Improving Service Performance of Using Simulation System: A Case Study

by Erri Wahyu Puspitarini

IMPROVING SERVICE PERFORMANCE OF USING SIMULATION SYSTEM: A CASE STUDY

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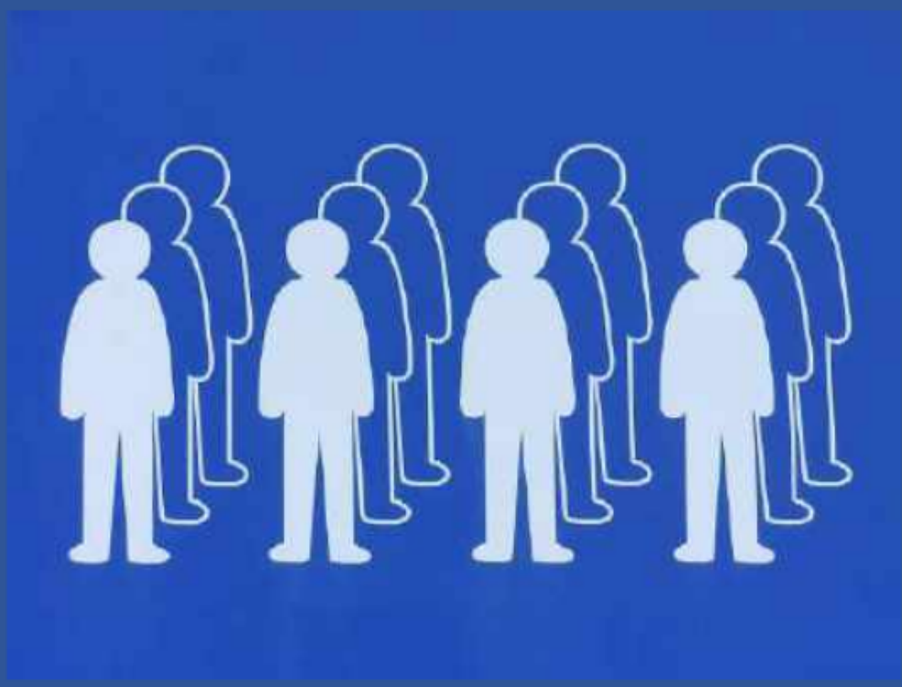

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Published by President University

Jalan Ki Hajar Dewantara, Mekarmukti, Cikarang Utara, Bekasi 17530

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Book Cover Photo

https://www.freeimages.com/photo/discipline-1316346

Publisher

President University

Jalan Ki Hajar Dewantara, Mekarmukti, Cikarang Utara

Bekasi 17530

ISBN: 978-623-6655-46-7

PREFACE

This book discusses the application of system simulation methods to improve system performance. In particular, this book presents a discussion of improving system performance in a government service system, namely the SAMSAT Cikarang service. I hope this book will provide your introduction and understanding of system simulation methods and their use in evaluating system performance and improving performance.

The system simulation in this book uses ProModel software. This software provides features that are quite complete and easy to use. This software can be used to simulate service systems as well as manufacturing systems. Brief steps in using this software are also shown in this book.

I thank God for all His blessings. Thanks also to fellow lecturers and industrial engineering students at the President University who supported this book's completion.

Cikarang, March 2021

Researcher

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ABSTRACT

This study aims to evaluate the performance of the government service system at Sistem Administrasi Manunggal Satu Atap (Samsat) located in Cikarang Utara, Jawa Barat. The method used in this research is simulation. By simulating the system, the current system performance will be known as well as future system improvement proposals. Based on the simulation results, it is known that the service time is still too long. The proposal given to improve the performance of the Samsat office is to add employees in several locations and simplify SOPs to minimize service times so that many people will be served in Samsat Cikarang Utara.

Keywords: government service system, Samsat, simulation, improvement.

CHAPTER I
INTRODUCTION

1.1 Background

Sistem Administrasi Manunggal Satu Atap (Samsat) is an administration system in Indonesia that formed to quicken the service of public interest and the activity is held in one buiding. There are several services that provided by Samsat; registration and identification of motor vehicle (registrasi dan indentifikasi kendaraan bermotor), tax payment of motor vehicle (pembayaran Pajak Kendaraan Bermotor or PKB), charge duty of motor vehicle name (Bea Balik Nama Kendaraan Bermotor or BBNKB), and payment of obligated donation of traffic accident fee and road transport (pembayaran Sumbangan Wajib Dana Kecelakaan Lalu Lintas dan Angkutan Jalan or SWDKLLAJ).

Samsat is still packed with people who choose to use Samsat's services because it facilitates a variety of activities. Therefore, Samsat is experiencing several problems, and one of the issues is the system's service performance, which is a concern in every Samsat office in Indonesia. One of the Samsat office is located in Cikarang Utara, Jawa Barat. The Samsat office in Cikarang is the research object where data and problems regarding total entity exits are collected..

To be served in Samsat Cikarang, people should pass several processes. The people should pass the vehicle

physical checking first, and then they can continue to check in process. After the check-in process, the people should fill a form and give the form to the information and progressive tax counter. After that, they will continue to the waiting place and wait for their name to be called. Since the office is always crowded, sometimes the people cannot hear that their name is being called. If they do not hear their name, they disorganized the queuing system; the office will not services them. After being at the counter, the people also have to wait for payment, take STNK, and take the plate number process. If there are only a few people in the waiting line, the process can be done quickly. But what becomes a problem is when the waiting place is crowded, the process can be very long. Even though each counter has its own standard time, if the waiting place is crowded, there is a high possibility that the process will exceed the standard time; also, the number of people in charge in each locket is not suitable. Therefore this also become one of the problems.

These issues should be investigated in order to reduce service time and increase overall entities' exits. In reducing the service time, several data are needed to be examined Therefore the observation is conducted. The data is about the service time and total exits in each counter held in Samsat Cikarang. After the data is collected, the analysis, improvements, and suggestions can be made.

In analyzing and improving the problems, the method used is modeling and simulation (M&S). M&S is the use of models,

physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process methods for implementing a model (either statically or) over time to develop data as a basis for managerial or technical decision making. M&S supports analysis, experimentation, and training. As such, M&S can facilitate understanding a system's behaviour without actually testing the system in the real world. Besides, simulation can support experimentation that occurs totally in software or in human-in-the-loop environments where simulation represents systems or generates data needed to meet experiment objectives. Furthermore, simulation can be used to train persons using a virtual environment that would otherwise be difficult or expensive to produce.

1.2 Problem Statement

some research questions that will be the focus of this research are:

a. How many total entities exit in the current system?
b. How long does the service time in each process, and how many people in charge of each process?
c. How to improve the service performance at Samsat Cikarang?

1.3 Objectives

The research objectives of the research are:

a. Identify the system output, which is number of customers, served in the current system.

b. Identify the service time and the capacity in each locket to finish each process.
c. Analyze and improve the service performance by minimizing the service time and adding capacity to achieve the optimal number of total entities exit.

1.4 Assumption

This research assumes that the data is stationary. It means that the probability distribution of the data is constant every time.

CHAPTER II
LITERATURE REVIEW

2.1 System's Definition

Russel (1994) have another opinion about system, A system is defined as a set of two or more elements that meet the following requirement:

- The behaviour of each element has an impact on the overall behaviour
- The interactions between the elements and their effect, on the whole, are intertwined
- Regardless of how subgroups of elements are formed, each has an impact on the overall behaviour, and none is distinct.

According to Burkeman (2014), A system, by contrast, is "something you do regularly that increases your odds of happiness in the long run", regardless of the immediate outcome. From these definitions, it can be concluded that a system is a combination of several elements to achieve specific goals. Each element has an effect on the whole system, and the result is independent.

2.2 Simulation's Definition

According to Shannon (1975), simulation is the method of creating a model of a real system and performing experiments with it for either understanding the system's behaviour or

analyzing different methods for its operation (within the constraints imposed by a criterion or collection of criteria).

Simulating the action of a real-world operation or system over time is known as simulation.. Simulation involves the generation of an artifcial history of the system, and the observation of that artifcial history to draw inferences concerning the operating characteristics of the real system that is represented (Radu, 2010).

From the definition, simulation can be concluded as the design process of a real system to understand the system and evaluate strengthness and weaknesses of the system to improve the system based on several criteria.

2.2.1 Process of Simulation Experimentation

According to Harrell, Ghosh, and Bowden (2012), there are several procedures in doing simulation, following the scientific method:

• Formulating a hypothesis

Articulate a hypothesis related to design or operating policies work best.

• Setting up an experiment

Set up the experiment in the form of a simulation model to test the hypothesis.

• Testing the hypothesis through experimentation

Conduct several replications of the experiment or simulation.

• Drawing conclusions about the validity of the hypothesis

Analyze the simulation results and draw conclusions about the hypothesis. If the hypothesis is correct, the process can be move ahead to make design or operational changes (assuming time and other implementation constraints are satisfied).

2.2.2 Steps to Apply and Develop Simulation

To apply and develop a simulation, there are several steps required. There are twelves steps in simulation study, as outlined by Banks and Carson (1984), as follows:

• Problem formulation

Any research should start with a problem statement. If the statement comes from policymakers or people who are experiencing the issue, the researcher must make sure that the problem is well-defined. If the researcher is developing a problem statement, it is critical that the policymaker agree and support with the formulation.

• Setting goals and creating a project schedule

The goal specifies the questions that must be answered. At this stage, you should decide if simulation is the right methodology for the issue and the goals you've set.

If simulation is chosen, the overall project strategy should contain a statement of the alternate systems to be explored as well as a framework for assessing the feasibility of these alternatives..

It should also include the study's plans, such as the number of people who will be involved, the study's expense, and the

number of days taken to complete each step of the work, as well as the anticipated outcome at the end of each point.

• Conceptualization of model

The development of a system model is likely as much art as science. The ability to abstract the fundamental features of a query and pick and adjust simple inference outcomes enhances the art of modelling. As a result, it's best, to begin with, a basic model and gradually increases.

A one-to-one mapping between the model and the actual system is not needed. The essence of the fundamental structure is all that is required. It is a good idea to include the model user in the conceptualization process. Involving the model user would improve the consistency of the final model while also increasing the model user's trust in its implementation.

• Data collection

The design of the model and the gathering of the necessary input data are constantly intertwined. The requisite data elements can change as the model's complexity increases. Furthermore, since data collection consumes such a significant portion of the overall time taken for simulation, it is important to begin it as soon as possible, typically concurrently with the early stages of model development.

The type of data to be gathered is heavily influenced by the quantitative analysis. For example, in a bank analysis, if the goal is to learn about the length of waiting lines as the number of

tellers changes, the types of data required are inter-arrival time distributions, teller service time distributions, and historical waiting line length distributions under varying conditions. The simulation model will be validated using this last form of data.

• Model translation

Since most real-world applications produce models that involve a lot of data storage and computation, the model must be saved in a computer-readable format. We use the term "program" even though in many cases the desired outcome can be achieved with little to no real coding. The modeller must determine if the experiment should be programmed in simulation language or not.

• Verification

The programming software created for the simulation model is subject to verification. Is the machine software working as it should? It's difficult, if not impossible, to translate a complex model effectively in its entirety without a lot of debugging; verification is complete when the input parameters and logical form of the model are accurately expressed in the computer. The majority of the time, common sense is used to complete this step.

• Validation

Validation is typically accomplished by model calibration, which is an iterative method of matching the model to real device behaviour and using the differences between the two and the knowledge obtained to refine the model. This procedure is repeated until the precision of the model is deemed satisfactory.

• Experimental design

It's necessary to find out which options need to be simulated. Choosing which alternatives to simulate is often based on the results of previously performed and analyzed runs. Decisions on the duration of the initialization time, the length of simulation runs, and the repetition of each run must be taken for each configuration that is simulated.

• Production runs and analysis

Production runs and their subsequent review are used to approximate efficiency metrics for the simulated system designs.

• More runs

The analyst decides whether additional runs are required based on the review of completed runs and what design such additional tests should pursue.

• Documentation and reporting

Program and progress documentation are the two forms of documentation. To learn how the software works, you will need to read the program's documentation. It is a lot quicker to change the software. Users of the model may alter parameters to determine the relationship between input parameters and performance output measures or to determine the relationship between input parameters and performance output measures.

