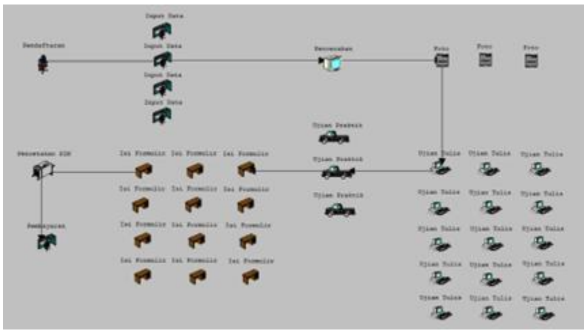


Figure 8. Simulation Model Verification

After running the simulation model in accordance with the actual system, the simulation model was verified and the process ran smoothly, with no indication of system errors. This can be seen from the results of the process, as shown in the image. If a system error occurs, the ProModel software will automatically generate a verification report related to the error, and the simulation model cannot be run.

Validation

The validation process in this study used a two-sample t-test, which is used to compare two data samples[23], [24], [25]. In this case, the data came from the simulation model results and the actual system output. The results of the two-sample t-test showed a comparison between the average processing time and queue time in the actual and simulated systems. The processing time and queue time data for both systems are presented in the following analysis.

Table 3. Comparison of SIM C Production Time in Real Systems and Simulations

Process	Actual (minutes)	Simulation (minutes)
Registration	3.06	3.06
Data entry	4.06	4.06
Briefing	5.17	5.02
Photograph and fingerprinting	3.12	3.1
Theory test	11.64	11.1
Practical test	10.17	10.1
Form filling	5.14	5.14
Printing	3.12	3.12
Payment	3.14	3.09

The t-start value indicates that H0 (null hypothesis) of the time required to produce a SIM C in the real system is the same as in the simulation system, has a value smaller than the two-tailed t-critical value. Thus, H0 can be accepted, indicating that the data on the time required to produce a SIM C in the real system is not significantly different from the time required in the simulation system or model. This shows that the validity of the simulation system in terms of the time required in the real system can be considered valid.

Running

According to [6], the running system is a process of running a simulation model that has been created using auxiliary software on a computer [6]. In the simulation, the system operation is carried out using ProModel software, which generates output based on the predetermined working hours for running the simulation process. The following are adjustments to working hours in accordance with the actual system used in running the simulation model.

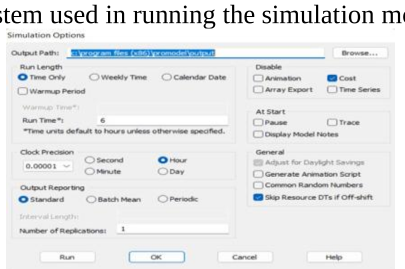


Figure 9. Running Simulation Options

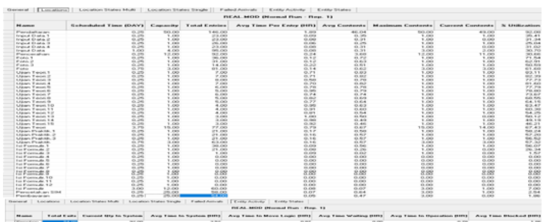


Figure 10. Output Results of SIM C Creation Simulation at Karawang Police Headquarters

The output results of the C driver's licence simulation, which ran for 6 hours, showed a total output of 54 entries at the end of the C driver's licence application process, namely the payment process, and a total exit of 54 applicants. The total exit for SIM C production in this simulation system is in line with the actual system, which produces an output of 54 applicants in one day during 6 hours of work. In addition to the calculation results, the ProModel system also produces statistics in the form of graphs for each process. The following is a statistical graph showing the results of SIM C production at the Karawang Police Station.

1. Location Capacity Statistics are the result of system operations that have been carried out, including output data on the capacity of each location in the SIM C production process.

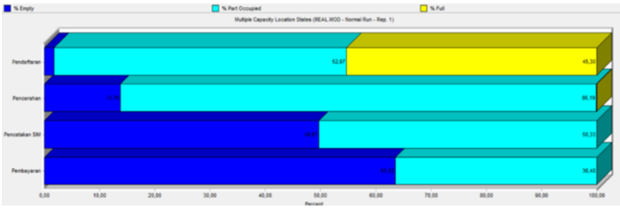


Figure 11. Location Capacity Statistics

There is one process that has a %full process of more than 40%, which affects other processes. This condition causes an imbalance in the SIM C creation process between departments.