In a final report, the results of all the analyses should be presented accurately and concisely. The final formulation, the alternative systems that were discussed, the criteria against

which the solutions were compared, the outcomes of the tests, and the proposed approach to the problem would all be available to model consumers.

• Implementation

The performance of the implementation process is entirely dependent on the execution of the preceding 11 phases. It also depends on how engaged the observer has been with the ultimate model customer in the simulation process.

The risk of a vigorous implementation is increased if the model consumer has been fully engaged in the model development process and knows its essence and performance.

2.3 Model's Definition

According to Ford (2009), models are available in a variety of forms, weights, and designs. It's important to remember that a model isn't the real world; rather, it's a human concept that can help us understand real-world processes better. Both models, in general, include information input, an information processor, and an estimated outcome output.

All models can be grouped into three types, based on James (2010):

• Graphic models

Conceptual sketches, graphs, maps, and diagrams are popular graphic templates. The designer's designs for specific systems and items are captured in conceptual drawings. It depicts a broad overview of the components and their connections.

Designers may use graphs to arrange and plot results. Graphs display numerical data that can be used to create items and evaluate test outcomes.

The relationship between individuals, acts, or operations is depicted in charts. It aids in the selection and sequencing of activities required to complete a project. For different activities, different charts are used. Diagrams depict how elements in a system interact.

• Mathematical models

Relationships are depicted in mathematical models using formulas. The formula shows the relationship between voltage, amperage, and resistance in an electrical circuit is E = IR, where E = electromotive force measured in volts, I = electrical current in amperes, and R = electrical resistance measured in ohms.

Similarly, the formula for work shows the relationship between the force used to move an object and the distance it is lifted: Work = Force x Distance.

So far, the examples have been for basic mathematical models. Individuals use more sophisticated equations containing thousands of calculations to forecast the outcomes of complex interactions.

• Physical models

Three-dimensional representations of reality are called physical structures. Mock-ups and prototypes are two kinds of physical

models. The first form of a physical model is used to demonstrate the appearance of a product or structure. An appearance model, also known as a Conceptual, Physical, and Mathematical Models mock-up, is a model type. It is used to assess a technology artifact's styling, symmetry, colour, or other aesthetic features. Mock-ups are usually made from materials that are simple to deal with.

A prototype is the second category of a physical model. A functional model of a machine, assembly or product is referred to as a prototype. Prototypes are created to measure the item's function, repair, and protection. It is usually made of the same stuff as the finished product. It will be impossible to construct a full-scale skyscraper prototype. To validate and analyze the solutions, prototypes and other templates should be used.

2.4 ProModel Software

The program itself is used to perform the software process simulation modelling. ProModel is one of the most widely deployed programs. ProModel is a discrete-event modelling technology for planning, designing, and improving new and current production, logistics, and other operating structures. It enables users to reflect real-world processes reliably, including their intrinsic uncertainty and interdependencies, to do predictive research on future changes. Improve the system's efficiency by focusing on the main performance metrics (ProModel, 2017).

2.4.1 ProModel Methodology

• Visualize

Build an immersive, animated simulated model of the business environment using CAD files, process or value stream maps, or Process Simulator models. Observe and comprehend existing practices and systems in action.

• Analyze

Using the blueprint, brainstorm future updates and create scenarios to validate enhancements that can help the company meet its goals. Run scenarios separately and analyze responses in the Output Viewer, which was developed using the new Microsoft® WPF technology.

• Optimize

With predictive scenario comparisons, you can quickly test the effect of improvements on existing and future activities. Determine optimum business performance with a high likelihood of achieving the objectives.

2.4.2 ProModel Advantages

ProModel enables decision-makers to test novel solutions for process and method design or development before devoting the time and money required to construct or modify the existing system.

ProModel is concerned with topics such as:

- Resource Utilization
- System Capacity
- Process Improvement
- Throughput and Bottleneck Analysis

- Supply Chain and Logistics
- Customer Service Levels

Leaders may experiment with various operational strategies and architectures to achieve optimum efficiency for their companies by designing the important elements of a production, storage, or operation structure.

2.4.3 ProModel Elements

According to Benson (1992), ProModel's simulation elements serve as building blocks for describing the physical and conceptual components of the structure under consideration. Parts, machines, and tools are all physical elements of the system that can be referenced graphically or by name. Modeling feature names can be any word of up to 80 alphanumeric characters.

• Locations

Routing locations are fixed locations in the system where components or persons are routed for processing, storage, or merely to make a routing decision. Routing sites may either be single-unit or multi-unit locations.

Routing sites may have more than one capability. They may experience intermittent downtimes due to clock time (e.g. shift changes), consumption time, usage duration, content adjustment, or some other user-defined condition.

Input and output rules may be allocated to routing sites. In a multi-capacity location, input rules are used to determine the entity to process next, while output rules are used to rate entities.

• Entities

The objects being stored in the system are referred to like parts or individuals. This includes raw materials, component parts, components, loads, work-in-progress, and finished goods, among other things.

Entities of the same or different types may be combined, split into two or three additional entities, or converted into new entity types.

Attributes should be allocated to entities that can be used to make judgments or collect advanced data. An entity's graphic may be modified as a result of an action to depict a physical transition during animation.

• Path Networks

Path networks are optional, and they specify the paths that actors and services will take as they move across the system. Path networks are made up of nodes linked by path segments that are graphically described with a few mouse clicks.

There might be several path networks established, with one or more resources and/or organizations sharing the same network. Movement along a route network can be measured in terms of distance and speed, or it can be measured in terms of time.

Path distances are calculated automatically based on the user-defined layout size. Passing, non-passing, and crane path networks are the three forms of path networks.

When entities and resources are able to surpass one another, a moving network is used. Non-passing networks are made up of single-file tracks or guide routes, such as those used by AGVs, where vehicles can't pass. Crane networks describe the operational envelope and interface points for bridge cranes.

• Resources

A resource may be an individual, a tool, a car, or some other item that can be used to accomplish a goal:

1. Transport material between routing locations.
2. Perform an operation on the material at a location
3. Perform maintenance on a location or other resource that is down.

Static resources may be delegated to a route network for dynamic travel. Cranes are a unique category of complex resource. Built-in decision rules can be used to allocate capital and prioritize pick-up and distribution of parts. It is also possible to specify resource motion characteristics such as empty and full speeds, acceleration and deceleration, as well as pickup and distribution times.

• Processing

This feature specifies the order in which individuals are processed and how they flow between routing locations. The

Processing factor may be used to characterize operating or service times at locations, resource needs, processing logic, input/output relationships, routing constraints, and move times or requirements.

Constants, distributions, functions, attributes, subroutines, and other variables, as well as an expression containing some combination of these, can be used to describe operation times. IF-THEN-ELSE statements, loops, nesting expression blocks, and subroutine calls are all examples of operation logic. The use of Boolean expressions in resource-dependent statements like GET, USE, and JOINTLY GET, as well as built-in operation statements like ACCUM, JOIN, and GROUP, significantly simplifies otherwise complex logic in defining processing requirements. Built-in and user-defined routing rules give you the freedom to model any form of routing situation.

• Arrivals

This factor can be used to model deterministic, conditional, or stochastic arrivals. The Arrivals feature in ProModel will read external files such as output schedules or arrival data. Inter-arrival times and quantities may be described using built-in or user-defined distributions or data provided in a spreadsheet.

• Shifts

The ability to identify custom work and split schedules via ProModel's Shifts module is a valuable feature. Work and break schedules are graphically depicted by the time of day and weekday. After that, resources or locations are allocated to a

moving schedule. You may also describe the change and break logic that governs how locations and resources behave when they go offline and what happens when they come back online.

2.5 Sistem Administrasi Manunggal Satu Atap (Samsat) Kabupaten Bekasi

Sistem Administrasi Manunggal Satu Atap (Samsat) Kabupaten Bekasi is located in Cikarang, specifically in Jl. Raya Industri Pasir Gombong No.14, Pasirgombong, Cikarang Utara, Bekasi, Jawa Barat. Samsat Kabupaten Bekasi opens from 08:00 AM – 02:00 PM, from Monday until Saturday.

Samsat Kabupaten Bekasi provides several services for those who need (Mengenal Giat dan Fungsi Sistem Administrasi Manunggal Satu Atap (Samsat), 2016), such as:

- Registration and identification of motor vehicle (registrasi dan indentifikasi kendaraan bermotor)
- Tax payment of motor vehicle (pembayaran Pajak Kendaraan Bermotor or PKB)
- Charge duty of motor vehicle name (Bea Balik Nama Kendaraan Bermotor or BBNKB)
- Payment of obligated donation of traffic accident fee and road transport (pembayaran Sumbangan Wajib Dana Kecelakaan Lalu Lintas dan Angkutan Jalan or SWDKLLAJ)

Because Samsat Kabupaten Bekasi provides several services, the queuing system in Samsat Kabupaten Bekasi is having several troubles. To improve the queuing system in Samsat

Kabupaten Bekasi, software process simulation modelling is conducted. The software that is used is ProModel.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Methodology

This section would go through the measures involved in undertaking a comprehensive research project. The process, measures, and improvements in solving the problem will all be explicitly outlined. Research methodology is depicted in Fig. 3.1.

Figure 3.1 Research Methodology

The steps in conducting the research are:

1. Introduction

The first step in doing research is to recognize questions that will be investigated further. Precise observation is needed to locate the issues. As a result, direct observation takes place at the Samsat Cikarang office, Kab. Bekasi.

The problems that were identified from Samsat Cikarang office is that the Samsat Cikarang is too crowded. Because the office is always too crowded, the queuing is also almost always full. Since the queuing capacity is full, the customers' waiting time also tends to be very long.

The study goals will be found after the objectives have been established. The tools and steps for performing the study should also be decided in order to achieve the objectives.

2. Literature Review

In order to perform research, a variety of knowledge from various sources is required to validate the research. The literature is mostly concerned with the system's fundamentals and the analysis methodology, which is commonly referred to as a literature review.

3. Research Methodology

There are several steps to doing analysis. The stages of doing research are outlined systematically and explicitly in research methodology. From the beginning to the end of the study, the measures will be clarified.

4. Data Collection and Analysis

First and foremost, entities, locations, and triggering events must be identified in order to capture data. Observation may be used to find data on individuals, locations, and initiating events.

The time study data is required after the entities, locations, and triggering events have been identified. The information was gathered from observations made in Samsat Cikarang. The data is gathered in a quantitative manner using a stop watch. The information pertains to the customer's wait time in the queueing system as well as the service time of and worker in each locket.

Once the data has been gathered, use ProModel tools to interpret it to determine if the data is independent or not and the distribution that best matches the data. There are several tests that the data must satisfy to be appropriate for analysis. Since ProModel program has the ability to validate records, it is used. The scatter map, autocorrelation plot, and run test are used to determine if the data is independent, and the log-normal, exponential, and uniform tests are used to determine what kind of distribution best fits the data.

The data documentation is needed after the data has passed all of the tests. The entity flow diagram, processing description and order, move time, work schedule, and assumption list of the whole process in Samsat Cikarang were all included in the data documentation.

Once you have completed the data documentation, run the simulation using ProModel tools. From the beginning to the end, the model is built on observation. Then, with the current model, perform verification and validation.

After the current model is developed, the flaws in the Samsat Cikarang mechanism will be revealed. As a result, the new iteration, which was created using ProModel, has been changed based on the current model's weaknesses.

Compare the two versions as there is an existing and proposed one. The comparison aims to see if the proposed model would

significantly impact reducing waiting times in Samsat Cikarang's queuing system.

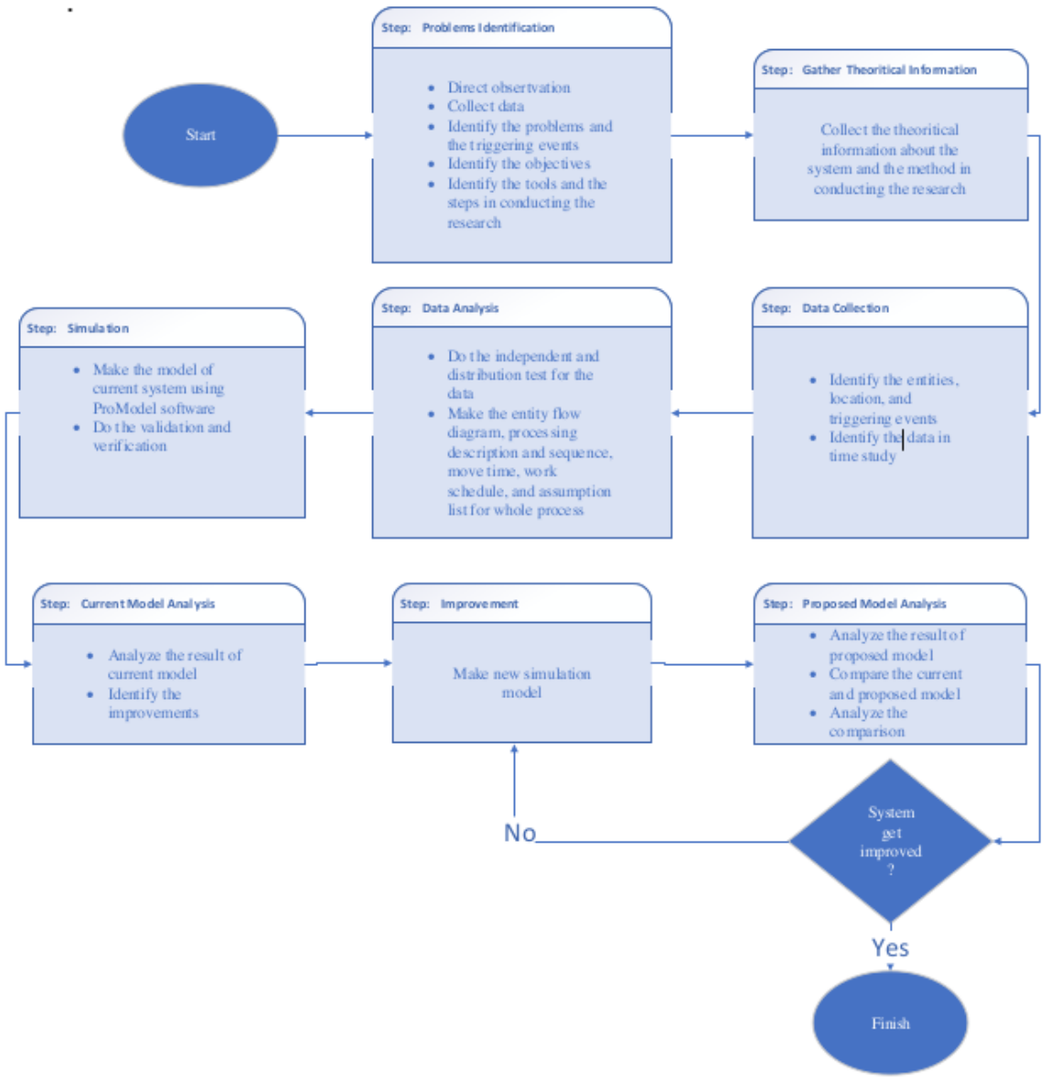
5. Conclusion and Recommendation

After collecting data and analyzing it, conclude the research's findings. The conclusion is reached in several chapters on the flaws in the existing system that trigger long queuing times, and the recommendation is about how to change the current system and make it a better system.

3.2 Research Framework

The research framework depicts the trajectory of the study of waiting time in Samsat Cikarang's queuing system, from finding the problem to implementing improvements to reduce queuing time. The research framework is depicted in Fig. 3.2.

Figure 3.2 Research Framework



CHAPTER IV
DATA COLLECTION AND ANALYSIS

4.1 Identification of Entities

Entities are the objects that are processed in a system that represent the system's input and output. People are the Samsat Cikarang system's entities.

There are several entities there, such as:

a. People who doing Re –Registration Annual

   People who doing Re-Registration annual is the entity who like to extend their STNK. This entity will start from the check in process until taking their STNK. For this entity, no need for the physical vehicle checking process.

b. People who are doing Re-Registration 5 Years

   People who are doing Re-Registration 5 years is the entity who like to extend their STNK after five years. This entity will start from the physical vehicle checking until taking STNK and plat.

c. People who are doing Registration of Vehicle Changing Information

   People who register for vehicle changing information are the entity that would like to change their vehicle changing information, such as name of owner, address, etc. This entity will start from the physical vehicle checking until taking their plat.

d. People who are doing Registration from Outside Region
People who are doing registration from the outside region is the entity which would like to extend their STNK, but from others region outside Cikarang. This entity will start from the physical vehicle checking until taking their STNK.

e. People who are doing New Vehicle Registration
People who are doing new vehicle registration is the entity that would like to regsister their new vehicle. This entity will start from the physical vehicle checking until taking their plat

4.2 Identification of Locations

Locations are the place that entities visit for processing. In the Samsat Cikarang, there are several locations, such as:

a. Vehicle Physical Checking
Several entities, not all entities, have just visited physical vehicle checking. So, this location considered optional based on a process. There are seven servicemen there who are ready to serve the customers. The input and output are based on turn rules. The entities will wait until they turn to the following location.

b. Check-in Desk
Check-in is a place for the taking form. This location has one man who will give the form to the customers. The input and output is based on first-in, first-out (FIFO) rules. The entities will wait until it turn to the next location. The check-in location can be seen in Fig. 4.1.

Figure 4.1 Check In Location

c. Fill Form Place

Fill form place is the customers will visit the next location. There are 20 desks available to be used by the customers. The input and output is based on turn rules. The entities will wait until it turn to the next location. The Fill Form Location can be seen in Fig. 4.2.

Figure 4.2 Fill Form Location

d. Information and Progressive Tax

Information and Progressive tax is the place for the customer to check the completeness of documents, checking the Progressive tax, and give the documents. There are two men to serve the customers. The input and output is based on turn rules. The entities will wait until they turn to the next location. The Information and Progressive Tax Location can be seen in Fig. 4.3.

Figure 4.3 Information and Progressive Tax Location

e. Waiting Place for Registration

After the customers give the documents to information desk, now they will waiting in the waiting place. They will wait until the operators in registration give the invoice payment to them. The input and output is based on first-in, first-out (FIFO) rules. The entities will wait until they turn to the next location. The entities will wait until it turn to the next location. The Waiting Place for Registration Location can be seen in Fig. 4.4.

Figure 4.4 Waiting Place for Registration Location

f. Re –Registration Annual Locket

Re-registration annual locket is the locket for proccesing the documents of customers who like to re-registration annually. The location will be served by one man. The input and output is based on first in first out (FIFO) rules. The entities will wait until it turn to the following location.

g. Re –Registration 5 Years Locket

Re-registration 5 years locket is the locket for proccesing the documents of customers who like to re-registration 5 years. The location will be served by one man. The input and output is based on first in first out (FIFO) rules. The entities will wait until it turn to the next location.

h. Registration of Vehicle Changing Information Locket

Registration of vehicle changing information locket is the locket for proccesing the documents of customers who like

to registration of vehicle changing information. The location will be served by one man. The input and output is based on first in first out (FIFO) rules. The entities will wait until it turn to the next location.

i. Registration from Outside Region Locket

Registration of outside region locket is the locket for proccesing the documents of customers who like to registration of outside region. The location will be served by one man. The input and output is based on first in first out (FIFO) rules. The entities will wait until it turn to the next location.

j. New Vehicle Registration Locket

The new vehicle registration locket is the locket for processing the documents of customers who like to new vehicle registration. One man will serve the location. The input and output is based on first-in, first-out (FIFO) rules. The entities will wait until they turn to the next location.

k. Waiting Place for Payment

After the customers receive the invoice payment, now they will wait in the waiting place for payment. They will wait until the operators in payment, call their name. The input and output is based on first-in, first-out (FIFO) rules. The entities will wait until they turn to the next location.

l. Payment Counter

Payment counter is the locket for doing the payment. Two operators will serve the location. The input and output is based on by turn rules. The entities will wait until it turn to the next location. The Payment Counter Location can be seen in Fig. 4.5.

Figure 4.5 Payment Counter Location

m. Waiting Place for Taking STNK

After the customers make the payment, now they will be waiting in the waiting place for taking STNK. They will wait until the operators in Taking STNK counter call their name. The input and output is based on first-in, first-out (FIFO) rules. The entities will wait until they turn to the following location.

n. STNK Counter

The payment counter is the locket for taking STNK. Two operators will serve the location. The input and output is

based on by turn rules. The entities will wait until it turn to the next location. The STNK Counter Location can be seen in Fig. 4.6.

Figure 4.6 STNK Counter Location

o. Waiting Place for Taking Plat

Not all entities pass this locations, only several entities. After the customers taking STNK, now they will waiting in the waiting place for taking plat. They will wait until the operators in Taking Plat counter, call their name. The input and output is based on first-in, first-out (FIFO) rules. The entities will wait until they turn to the next location.

p. Plat Counter

Plat counter is the locket for taking vehicle plat. One operator will serve the location. The input and output is based on first-in, first-out (FIFO) rules.The entities will wait until they turn to the next location.

4.3. Identification Triggering Events

It is important to identify the causes that trigger the activities. There are several causes of the triggering events, such as:

- Do not enough capacity to serve the customers
- The layout of the locations

The current system will be model by using ProModel software. Using simulation, we can improve and make the system run better and prevent the triggering events. It will be analyzed in this report by using ProModel.

4.4 Time Study

The data collection is collected by using the time study method. The observers take the data randomly, from Monday and Friday, in the morning and afternoon. The result of the time study is showed as below. All of the data are in minutes. The time study results are shown in Table 4.1.

Table 4.1 Time Study Result

No	Interarrival	Phsyical Checking	Fill Form	Information /Progressive Checking Test	Re-registration Process	Registration of Vehicle Changing Information	Registration from Outside Region Locket	New Vehicle Registration	Payment	Taking STNK	Taking Plat
1	-	0.08	3.05	0.13	20	202.675	195.305	250.194	0.13	0.38	3.5
2	0.33	0.24	3.2	0.15	15.12	191.117	286.1	274.62	0.65	0.08	6.67
3	0.53	0.10	2.02	0.10	14.2	263.711	278.225	301.97	0.78	0.05	5.12
4	0.13	0.06	3.67	0.16	11.3	220.11	150.098	312.67	0.50	0.20	7.3
5	0.17	0.04	3.56	0.07	31.8	250	165.401	203.39	1.00	0.37	10.9
6	0.27	0.27	3.2	0.10	9.41	243.87	177.84	288.64	0.65	0.60	5.6
7	0.75	0.10	1.75	0.17	19.37	162.939	244.45	311.47	0.68	0.08	5
8	0.10	0.13	2.15	0.09	13.09	231.8	196.273	259.343	0.60	0.07	10
9	0.17	0.06	3.21	0.14	12	242.335	208.878	390.79	0.53	0.10	5.03
10	0.10	0.26	4	0.08	26.4	132.57	170.28	252.81	0.78	0.12	12
11	0.38	0.31	4.1	0.05	37.63	210	254.65	267.62	0.65	0.05	4.3
12	0.33	0.05	4.26	0.11	15	179.38	274.29	192.51	0.32	0.10	11
13	0.90	0.14	4.52	0.12	13.36	215.525	223.54	307.86	0.20	0.10	18.93
14	0.07	0.03	3.1	0.07	10.07	284.317	171.029	251.39	0.22	0.15	14.08
15	0.87	0.18	3.2	0.09	28.97	121.154	204.18	257.454	0.78	0.08	14.96
16	0.12	0.07	3.4	0.15	14.3	204.88	217.36	334.607	1.38	0.05	10