2. Statistical entities, which are the results of running system simulations, include statistical output data on entities that are the subject of the SIM C creation process.

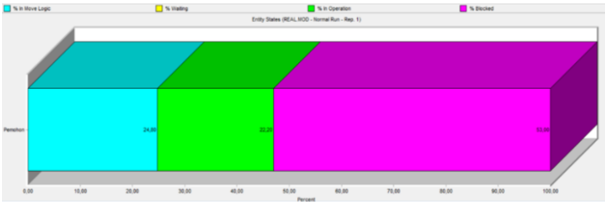


Figure 12. Entity Statistics

The applicant entity has a blocked rate of 53%, which can hinder the optimisation of SIM C production output. Therefore, an improvement scenario is needed to optimise SIM C production output by reducing the blocked entity rate.

Improvement Scenario 1

The improvement scenario implemented in the first phase was to increase the number of registration and information units from 1 to 4 in the process of issuing C driving licences. This increase was made after simulations on a model based on the actual system showed a high percentage of full processes in the registration section, which affected the output in the issuance of C driving licences. The following are the results of improvement scenario 1..

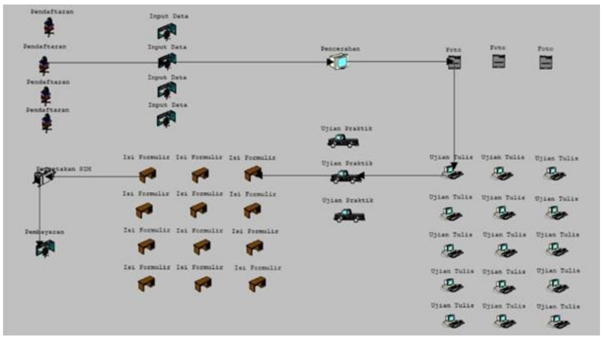


Figure 13. Improvement Scenario Layout 1

Based on **Figure 13** above, the improvement scenario in the first phase focuses on adding units to the registration and information sections for the C driver's licence application process. The purpose of adding these units is to reduce the %full process in the previous section. The following are the output statistics generated.

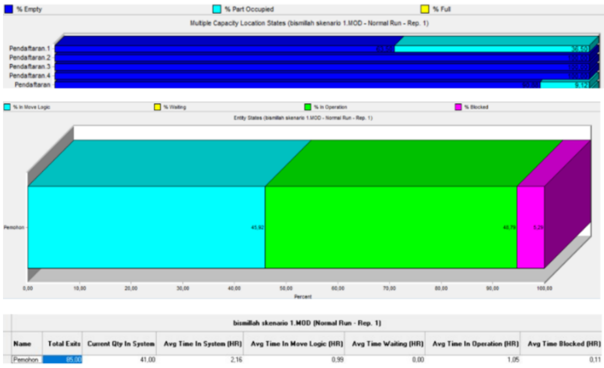


Figure 14. Statistics on Improvement Scenario 1 Output

Reviewing **Figure 14** above, the statistics generated from the first phase improvement scenario show a decrease in the %full process in the registration section, which was initially 45% in the actual system to 0%, thereby affecting the total exit, which increased from 54 applicants in the actual system to 80 applicants.

Improvement Scenario 2

The improvement scenario implemented in the second phase was to increase the number of enlightenment units from 1 to 3 in the SIM C production process. This addition was made after simulations on a model based on the actual system showed %full process in the enlightenment section, thereby affecting the output in SIM C production. The following are the results of improvement scenario 2.

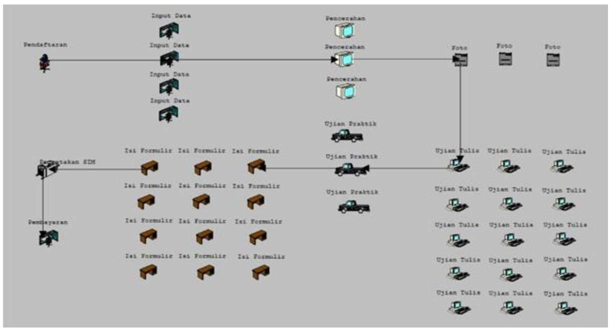


Figure 15. Improvement Scenario Layout 2

Based on **Figure 15** above, the improvement scenario in the second phase focuses on adding an enlightenment unit to the SIM C production process. The purpose of adding this unit is to reduce the %full process in the previous section. The following are the output statistics generated.