17	0.58	0.83	2.9	0.21	16.32	151.292	153.46	280.36	1.08	0.12	6.4
18	0.35	0.46	4.3	0.05	35.8	136.99	224.47	225.19	0.45	0.18	6.1
19	0.13	0.06	2.02	0.26	9.67	296.11	173.95	195.64	0.38	0.32	7.29
20	0.1	0.07	2.05	0.12	9.36	288.91	202.27	257.67	0.32	0.15	5
21	0.07	0.09	3.03	0.06	25.3	165.43	292.86	277.292	0.42	0.18	8.04
22	0.20	0.09	4.2	0.35	13.9	229.08	256.36	348.54	1.80	0.07	9.93
23	0.07	0.07	3.2	0.05	17.2	134.117	184.63	274.21	0.93	0.13	15
24	0.10	0.28	3.8	0.17	32.7	237.62	191.825	322.38	0.68	0.18	6.68
25	0.12	0.07	2.3	0.12	15.39	178.96	149.037	287.19	0.97	0.13	9.34
26	0.15	0.29	2.3	0.18	14.02	270.7	269.74	355.76	0.62	0.15	18
27	0.05	0.09	4.3	0.38	24.3	202.249	185.72	215.18	0.52	0.27	9.06
28	0.07	0.19	1.2	0.08	33.84	237.78	190.09	222.84	0.43	0.38	8.38
29	0.38	0.08	1.8	0.06	14.2	222.14	241.06	309.705	0.72	0.07	15.08
30	0.43	0.12	2.6	0.16	27.72	250.331	188.155	283.53	0.68	0.12	6.2
31	0.53	0.48	3.2	0.12	15.46	156.92	217.06	350.833	1.92	0.10	5.3
32	0.08	0.04	1.1	0.23	27.78	116.665	241.8	182.61	0.17	0.87	14.07
33	0.07	0.26	5.13	0.03	30.05	278.571	223.197	285.91	0.53	0.07	16.33
34	0.10	0.17	2.02	0.13	23.7	221.115	290.68	353.511	1.15	0.13	18
35	0.20	0.27	4.46	0.08	10.07	177.73	295.006	250.507	1.33	0.30	17
36	0.50	0.03	2.2	0.17	15.6	198.336	248.557	305.506	1.18	0.35	8

4.5 Independence and Distribution Test

To determine their suitability for use in the simulation model, the data should be evaluated. The independence test is a series of sample tests that are independent of one another and random. A measure for independence may be used to determine whether or not the data is independent. Scatter plots, autocorrelation plots, and run tests are three types of tests. StatFit can be used in ProModel software to validate the results. In a time study, the independence tests must be performed on each location or data. All of the data used in this analysis are found to be independent of one another.

Determine the distribution for each data after testing the independence measure. In StatFit, you can choose from various distributions, including log-normal, regular, exponential, and uniform. The random variable logarithm is usually distributed in a lognormal continuous probability distribution. The normal distribution is a symmetrical continuous probability distribution in which the mean and median are identical. Exponential likelihood describes the occurrences of events over a period of time. A uniform distribution is a probability under which all values have the same chance of occurring. Table 4.2 summarizes the distribution of the results.

4.6 Data Documentation

4.6.1 Objective

This study aims to determine the queue time and distinguish the difference between the current system and the proposed system and find a solution to a better system by minimizing the queue time.

4.6.2 Entity Flow Diagram

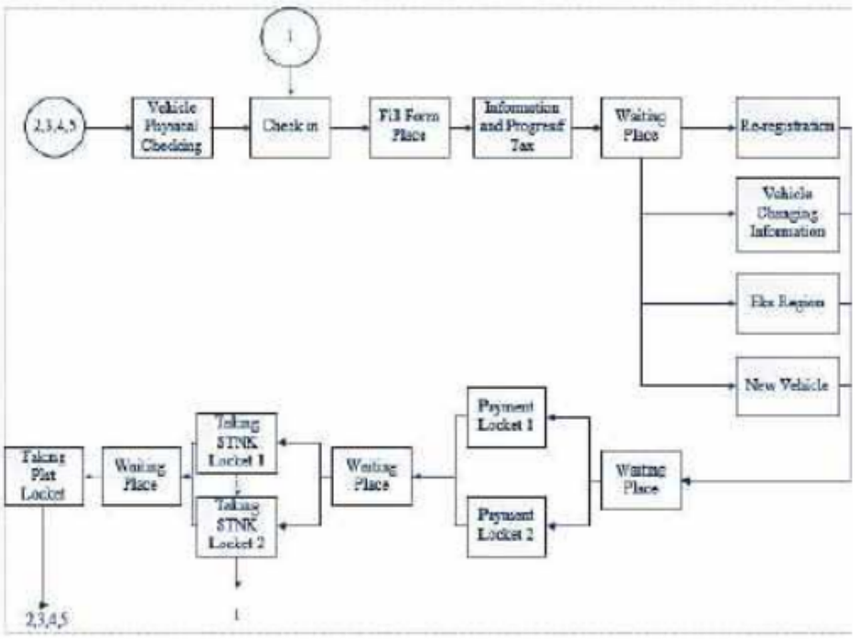
Below are shown the entity flow diagram from the beginning until the end. This diagram showed several entities, such as people who re-registration (symbol 1), registration of vehicle changing information (symbol 2), registration from the outside region (symbol 3), registration from the outside region (symbol 4), and new vehicle registration (symbol 5).

For entity 1, directly to check-in location, but for entities 2,3,4, and 5, should go to physical vehicle checking first and then go to check-in process. All of the entities will go through fill form place, information and progressive tax, and go to queuing place. Here, the entities' documents will be processed based on objectives, whether in re-registration, vehicle changing information, ex region, and new vehicle process.

After already processed, the entities will receive the payment invoice and queuing a place for payment. The operators in the payment counter will call the entity for payment. After the

payment process, the entity will go to queuing place for taking STNK. The operators in taking STNK counter will call the entity for taking STNK. For 1st entity will stop until this process. But, for entities, 2-5th will continue to queue for taking plat. If making plat process already, so the entities will take the plat and finished. The entity flow diagram can be seen in Fig. 4.7.

Figure 4.7 Entity Flow Diagram



4.6.3 Processing Description and Sequence

A processing summary is a set of instructions that explains how data is passed through the system. The process description for Samsat Cikarang is shown below. Table 4.2 below are the processing description for entity 1, re-registration annually.

Table 4.2 Processing Description 1

Fill form	L(3.18, 0.67)min	None	Information and Progresif Tax Checking	None	None	None
Information and Progresif Tax Checking	L(0.13, 0.01)min	Officers	Waiting Place	None	None	Officers
Waiting Place	None	None	Registration Counter	None	None	None
Registration Counter	L(19.57, 8.31)min	Officer	Waiting Place	None	None	None
Waiting Place	None	None	Payment	None	None	None
Payment	L(0.73, 0.17)min	Officers	Waiting Place	None	None	None
Waiting Place	None	None	Taking STNK	None	None	None
Taking STNK	L(0.19, 0.03)min	Officers	Exit	None	None	None

After taking STNK, the people will exit from the system and total the number of people who are doing annual re-registration are recorded.

Below are processing description for entity 2, 3, 4, and 5, such as re-registration five years, vehicle changing information, ex region, and new vehicle registration.

Table 4.3 Processing Description 2

Location	Activity Time	Activity Resource	Next Location	Move Trigger	Move Time	Move Resource
Vehicle Physical Checking	L(0.17, 0.03)min	Operators	Check In	None	0.5 min	None
Check In		Officer	Fill form	None	None	None
Fill form	L(3.18, 0.67)min	None	Information and Progresif Tax Checking	None	None	None
Information and Progresif Tax Checking	L(0.13, 0.01)min	Officers	Waiting Place	None	None	Officers
Waiting Place	None	None	Registration Counter	None	None	None
Registration: For entity 2 For entity 3 For entity 4 For entity 5	 L(19.57, 8.31)min N(209, 49)min L(212.72, 43.82)min L(279, 49.6)	Officer	Waiting Place	None	None	None
Waiting Place	None	None	Payment	None	None	None
Payment	L(0.73, 0.17)min	Officers	Waiting Place	None	None	None
Waiting Place	None	None	Taking STNK	None	None	None
Taking STNK	L(0.19, 0.03)min	Officers	Waiting Place	None	0.5 min	None

Waiting Place	None	None	Taking Plat	None	None	None
Taking Plat	L(9.82, 4.53)min	None	Exit	None	None	None

After taking plat, the people will exit from the system. The number of people who are doing annual re-registration are recorded.

After process description/on defined, here is processing sequence as shown below.

Table 4.4 Processing Sequence

Entity	Station	Operating Time in Minutes (min, mode, max)
Re-registration annualy (1)	Check In	
	Fill Form	1.75, 3.2, 4.52
	Information and Progressif Tax	0.03, 0.17, 0.38
	Waiting Place	
	Registration Counter	9.36, 14.20, 37.63
	Waiting Place	
Re-registration 5 years	Payment	0.13, 0.65, 1.92
	Waiting Place	
	Taking STNK	0.05, 0.07, 0.87
Re-registration 5 years	Vehicle Physical Checking	0.03, 0.03, 0.83
	Check In	
	Fill Form	1.75, 3.2, 4.52
	Information and Progressif Tax	0.03, 0.17, 0.38
	Waiting Place	
	Registration Counter	9.36, 14.20, 37.63
	Waiting Place	

	Payment	0.13, 0.65, 1.92
	Waiting Place	
	Taking STNK	0.05, 0.07, 0.87
	Waiting Place	
	Taking Plat	3.5, 5, 18.93
Registration Vehicle Changing Information	Vehicle Physical Checking	0.03, 0.03, 0.83
	Check In	
	Fill Form	1.75, 3.2, 4.52
	Information and Progressif Tax	0.03, 0.17, 0.38
	Waiting Place	
	Registration Counter	116.67, - , 296.11
	Waiting Place	
	Payment	0.13, 0.65, 1.92
	Waiting Place	
	Taking STNK	0.05, 0.07, 0.87
Registration Vehicle Changing Information	Waiting Place	
	Taking Plat	3.5, 5, 18.93
Registration Outside Region	Vehicle Physical Checking	0.03, 0.03, 0.83
	Check In	
	Fill Form	1.75, 3.2, 4.52
	Information and Progressif Tax	0.03, 0.17, 0.38
	Waiting Place	
	Registration Counter	149.04, -, 295.01
	Waiting Place	
	Payment	0.13, 0.65, 1.92
	Waiting Place	
	Taking STNK	0.05, 0.07, 0.87
	Waiting Place	
	Taking Plat	3.5, 5, 18.93
New Vehicle Registration	Vehicle Physical Checking	0.03, 0.03, 0.83
	Check In	
	Fill Form	1.75, 3.2, 4.52

	Information and Progressif Tax	0.03, 0.17, 0.38
	Waiting Place	
	Registration Counter	182.61, -, 390.79
	Waiting Place	
	Payment	0.13, 0.65, 1.92
	Waiting Place	
New Vehicle Registration	Taking STNK	0.05, 0.07, 0.87
	Waiting Place	
	Taking Plat	3.5, 5, 18.93

4.6.4 Arrivals

By interviewing the officers in Samsat Cikarang, the probability of inter-arriving people in the registration process are taken and shown in Table 4.5.

Table 4.5 Arrivals

Entity	Probability
Re-registration Annual	0.2
Re-registration After 5 Years	0.15
Vehicle Changing Information	0.15
Eks Outside Region	0.1
New Vehicle Registration	0.4

4.6.5 Move Time

The amount of time it takes to move one item from one location to another is known as move time. Since the actual move time is so limited in this scheme, not all movement is considered to move time. As a result, the system is unaffected. The following are the move times that were deemed necessary to the system.

Table 4.6 Moving Times

From	To	Time (minutes)
Vehicle Checking	Check In	0.5
Taking STNK	Queuing for Taking Plat	0.5

4.6.6 Work Schedule

All of locations are scheduled to operate eight (8) hours a day.

4.6.7 Assumption List

There are several assumptions from this simulation system, such as :

- No downtimes in each locations
- The arrival time for all entities assumed the same
- All officers and operators are available at that time to serve the people
- Moving time which not significantly affect to the system is ignored.

4.7 Current Model

In this part, there will be a translation of a system's conceptual model into a simulation model. The conceptual model is the result of the data-gathering effort and is a formulation in one's mind of how a particular system operates. Simulation is the representation, imitation of a real system, in other words, through a model, people would like to represent the model, in order to analyze it, get the results and give some improvements. The results is a representation of an actual system, if the model was made in proper ways, so the results will not be useful and does

not represent an actual system that will lead to wrong decisions. The model itself should be modelled close to real system understudy to get accurate results. Through ProModel, it is possible to create a model that represents close to the actual system. It is necessary to create a model that represents the actual system by passing several logical procedures to achieve the desired goals and objectives.

The simulation model was built by collecting the actual data during observation in SamSat Cikarang. There are fifteen locations in the system, such as physical vehicle checking, check-in, fill form place, information and progresif tax, waiting-area for registration, re-registration locket, vehicle changing information locket, ex region locket, new vehicle locket, waiting-area for payment, payment locket, waiting area for taking STNK, taking STNK locket, waiting place for taking plat, and taking plat locket. The entity (people) is divided into five specific entities: annual re-registration, five-year re-registration, vehicle changing information registration, ex region, and new vehicle registration. It is divided into several entities since each process has its own registration time and different from each others.

The people will enter from the incoming place which the interarrival time follow log-normal distribution with mean, 0.27 mins and standard deviation, 0.04 mins. And then, this entitiy will be divided into several entities with probability such as, people doing re-registration annualy (0.2), people doing re-registration 5 years (0.15), people doing vehicle changing information registration (0.15), people doing ex region registration (0.1), and

people who doing new vehicle registration (0.4). The total probability is 1. All of the probability are based on the expert who handle the registration process. And then, for people doing re-registration annually, they continue to take form at check-in desk by FIFO rule. Then, continue to fill form place. There are 21 available place for one entity to fill the form and under by turn rule. After filling form, the entity will go to information and progressive tax checking. And then, continue to waiting area for registration, re-registration locket until taking STNK locket and exist. The detailed process will shown explained in the process and routing in ProModel. Especially, for entity re-registration 5 years, vehicle changing information registration, eks region, and new vehicle registration, in the beginning, they should pass the physical vehicle checking first, and then continue to check-in place. Each entity will continue to fill form place, information and progressive tax checking, waiting for registration, registration locket, until taking plat, and finished. The detailed process will shown explained in the process and routing in ProModel.

The simulation was run for 8 hours/day with a number of replications are 10. The total people who are doing re-registration annually are 46. The total exits of people doing re-registration five years annually are 25. The total exits of people doing vehicle changing information registration are four The total exits of people doing outside region registration are three. And the total exits of people doing new vehicle registration are six.

The layout from ProModel can be seen in the Appendix 1 : Current Model. The location, entities, processing, and arrival of the current system ProModel can be seen in Table 4.7.

Table 4.7 Locations

Locations

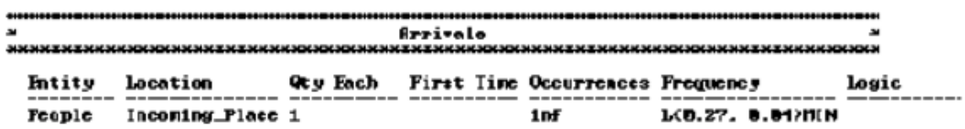
Name	Cap	Units	Stats	Rules	Cost
Vehicle_Physical_Checking	7	1	Time Series	Oldest, ,	
Check_In_Desk	1	1	Time Series	Oldest, ,	
Fill_Form_Table	3	7	Time Series	Oldest, , First	
Fill_Form_Table.1	3	1	Time Series	Oldest, ,	
Fill_Form_Table.2	3	1	Time Series	Oldest, ,	
Fill_Form_Table.3	3	1	Time Series	Oldest, ,	
Fill_Form_Table.4	3	1	Time Series	Oldest, ,	
Fill_Form_Table.5	3	1	Time Series	Oldest, ,	
Fill_Form_Table.6	3	1	Time Series	Oldest, ,	
Fill_Form_Table.7	3	1	Time Series	Oldest, ,	
Information_and_Progresif_Tax	2	1	Time Series	Oldest, , First	
Waiting_Place_Registration	Inf	1	Time Series	Oldest, ,	
ReRegistration_Locket	3	1	Time Series	Oldest, ,	
Vehicle_Changing_Information_L	2	1	Time Series	Oldest, ,	
Eks_Region_Locket	2	1	Time Series	Oldest, ,	
New_Vehicle_Locket	5	1	Time Series	Oldest, ,	
Waiting_Place_for_Payment	inf	1	Time Series	Oldest, ,	
Payment_Locket	1	2	Time Series	Oldest, , First	
Payment_Locket.1	1	1	Time Series	Oldest, ,	
Payment_Locket.2	1	1	Time Series	Oldest, ,	
Waiting_Place_for_Taking_STNK	inf	1	Time Series	Oldest, ,	
Taking_STNK_Locket	1	2	Time Series	Oldest, , First	
Taking_STNK_Locket.1	1	1	Time Series	Oldest, ,	
Taking_STNK_Locket.2	1	1	Time Series	Oldest, ,	
Waiting_Place_for_Taking_Plat	inf	1	Time Series	Oldest, ,	
Taking_Plat_Locket	1	1	Time Series	Oldest, ,	
Incoming_Place	inf	1	Time Series	Oldest, ,	

Table 4.8 Entities

Entities

Name	$peed (fpm)	Stats	Cost
People_who_Doing_Reregistratio	150	Time Series	
People_who_Doing_Reregistratio	150	Time Series	
People_who_Doing_Registration_	150	Time Series	
People_who_Doing_Registration_	150	Time Series	
People_who_Doing_New_Vehicle_R	150	Time Series	
People	150	Time Series	

Table 4.9 Processing



Entity	Location	Qty Each	First Time	Occurrences	Frequency	Logic
People	Incoming_Place	1		inf	LOG(0.27, 0.04)MIN	

This simulation model's result could be seen in Table 4.10, consisting of general information, locations, locations states multi, locations states single, entity activity, and entity states.

Table 4.10 General Information

Name	Value
Run Date/Time	[illegible]
Model Title	Normal Run
Model Path/File	[illegible]
Average Warm-up Time (HR)	0
Average Simulation Time (HR)	8

This simulation model runs for 8 hours in one day and 25 replications on average. It shows the general information of the current model.

Table 4.11 Locations Output

SAMSAT CIKARANG MOD (Normal Run - Avg. Reps)

Name	Scheduled Time (HR)	Capacity	Total Entries	Avg Time Per Entry (MIN)	Avg Contents	Maximum Contents	Current Contents	% Utilization
Vehicle Physical Checking	8,00	7,00	966,79	3,45	6,56	7,00	7,00	96,56
Check In Desk	8,00	1,00	1317,98	0,00	0,00	1,00	0,00	0,00
Fill Form Table 1	8,00	3,00	417,09	3,15	2,73	3,00	3,00	91,15
Fill Form Table 2	8,00	3,00	384,39	3,17	2,54	3,00	2,50	84,63
Fill Form Table 3	8,00	3,00	322,29	3,15	2,12	3,00	2,60	70,69
Fill Form Table 4	8,00	3,00	168,79	3,18	1,12	3,00	1,40	37,26
Fill Form Table 5	8,00	3,00	25,39	3,15	0,17	3,00	0,00	5,56
Fill Form Table 6	8,00	3,00	0,49	1,43	0,00	0,40	0,00	0,10
Fill Form Table 7	8,00	3,00	0,09	0,00	0,00	0,00	0,00	0,00
Fill Form Table	65,00	21,00	1317,99	3,16	1,24	15,40	9,50	41,34
Information and Progrest Tax	8,00	2,00	1309,49	0,13	0,35	2,00	0,30	17,72
Waiting Place Registration	8,00	999999,00	1309,19	210,64	905,86	1212,30	1212,20	0,66
ReRegistration Locket	8,00	3,00	74,09	15,27	2,57	3,00	3,00	98,50
Vehicle Charging Information Locket	8,00	2,00	5,79	166,35	1,96	2,00	2,00	98,12
Elsa Region Locket	8,00	2,00	5,59	174,98	1,96	2,00	2,00	98,04
New Vehicle Locket	8,00	5,00	10,79	222,46	4,53	5,00	5,00	90,50
Waiting Place for Payment	8,00	999999,00	63,99	0,00	0,00	1,00	0,00	0,00
Payment Locket 1	8,00	1,00	77,39	0,73	0,12	1,00	0,10	11,78
Payment Locket 2	8,00	1,00	6,69	0,72	0,01	1,00	0,00	0,99
Payment Locket	16,00	2,00	83,99	0,73	0,05	2,00	0,10	6,38
Waiting Place for Taking STNK	8,00	999999,00	82,09	0,00	0,00	1,00	0,00	0,00
Taking STNK Locket 1	8,00	1,00	81,89	0,19	0,03	1,00	0,10	3,28
Taking STNK Locket 2	8,00	1,00	2,09	0,16	0,00	0,90	0,00	0,00
Taking STNK Locket	16,00	2,00	83,99	0,19	0,02	1,90	0,10	1,66
Waiting Place for Taking Plat	8,00	999999,00	38,29	11,97	0,56	4,50	1,20	0,00
Taking Plat Locket	8,00	1,00	36,59	9,79	0,74	1,00	0,90	74,20
Incoming Place	8,00	999999,00	1729,78	61,33	227,37	455,10	453,80	0,02

Table 4.11 shows the information in each location. Each location has scheduled time, capacity, total entries, average time per entry, average contents, maximum contents, current contents, and utilization in per cent.

Table 4.12 Location States Multi

SAMSAT CIKARANG.MOD (Normal Run - Avg. Reps)					
Name	**Scheduled Time (HR)**	**% Empty**	**% Part Occupied**	**% Full**	**% Down**
Vehicle Physical Checking	8,00	0,11	1,08	98,81	0,00
Fill Form Table.1	8,00	0,20	23,56	76,24	0,00
Fill Form Table.2	8,00	1,14	35,64	63,22	0,00
Fill Form Table.3	8,00	4,91	54,09	40,99	0,00
Fill Form Table.4	8,00	35,38	51,78	12,84	0,00
Fill Form Table.5	8,00	88,19	10,97	0,84	0,00
Fill Form Table.6	8,00	99,70	0,30	0,00	0,00
Fill Form Table.7	8,00	100,00	0,00	0,00	0,00
Fill Form Table	56,00	47,08	25,19	27,73	0,00
Information and Progresif Tax	8,00	69,39	25,77	4,84	0,00
Waiting Place Registration	8,00	1,42	98,58	0,00	0,00
ReRegistration Locket	8,00	0,90	0,40	98,69	0,00
Vehicle Changing Information Locket	8,00	1,63	0,50	97,87	0,00
Eks Region Locket	8,00	1,65	0,62	97,73	0,00
New Vehicle Locket	8,00	0,99	0,99	98,03	0,00
Waiting Place for Payment	8,00	99,99	0,01	0,00	0,00
Waiting Place for Taking STNK	8,00	100,00	0,00	0,00	0,00
Waiting Place for Taking Plat	8,00	52,38	47,62	0,00	0,00
Incoming Place	8,00	0,60	99,40	0,00	0,00

Table 4.13 Location States Single

SAMSAT CIKARANG.MOD (Normal Run - Avg. Reps)							
Name	**Scheduled Time (HR)**	**% Operation**	**% Setup**	**% Idle**	**% Waiting**	**% Blocked**	**% Down**
Check In Desk	8,00	0,00	0,00	100,00	0,00	0,00	0,00
Payment Locket.1	8,00	11,78	0,00	88,22	0,00	0,00	0,00
Payment Locket.2	8,00	0,99	0,00	99,01	0,00	0,00	0,00
Payment Locket	16,00	6,38	0,00	93,62	0,00	0,00	0,00
Taking STNK Locket.1	8,00	3,25	0,00	96,75	0,00	0,00	0,00
Taking STNK Locket.2	8,00	0,08	0,00	99,92	0,00	0,00	0,00
Taking STNK Locket	16,00	1,66	0,00	98,34	0,00	0,00	0,00
Taking Plat Locket	8,00	74,20	0,00	25,80	0,00	0,00	0,00

Table 4.14 EntityActivity

Table 4.15 Entity States

SAMSAT CIKARANG.MOD (Normal Run - Avg. Reps)				
Name	% In Move Logic	% Waiting	% In Operation	% Blocked
People who Doing Reregistration	0,00	0,00	10,78	89,22
People who Doing Reregistration 5 Years	0,45	0,00	15,02	84,53
People who Doing Registration of Vehicle Changing Info	0,34	0,00	75,69	23,97
People who Doing Registration from Outside Region	0,32	0,00	76,87	22,81
People who Doing New Vehicle Registration	0,31	0,00	90,75	8,94
People	0,00	0,00	0,00	0,00

4.8 Validation and Verification

The method of determining whether the system accurately represents the conceptual model is known as model verification. The method of determining whether the conceptual model correctly reflects the actual system is known as model validation. Both are crucial in determining the simulation model's success.