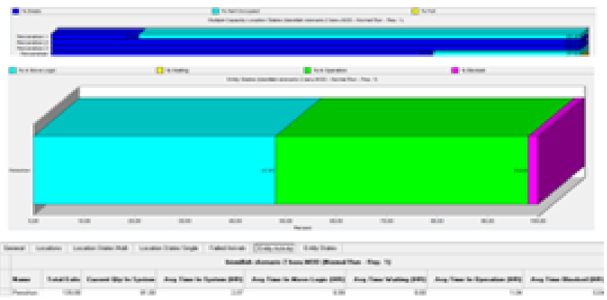


Figure 16. Statistics on Improvement Scenario 2 Output

Reviewing **Figure 16** above, the statistics generated from the second phase improvement scenario show a decrease in %full process in the enlightenment section, which was initially 0.04% in the actual system to 0%, thereby affecting the total exit, which increased from 54 applicants in the actual system to 139 applicants.

Implementing Improvement Scenarios

This implementation is a proposal that Data Processing has submitted to the Karawang Police for optimising the output of C driver's licence production. **Figure 17** is a comparison of the results of two improvement scenarios with real system simulations.

%Empty	Pendaftaran	Input Data	Pencerahan	Pengambilan Foto & Sidik Jari	Ujian Teori	Ujian Praktik	Pengisian Formulir	Pencetakan	Pembayaran	Rata-rata
Sistem Nyata	1.73%	69.30 %	13.78%	38.32%	32.57 %	42.68 %	93%	49.67%	63.52%	44.95 %
Skenario 1	90.88%	92.58 %	72.06%	84.37%	96.53 %	64.35 %	90.52%	59.15%	63.72%	79.35 %
%Part Occupied	**Pendaftaran**	**Input Data**	**Pencerahan**	**Pengambilan Foto & Sidik Jari**	**Ujian Teori**	**Ujian Praktik**	**Pengisian Formulir**	**Pencetakan**	**Pembayaran**	**Rata-rata**
Sistem Nyata	52.97%	29.38 %	86.19%	22.70%	13.67 %	57.32 %	7%	50.33%	36.48%	39.56 %
Skenario 1	9.12%	7.42%	27%	14.14%	3.35%	24.23 %	9.48%	40.85%	36.28%	19.13 %
%Full	**Pendaftaran**	**Input Data**	**Pencerahan**	**Pengambilan Foto & Sidik Jari**	**Ujian Teori**	**Ujian Praktik**	**Pengisian Formulir**	**Pencetakan**	**Pembayaran**	**Rata-rata**
Sistem Nyata	45.30%	1.32%	0.04%	38.98%	53.75 %	0%	0%	0%	0%	15.49 %
Skenario 1	0	0	0.65%	1.49%	0.12%	11.42 %	0%	0%	0%	1.52%
Output	**Pendaftaran**	**Input Data**	**Pencerahan**	**Pengambilan Foto & Sidik Jari**	**Ujian Teori**	**Ujian Praktik**	**Pengisian Formulir**	**Pencetakan**	**Pembayaran**	**Rata-rata**
Sistem Nyata	146	95	92	81	77	63	60	58	54	80.67
Skenario 1	114	97	81	80	80	80	80	80	80	85.78

Figure 17. Comparison of Real System results with Improvement Scenario 1

In improvement scenario 1, changes were made to increase the number of registration units to 4 units. After the calculation process was carried out, the overall results showed a decrease in the obstacles to the C driver's licence production process. The percentage of empty processes in each part of the C driver's licence production increased from 44.95% to 79.35%, or by 34.4% based on the average calculation. The percentage of occupied parts in each section decreased from 39.56% to 19.13%, or by 20.43%, and the full process time decreased from 15.49% to 1.52%, or by 13.97%. These results caused the applicant output to increase from 54 to 80, or an increase of 26 applicants.

To compare the actual system with improvement scenario 2, a change was made to add 3 lighting units. This was done to reduce the percentage of the full process in the lighting section, as can be seen in the following table.