Simulation models are a visual representation of real-world models that will never be identical to the real-world system. As a result, in order to meet the desired goals and aims, the model should be verified and validated. Validating the output from the overall simulation model, face validity (experts), and seeing the animation are three approaches used to validate the model.

The first step is to validate the simulation model's output. Checking whether the simulation model's output exactly matches the cumulative outputs of the actual system is one of the most definitive measures of a validative output simulation. The performance results from the simulation and actual systems are matched if a simulation system is close to the real system. It can be inferred that the simulation model is accurate if two sets of data are very similar. The simulation model is focused on

decision makers' utility functions. If the model is valid, the user should be certain that the simulation system's results are similar to those of the actual system.

The simulation model will be compared to the real system in this study, under the same conditions and assumptions. The aim is to see if the simulation model's performance is identical to the actual system and if the simulation model is accurate. By asking experts/information staff in SamSat Cikarang, the average number of people exist within 8 hours who are doing re-registration are 50, people doingfive-year re-registration are 25, people doing vehicle changing information are 5, people doing ex region registration are 5, and people doing new vehicle registration are 5. The simulation model was built based on actual data in ProModel software. The simulation model can be seen in Appendix 1. The output data of the simulation model was compared with the output data of actual system. The result of simulation model such as number of people within 8 hours who doing re-registration are 46, people doing re-registration 5 years are 24, people doing vehicle changing information are 4, people doing eks region registration are 3, and people doing new vehicle registration are 6. Since the value of the existing system and simulation model are closely similar. By comparing the both of them, it could be considered that the simulation model is valid.

Second, face validity entails frequent interactions with decision-makers. The analyst can engage with the policy maker and other team members daily, which is one of the most critical concepts for creating a reliable and accurate model. The following are

some of the main advantages of this approach: it ensures that the right problem is solved. It is possible that the actual existence of the issue would not be understood right away. During the analysis, the decision-maker could alter his or her priorities. The research maintains the decision maker's confidence and commitment. When the decision-maker knows and agrees with the model's predictions, the model is more credible.

The researcher tests the feasibility of the system by consulting with experts and personnel at Samsat Cikarang to see if it is already right. The researcher interviewed information staff in Samsat Cikarang for this study. She watched the simulation and verified that the real system is similar to the model. The staff's approval indicates that the simulation model is already valid.

Watching animation is the third and final approach for verification and validation. It may be used to track the movement of entities from one location to another to determine whether or not it is accurate. The visual animation of the model's operating behavior is contrasted to one's understanding of how the real system behaves. Visual errors are observed that may otherwise go unnoticed. In certain cases, animation is more useful in defining a problem than in identifying the cause of a problem.

In ProModel, the researcher runs the animation and watches it. When the simulation system is finished, it can be compared to the current system. Both have the same pattern, and the movement of entities behaves similarly to the real system. As a result, it is possible to assume that the simulation model is valid.

4.9 Improved System

After making the current model, the researcher would like to improve the model by increasing the total exits of each entity, such as people who are doing reregistration annually, people who are doing five-year reregistration, people who are doing vehicle changing information, people who are doing ex region registration, and people who are doing new vehicle registration. The three proposed systems is conducted to have several selections of which model is the most efficient one in improving the system performance. The proposed system consist of shorter-term, medium, and long-term proposed system. First, shorter-term by adding several service capacities in several location such as physical vehicle checking, number of employee in each registration locket, and last, adding employee in taking plat locket. Giving training to the employee and simply the standard operational procedure (SOP) will reduce the service time in the medium term. Third, long tern proposed a system, by combining both method and create plan for the future. In this proposed system, the number of employees is balanced and the service time is reduced by simplifying the work method and SOP.

4.9.1 Proposed System I (Shorter's Proposed System)

In this first improvement, the location capacity is increased in order to maximize the number of exits. Not all locations are needed, just the important location from the model. The information regarding adding the location capacity are showed as belows.

Table 4.16 Comparation between Current and Proposed 1 Location Capacity

	Current Location Capacity	Proposed Location Capacity
Vehicle Physical Checking	7	15
Reregistration Locket	3	6
Vehicle Changing Information Locket	2	7
Eks Region Registration	2	7
New Vehicle Registration	5	20
Taking Plat Locket	1	2

Since the arrival mean is 0.27 min, so to fulfill the customer incoming, the physical vehicle checking should be increased and then push the total exits of the re-registration process, so the number of capacity increases. Last, because taking plat take time 9.82 min, so adding one capacity. Table 4.17 present the information of a proposed system 1.

Table 4.17 Location Proposed System1

```
*******************************************************************************
*                                  Locations                                  *
*******************************************************************************

Name                            Cap Units Stats       Rules           Cost
------------------------------- --- ----- ----------- --------------- ----------
Vehicle_Physical_Checking       15  1     Time Series Oldest, ,
Check_In_Desk                   1   1     Time Series Oldest, , First
Fill_Form_Table                 3   7     Time Series Oldest, , First
Fill_Form_Table.1               3   1     Time Series Oldest, ,
Fill_Form_Table.2               3   1     Time Series Oldest, ,
Fill_Form_Table.3               3   1     Time Series Oldest, ,
Fill_Form_Table.4               3   1     Time Series Oldest, ,
Fill_Form_Table.5               3   1     Time Series Oldest, ,
Fill_Form_Table.6               3   1     Time Series Oldest, ,
Fill_Form_Table.7               3   1     Time Series Oldest, ,
Information_and_Progresif_Tax   2   1     Time Series Oldest, , First
Waiting_Place_Registration      Inf 1     Time Series Oldest, ,
ReRegistration_Locket           6   1     Time Series Oldest, ,
Vehicle_Changing_Information_L  7   1     Time Series Oldest, ,
Eks_Region_Locket               7   1     Time Series Oldest, ,
New_Vehicle_Locket              20  1     Time Series Oldest, ,
Waiting_Place_for_Payment       inf 1     Time Series Oldest, ,
Payment_Locket                  1   2     Time Series Oldest, , First
Payment_Locket.1                1   1     Time Series Oldest, ,
Payment_Locket.2                1   1     Time Series Oldest, ,
Waiting_Place_for_Taking_STNK   inf 1     Time Series Oldest, ,
Taking_STNK_Locket              1   2     Time Series Oldest, , First
Taking_STNK_Locket.1            1   1     Time Series Oldest, ,
Taking_STNK_Locket.2            1   1     Time Series Oldest, ,
Waiting_Place_for_Taking_Plat   inf 1     Time Series Oldest, ,
Taking_Plat_Locket              2   1     Time Series Oldest, ,
Incoming_Place                  inf 1     Time Series Oldest, ,
```

Table 4.18 Entities Proposed System 1

```
**********************************************************************************
*                                  Entities                                      *
**********************************************************************************

  Name                              $peed (fpm)  Stats        Cost
  --------------------------------- ------------ ---------- ------------
  People_who_Doing_Reregistratio    150          Time Series
  People_who_Doing_Reregistratio    150          Time Series
  People_who_Doing_Registration_    150          Time Series
  People_who_Doing_Registration_    150          Time Series
  People_who_Doing_New_Vehicle_R    150          Time Series
  People                            150          Time Series
```

Table 4.19 Processing Proposed System 1

Table 4.20 Arrivals Proposed System 1

Arrivals

Entity	Location	Qty Each	First Time	Occurrences	Frequency
People	Incoming_Place	1		inf	L(8.27, 8.84)MIN

4.9.2 Proposed System II (Middle's Proposed System)

In the second proposed system, the service time is reduced. It is reduced because after doing the research, it is known that service time also impacts the total exits of the entities. The larger the service time, the smaller the number of total exits of entities. Therefore, the service time from several locket are reduced. Table 4.21 shows the current and reduced service time in a specific locket.

Table 4.21 Comparison between Current and Reduced Service Time 1

	Current Service Time	Reduced Service Time
Re-registration Annually	19.57	10.57
Taking Plat	9.82	5.82
Vehicle Changing Information	209	159
Eks Region Registration	212.7	152.72
New Vehicle Registration	279	229

The reduced service time can be gotten by giving training to the employee in Samsat Cikarang. The training is about making every movement done by the person in charge in a process effectively, so that the person will make no unneeded movement to minimize the service time. After the training is conducted, change the standard operating procedure based on the training results to do the task regarding the new SOP. After the service

time is reduced, the total entities exits is increased. Below are shown the information of proposed system 2.

Table 4.22 Location Proposed System 2

Locations

Name	Cap	Units	Stats	Rules	Cost
Vehicle_Physical_Checking	7	1	Time Series	Oldest, ,	
Check_In_Desk	1	1	Time Series	Oldest, , First	
Fill_Form_Table	3	7	Time Series	Oldest, , First	
Fill_Form_Table.1	3	1	Time Series	Oldest, ,	
Fill_Form_Table.2	3	1	Time Series	Oldest, ,	
Fill_Form_Table.3	3	1	Time Series	Oldest, ,	
Fill_Form_Table.4	3	1	Time Series	Oldest, ,	
Fill_Form_Table.5	3	1	Time Series	Oldest, ,	
Fill_Form_Table.6	3	1	Time Series	Oldest, ,	
Fill_Form_Table.7	3	1	Time Series	Oldest, ,	
Information_and_Progresif_Tax	2	1	Time Series	Oldest, , First	
Waiting_Place_Registration	Inf	1	Time Series	Oldest, ,	
ReRegistration_Locket	3	1	Time Series	Oldest, ,	
Vehicle_Changing_Information_L	2	1	Time Series	Oldest, ,	
Eks_Region_Locket	2	1	Time Series	Oldest, ,	
New_Vehicle_Locket	5	1	Time Series	Oldest, ,	
Waiting_Place_for_Payment	inf	1	Time Series	Oldest, ,	
Payment_Locket	1	2	Time Series	Oldest, , First	
Payment_Locket.1	1	1	Time Series	Oldest, ,	
Payment_Locket.2	1	1	Time Series	Oldest, ,	
Waiting_Place_for_Taking_STNK	inf	1	Time Series	Oldest, ,	
Taking_STNK_Locket	1	2	Time Series	Oldest, , First	
Taking_STNK_Locket.1	1	1	Time Series	Oldest, ,	
Taking_STNK_Locket.2	1	1	Time Series	Oldest, ,	
Waiting_Place_for_Taking_Plat	inf	1	Time Series	Oldest, ,	
Taking_Plat_Locket	1	1	Time Series	Oldest, ,	
Incoming_Place	inf	1	Time Series	Oldest, ,	

Table 4.23 Entities Proposed 2

Entities

Name	$peed (fpn)	$tats	Cost
People_who_Doing_Reregistratio	150	Time Series	
People_who_Doing_Reregistratio	150	Time Series	
People_who_Doing_Registration_	150	Time Series	
People_who_Doing_Registration_	150	Time Series	
People_who_Doing_New_Vehicle_R	150	Time Series	
People	150	Time Series	

Table 4.24 Processing Proposed 2

Table 4.25 Arrivals Proposed 2

```
*****************************************************************************
*                              Arrivals                                     *
*****************************************************************************

  Entity   Location       Qty Each   First Time  Occurrences  Frequency        Logic
  -------- -------------- ---------- ----------  -----------  ---------------  -------------
  People   Incoming_Place 1                      inf          L(0.27, 0.04)MIN
```

4.9.3 Proposed System III (Long's Proposed System)

In this third proposed system, the researcher combine two method above by balancing the capacity location and reducing service time. In this proposed, the number of increasing location capacity are lowered than first proposed system, but holding the training to the employee so the service could be decreased. The comparison between the current system and the proposed system as belows.

Table 4.25 Comparison between Current and Proposed Location Capacity 2

	Current Location Capacity	Proposed Location Capacity
Vehicle Physical Checking	7	10
Reregistration Locket	3	5
Vehicle Changing Information Locket	2	4
Eks Region Registration	2	4
New Vehicle Registration	5	12
Taking Plat Locket	1	2

Table 4.26 Comparison between Current and Reduced Service Time 2

	Current Service Time	Reduced Service Time
Re-registration Annually	19.57	10.57
Taking Plat	9.82	5.82
Vehicle Changing Information	209	159
Eks Region Registration	212.7	152.72
New Vehicle Registration	279	229

After that, input to the ProModel and the result of view text are shown in Table 4.27.

Table 4.27 Location Proposed 3

```
*****************************************************************************************
*                                    Locations                                          *
*****************************************************************************************

  Name                            Cap Units Stats       Rules           Cost
  ------------------------------- --- ----- ----------- --------------- ----------
  Vehicle_Physical_Checking       10  1     Time Series Oldest, ,
  Check_In_Desk                   1   1     Time Series Oldest, , First
  Fill_Form_Table                 3   7     Time Series Oldest, , First
  Fill_Form_Table.1               3   1     Time Series Oldest, ,
  Fill_Form_Table.2               3   1     Time Series Oldest, ,
  Fill_Form_Table.3               3   1     Time Series Oldest, ,
  Fill_Form_Table.4               3   1     Time Series Oldest, ,
  Fill_Form_Table.5               3   1     Time Series Oldest, ,
  Fill_Form_Table.6               3   1     Time Series Oldest, ,
  Fill_Form_Table.7               3   1     Time Series Oldest, ,
  Information_and_Progresif_Tax   2   1     Time Series Oldest, , First
  Waiting_Place_Registration      Inf 1     Time Series Oldest, ,
  ReRegistration_Locket           5   1     Time Series Oldest, ,
  Vehicle_Changing_Information_L  4   1     Time Series Oldest, ,
  Eks_Region_Locket               4   1     Time Series Oldest, ,
  New_Vehicle_Locket              12  1     Time Series Oldest, ,
  Waiting_Place_for_Payment       inf 1     Time Series Oldest, ,
  Payment_Locket                  1   2     Time Series Oldest, , First
  Payment_Locket.1                1   1     Time Series Oldest, ,
  Payment_Locket.2                1   1     Time Series Oldest, ,
  Waiting_Place_for_Taking_STNK   inf 1     Time Series Oldest, ,
  Taking_STNK_Locket              1   2     Time Series Oldest, , First
  Taking_STNK_Locket.1            1   1     Time Series Oldest, ,
  Taking_STNK_Locket.2            1   1     Time Series Oldest, ,
  Waiting_Place_for_Taking_Plat   inf 1     Time Series Oldest, ,
  Taking_Plat_Locket              2   1     Time Series Oldest, ,
  Incoming_Place                  inf 1     Time Series Oldest
```

Table 4.28 Entities Proposed 3

```
*****************************************************************************************
*                                    Entities                                           *
*****************************************************************************************

  Name                            Speed (fpm)  Stats       Cost
  ------------------------------- ------------ ----------- ------------
  People_who_Doing_Reregistratio 150          Time Series
  People_who_Doing_Reregistratio 150          Time Series
  People_who_Doing_Registration_ 150          Time Series
  People_who_Doing_Registration_ 150          Time Series
  People_who_Doing_New_Vehicle_R 150          Time Series
  People                         150          Time Series
```

Table 4.29 Processing Proposed 3

Table 4.30 Arrivals Proposed 3

****
* Arrivals *
****

Entity	Location	Qty Each	First Time	Occurrences	Frequency	Logic
People	Incoming_Place	1		inf	L(0.27, 0.04)MIN	

4.9.4 Comparison Analysis

In order to determine which system is the most efficient one, the comparison should be made. The comparison is conducted between the current system and the three proposed systems. To compare the systems, several replications are required to make the result more accurate. Therefore, several replications are conducted in the simulation, and the average result will be compared. In order to compare the system, statistical methods are required, specifically the hypothesis test.

If the data is normally distributed, the comparison among alternatives systems can be conducted using ANOVA statistical method. The hypothesis is as follows:

$$H_0: \mu_1 = \mu_2 = \mu_3 = \mu$$

$$H_0: \mu_i \neq \mu$$

If reject Ho, so it is mean that at least one means are different between alternative. If not reject, so it means that no significant different among the alternatives.

If the data is not normally distributed and independent, so normal distribution could not be used. Non parameteric test will be used. To compare between two alternative, so Kruskal-Wallis Rank Test will be used. The hyphothesis are shown as belows.

$$H_0: M_1 = M_2 = M_3 = M$$

$$H_0: M_i \neq M$$

If reject Ho, so it is mean that at least one median are different between alternative. If not reject, so it is mean that no significant different between the alternative.

4.10 Output Comparison

4.10.1 Total Exits of Re-registration Entities

After improving the current system by proposed system 1, 2, and 3, the resuts are collected by 25 replications and the results of the output system are showed as below.

Table 4.31 Total Exits of Reregistration Entities

Annual Exit -Current System	P1	P2	P3
44	94	80	141
40	86	89	132
45	91	87	154
50	91	85	157
47	98	85	166
47	89	95	155
39	92	84	138
48	100	87	133
48	99	99	156
47	88	90	157
47	107	82	137
46	98	86	163
41	90	94	146
48	98	80	137
46	100	96	160
46	99	76	133
50	87	83	160
47	93	73	147
45	98	87	158
47	93	90	130
53	84	90	144
49	86	91	145
44	99	101	148
43	91	98	149
46	92	83	163

The result of ANOVA between current system and 3 alternative are shown as belows.

Figure 4.8 ANOVA Result 1

```
Method

Null hypothesis         All means are equal
Alternative hypothesis  At least one mean is different
Significance level      α = 0,05

Equal variances were assumed for the analysis.


Factor Information

Factor  Levels  Values
Factor       4  ANNUAL EXIT; P1; P2; P3


Analysis of Variance

Source  DF  Adj SS   Adj MS  F-Value  P-Value
Factor   3  132201  44066,9   828,00    0,000
Error   96    5109     53,2
Total   99  137310


Model Summary

      S    R-sq  R-sq(adj)  R-sq(pred)
7,29526  96,28%     96,16%      95,96%
```

Since the p-value is 0, which is higher than 0.05, so it could be conlcuded that at least one mean is different. To know which alternative are different with the current system, so tukey comparasion are conducted as belows.

Figure 4.9 Tukey Result 1

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

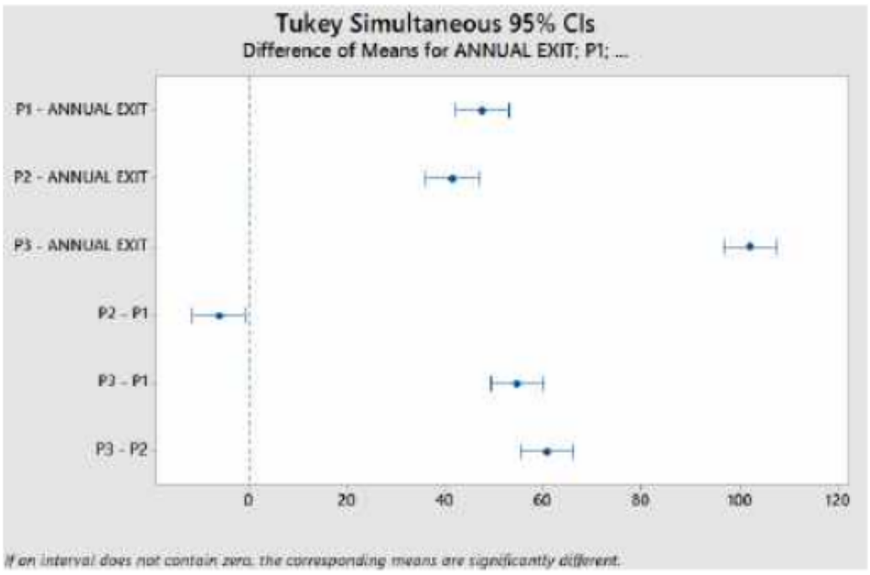
Factor	N	Mean	Grouping
P3	25	148,36	A
P1	25	93,72	B
P2	25	87,64	C
ANNUAL EXIT	25	46,120	D

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
P1 - ANNUAL EXIT	47,60	2,06	(42,20; 53,00)	23,07	0,000
P2 - ANNUAL EXIT	41,52	2,06	(36,12; 46,92)	20,12	0,000
P3 - ANNUAL EXIT	102,24	2,06	(96,84; 107,64)	49,55	0,000
P2 - P1	-6,08	2,06	(-11,48; -0,68)	-2,95	0,021
P3 - P1	54,64	2,06	(49,24; 60,04)	26,48	0,000
P3 - P2	60,72	2,06	(55,32; 66,12)	29,43	0,000

Individual confidence level = 98,97%



From the tukey comparasion, it showed that the p-value is lower than 0.05. So it could be concluded that the alternative system (P1, P2, and P3) are significantly different with annual exit (current model). To prove whether it is correct, so tukey simultaneous 95% CI are showed as below. It could be seen that

all comparasion do not include the 0, so significantly different. Because of that, so all alternative proposed could be implemented to the real system because of significantly different with current model.

4.10.2 Total Exits of Re-registration 5 Years Entities

After improving the current system by proposed system 1, 2, and 3, the results are collected by 25 replications, and the results of the output system are showed in Table 4.32.

Table 4.32 Total Exits of Reregistration 5 Years Entities

5YEARS EXITS	P1	P2	P3
23	44	45	82
25	49	44	74
30	43	45	66
17	42	37	81
21	41	38	79
26	45	57	81
29	37	39	74
21	36	38	75
23	37	44	75
26	39	41	83
25	31	44	80
27	42	42	74
26	39	46	69
22	36	33	70
22	44	34	62
23	36	47	78
24	36	49	75
23	41	47	83
19	43	39	65
23	36	32	75
18	47	41	73
19	40	43	88
22	36	39	70
27	40	54	79
28	43	41	68

The result of ANOVA between current system and 3 alternative are shown as below.

Figure 4.10 ANOVA Result 2

One-way ANOVA: 5YEARS EXITS; P1; P2; P3

Method

Null hypothesis	All means are equal
Alternative hypothesis	At least one mean is different
Significance level	α = 0,05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Factor	4	5YEARS EXITS; P1; P2; P3

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	34993	11664,4	445,43	0,000
Error	96	2514	26,2		
Total	99	37507			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
5,11729	93,30%	93,09%	92,73%

Figure 4.11 Tukey Result 2

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

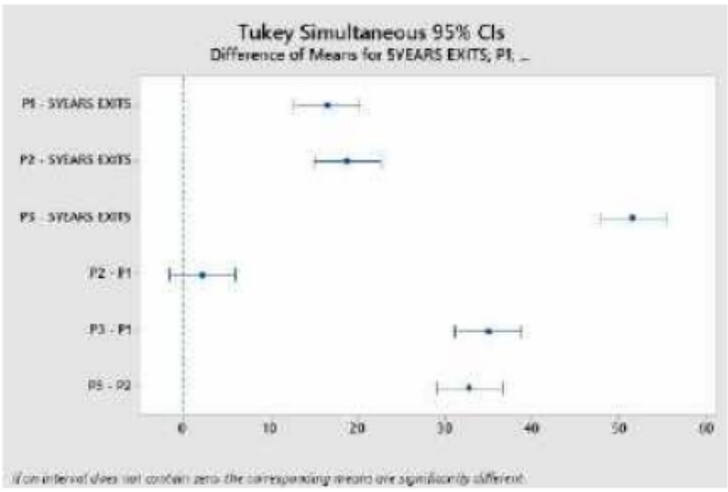
Factor	N	Mean	Grouping
P3	25	75,16	A
P2	25	42,36	B
P1	25	40,120	B
5YEARS EXITS	25	23,560	C

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
P1 - 5YEARS EXITS	16,56	1,45	(12,77; 20,35)	11,44	0,000
P2 - 5YEARS EXITS	18,80	1,45	(15,01; 22,59)	12,99	0,000
P3 - 5YEARS EXITS	51,60	1,45	(47,81; 55,39)	35,65	0,000
P2 - P1	2,24	1,45	(-1,55; 6,03)	1,55	0,413
P3 - P1	35,04	1,45	(31,25; 38,83)	24,21	0,000
P3 - P2	32,80	1,45	(29,01; 36,59)	22,66	0,000

Individual confidence level = 98,97%



Since the p-value is 0, which is higher than 0.05, so it could be conlcuded that at least one mean difference. To know which alternative are different from the current system, so tukey comparasion are conducted as below.