%Empty	Pendaftaran	*Input* Data	Pencerahan	Pengambilan Foto & Sidik Jari	Ujian Teori	Ujian Praktik	Pengisian Formulir	Pencetakan	Pembayaran	Rata-rata
Sistem Nyata	1.73%	69.30%	13.78%	38.32%	32.57%	42.68%	93%	49.67%	63.52%	44.95%
Skenario 2	26.16%	83.47%	72.18%	68.82%	94.68%	42.72%	80.94%	37.68%	48.10%	61.64%
%Part Occupied	**Pendaftaran**	***Input* Data**	**Pencerahan**	**Pengambilan Foto & Sidik Jari**	**Ujian Teori**	**Ujian Praktik**	**Pengisian Formulir**	**Pencetakan**	**Pembayaran**	**Rata-rata**
Sistem Nyata	52.97%	29.38%	86.19%	22.70%	13.67%	57.32%	7%	50.33%	36.48%	39.56%
Skenario 2	37.84%	16.53%	27.82%	29.66%	5.32%	39.68%	19.06%	62.32%	51.90%	32.24%
%Full	**Pendaftaran**	***Input* Data**	**Pencerahan**	**Pengambilan Foto & Sidik Jari**	**Ujian Teori**	**Ujian Praktik**	**Pengisian Formulir**	**Pencetakan**	**Pembayaran**	**Rata-rata**
Sistem Nyata	45.30%	1.32%	0.04%	38.98%	53.75%	0%	0%	0%	0%	15.49%
Skenario 2	0%	0%	0%	1.52%	0%	17.60%	0%	0%	0%	2.12%
Output	**Pendaftaran**	***Input* Data**	**Pencerahan**	**Pengambilan Foto & Sidik Jari**	**Ujian Teori**	**Ujian Praktik**	**Pengisian Formulir**	**Pencetakan**	**Pembayaran**	**Rata-rata**
Sistem Nyata	146	95	92	81	77	63	60	58	54	80.67
Skenario 2	220	220	214	183	176	165	162	156	139	181.67

Figure 18. Comparison of Real System Results with Improvement Scenario 2

Reviewing **Figure 18** above regarding the comparison of actual system results with improvement scenario 2, after the calculation process, the overall results show a decrease in the obstacles to the SIM C production process. The percentage of empty processes in each part of SIM C production increased from 44.95% to 61.64%, or by 16.69% based on average calculations. The percentage of part occupied in each section decreased from 39.56% to 32.24%, or by 7.32%, and the full process time decreased from 15.49% to 2.12%, or by 13.37%. These results caused the applicant output to increase from 54 to 139, or an increase of 85 applicants. The following is a comparison of the average results of the actual system with the two improvement scenarios that have been implemented.

Table 6. Final Comparison of Actual System and Improvement Scenario

Simulasi	*%empty*	*%part occupied*	*%full*	*Output pemohon*
Actual System	44,95%	39,56%	15,49%	54

Scenario 1	79,35%	19,13%	1,52%	80
Scenario 2	61,64%	32,24%	2,12%	139

Based on the comparison results in **Table 6** above, it can be concluded that the most effective improvement scenario to optimise applicant output is the phase 2 improvement scenario. This scenario involves adding 3 additional brightening units. These steps aim to reduce the full process time, thereby increasing applicant output.

Conclusion

Based on research conducted to determine the queueing model for SIM C production at the Karawang Police Station using ProModel software, it was concluded that to reduce the total processing time for SIM C production at the Karawang Police Station, the proposed improvement scenario after simulation is to implement phase 2. The validated discrete event simulation (DES) model shows that adding 'enlightenment' units from 1 to 3 reduces the average completion time from 130 to ≈113 minutes (−13.37%) and increases throughput from 54 to 139 applicants/6 hours. The %full process metric also decreased from 15.49% to 2.12%, in line with the reduction in downstream blocking. To improve the effectiveness of the C driver's licence issuance process to produce more optimal output at the Karawang Police Headquarters after the simulation and to develop an improvement scenario, the step taken was to implement the phase 2 scenario involving the addition of units in the enlightenment section to 3 units. In addition, the implementation of this phase 2 scenario increased the applicant output from 54 to 139, or an increase of 85 applicants. However, this study has several limitations, such as the assumption that arrival and service time data are stationary, so they do not represent daily or seasonal variations, the simplification of the reset process, and the assumption that officer capacity remains constant throughout operating hours.

Based on the conclusions and limitations of the study, to overcome these limitations, future research should model arrival variations based on daily or seasonal patterns, apply an appointment scheduling approach, integrate optimisation methods for resource allocation, and conduct cost-benefit analyses to evaluate the feasibility of implementing improvement scenarios in the field.

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