The tukey comparasion showed that the p-value compared with the current model (5 years exits) is lower than 0.05. So it could be concluded that the alternative system (P1, P2, and P3) are significantly different with 5 years registration exits (current model). Comparison between alternative, it could be seen that P2 –P1 is not significantly different, but between P3-P1 and P3-P2 are significantly different. To prove whether it is correct, so tukey simultaneous 95% CI are showed as below. It could be seen that all comparison, exclude P2-P1, do not include the 0, so significantly different. Because of that, so all alternative proposed could be implemented to the real system because of significantly different with current model.

4.10.3 Vehicle Changing Information

After improving the current system by proposed system 1, 2, and 3, the resuts are collected by 25 replications and the results of the output system are showed as below.

Table 4.33 Total Exits of Vehicle Changing Information Entities

INFO CHANGE EXITS	P1	P2	P3
3	9	4	10
4	9	6	10
4	10	4	9
2	7	4	9
3	10	5	10
2	11	5	8
3	8	6	10
4	9	4	7
4	10	5	8
3	9	4	8
3	9	5	9
4	9	6	9
2	8	4	10
3	8	5	9
3	9	4	8
3	9	4	10
4	9	5	9
2	11	5	8
4	10	4	7
4	11	5	9
4	10	4	9
4	11	4	9
4	10	5	9
3	9	5	12
3	9	4	9

The result of ANOVA between current system and 3 alternatives are shown as below.

Figure 4.12 ANOVA Result 3

One-way ANOVA: INFO CHANGE EXITS; P1; P2; P3

Method

Null hypothesis	All means are equal
Alternative hypothesis	At least one mean is different
Significance level	α = 0,05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Factor	4	INFO CHANGE EXITS; P1; P2; P3

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	705,95	235,317	287,56	0,000
Error	96	78,56	0,818		
Total	99	784,51			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0,904618	89,99%	89,67%	89,13%

Since the p-value is 0, which is higher than 0.05, so it could be conlcuded that at least one mean is different. To know which alternative are different with the current system, so tukey comparasion are conducted as belows.

Figure 4.13 ANOVA Result 3

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

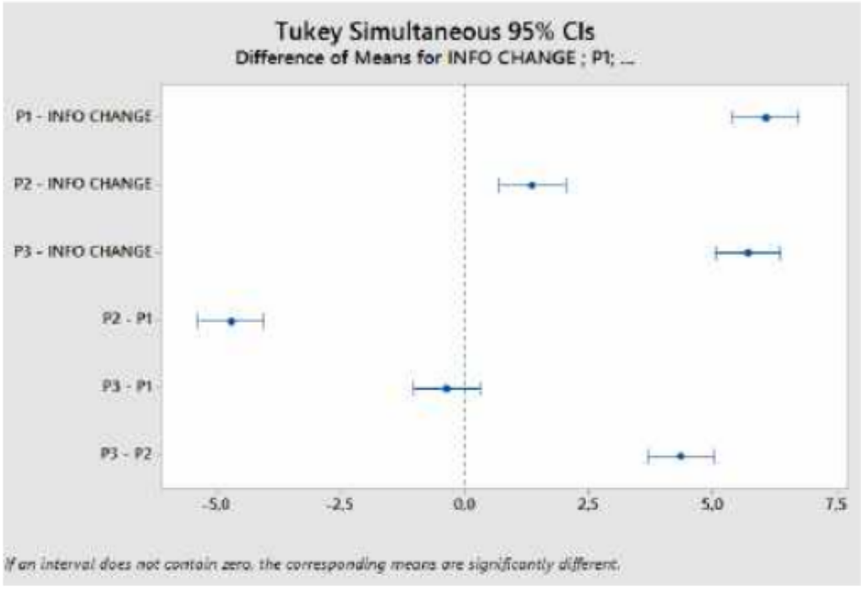
Factor	N	Mean	Grouping
P1	25	9,360	A
P3	25	9,000	A
P2	25	4,640	B
INFO CHANGE EXITS	25	3,280	C

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
P1 - INFO CHANGE	6,080	0,256	(5,411; 6,749)	23,76	0,000
P2 - INFO CHANGE	1,360	0,256	(0,691; 2,029)	5,32	0,000
P3 - INFO CHANGE	5,720	0,256	(5,051; 6,389)	22,36	0,000
P2 - P1	-4,720	0,256	(-5,389; -4,051)	-18,45	0,000
P3 - P1	-0,360	0,256	(-1,029; 0,309)	-1,41	0,498
P3 - P2	4,360	0,256	(3,691; 5,029)	17,04	0,000

Individual confidence level = 98,97%



The tukey comparasion showed that the p-value of comparison with the current model (info changes exits) is lower than 0.05. So it could be concluded that the alternative system (P1, P2, and P3) are significantly different with changing information registration exits (current model). The comparison between

alternatives shows that P3 –P1 is not significantly different, but between P2-P1 and P3-P2 are significantly different. To prove whether it is correct, so tukey simultaneous 95% CI is showed as below. It could be seen that all comparison, exclude P3-P1, do not include the 0, so significantly different. Thus, all proposed alternatives could be implemented to the real system because of significantly different with the current model.

4.10.4 Eks Region Registration

After improving the current system by proposed system 1, 2, and 3, the resuts are collected by 25 replications and the results of the output system are showed as below.

Table 4.34 Total Exits of Reregistration Entities

OUTSIDE EXITS	P1	P2	P3
3	8	6	11
2	8	5	9
2	12	4	10
4	9	5	9
3	11	5	11
3	12	6	9
3	8	4	10
3	8	5	9
3	9	6	10
4	9	5	11
4	9	4	11
4	8	5	11
3	9	6	12
3	9	6	10
4	10	5	10
2	8	5	10
2	7	5	11
4	8	4	9
2	10	6	12
2	8	6	10

3	8	5	9
4	9	4	11
2	9	5	12
3	9	5	9
4	8	4	9

The sample medians for the current model is three, and the three proposed systems are 9, 5, and 10. The average ranks show that proposed system 3 differs the most from the average rank for all observations and that this proposed system is higher than the overall median.

Both p-values are less than the significance level of 0.05. The p-values indicate that the median number of the proposed system differs for at least one system.

Figure 4.14 Kruskal-Wallis Test

Kruskal-Wallis Test: OUTSIDE TIME versus PROPOSED SYSTEM

```
Kruskal-Wallis Test on OUTSIDE TIME

PROPOSED
SYSTEM      N  Median  Ave Rank      Z
Current    25   3,000      14,0  -7,27
P1         25   9,000      68,0   3,48
P2         25   5,000      37,0  -2,68
P3         25  10,000      83,0   6,47
Overall   100              50,5

H = 85,53  DF = 3  P = 0,000
H = 86,68  DF = 3  P = 0,000  (adjusted for ties)
```

4.10.5 New Vehicle Registration

After improving the current system by proposed system 1, 2, and 3, the resuts are collected by 25 replications, and the results of the output system are showed as below.

Table 4.35 Total Exits of New Vehicle Registration Entities

VEHICLE EXITS	P1	P2	P3
5	20	9	18
5	21	7	20
5	21	6	18
5	20	8	17
6	20	8	17
7	20	9	19
5	19	8	14
5	21	7	15
5	20	7	18
5	20	9	20
5	19	9	18
5	20	6	17
5	20	10	15
5	16	8	19
5	20	8	18
7	20	5	17
5	19	8	19
5	19	7	20
5	19	8	18
5	20	7	18
5	20	9	14
5	20	6	16
5	20	8	19
5	20	8	19
5	18	6	15

The result of ANOVA between the current system and three alternative are shown as below.

Figure 4.15 ANOVA Result 4

One-way ANOVA: NEW VEHICLE EXITS; P1; P2; P3

Method

Null hypothesis	All means are equal
Alternative hypothesis	At least one mean is different
Significance level	α = 0,05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Factor	4	NEW VEHICLE EXITS; P1; P2; P3

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	3841,5	1280,52	833,76	0,000
Error	96	147,4	1,54		
Total	99	3989,0			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
1,23929	96,30%	96,19%	95,99%

Since the p-value is 0, which is higher than 0.05, so it could be concluded that at least one mean is different. To know which alternatives are different from the current system, so tukey comparison are conducted as below.

Figure 4.16 Tukey Result 4

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

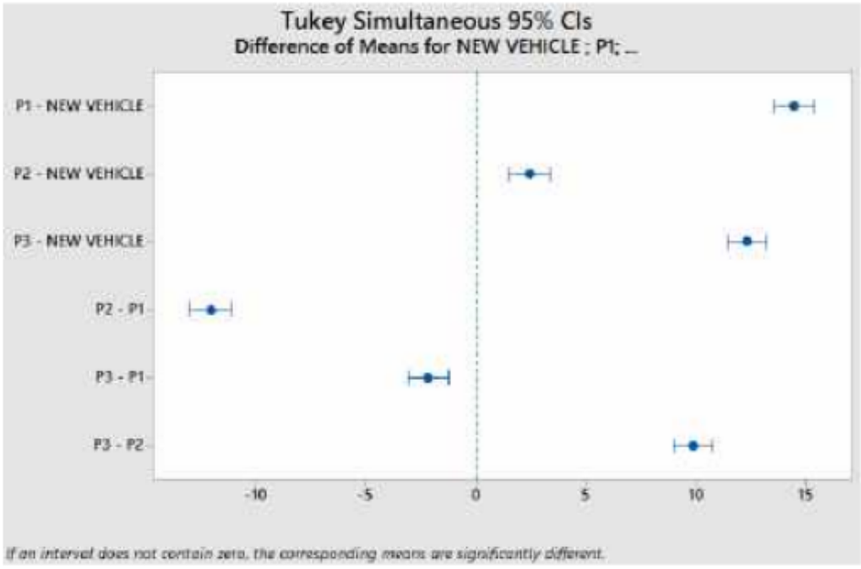
Factor	N	Mean	Grouping
P1	25	19,680	A
P3	25	17,520	B
P2	25	7,640	C
NEW VEHICLE EXITS	25	5,200	D

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
P1 - NEW VEHICLE	14,480	0,351	(13,563; 15,397)	41,31	0,000
P2 - NEW VEHICLE	2,440	0,351	(1,523; 3,357)	6,96	0,000
P3 - NEW VEHICLE	12,320	0,351	(11,403; 13,237)	35,15	0,000
P2 - P1	-12,040	0,351	(-12,957; -11,123)	-34,35	0,000
P3 - P1	-2,160	0,351	(-3,077; -1,243)	-6,16	0,000
P3 - P2	9,880	0,351	(8,963; 10,797)	28,19	0,000

Individual confidence level = 98,97%



The tukey comparison showed that the p-value is lower than 0.05. So it could be concluded that the alternative system (P1, P2, and P3) are significantly different with annual exit (current model). To prove whether it is correct, so tukey simultaneous 95% CI is showed as below. It could be seen that all comparison does not include the 0, so significantly different. Thus, all

alternatives could be implemented to the real system because they are significantly different from the current model.

After comparing the three proposed systems with the current model in each entity, the researcher would now like to know which one is the best alternative to maximize the number of exits of each entity. So the comparison between the proposed system is shown below.

Before summarizing which one is the best method, concluding all significant relationship between alternative, all of the relationships are a significant difference except the relationship in the table below.

Table 4.36 Summary of Comparison Results

Relationship		Entity		Significant	
P2-P1		Annual		Not Different	
P2-P1		5 Years		Not Different	
P3-P1		Vehicle Changing Information		Not Different	
	Test	Current	P1	P2	P3
Annual	ANOVA	46.12	93.72	87.64	**148.36**
5 Years	ANOVA	23.56	40.12	42.36	**75.16**
Vehicle Changing Info	ANOVA	3.28	**9.36**	4.64	**9**
Eks Region	Kruskall – Wallis	3	9	5	**10**
New Vehicle	ANOVA	5.2	**19.68**	7.64	17.52

The table above shows that between proposed system 3 and proposed system 1 in the vehicle changing information entity, not significantly different, so in proposes system 3 could be considered the highest value with proposed system 3. The table below shows that most of the highest number of entities located on proposed system 3. So it could be concluded that the

proposed system 3 as the best method to maximizing the number of entities exist compared with proposed system 1, 2 and 3. But otherwise, it will cost more because the Samsat Cikarang should hire a new employee and need the effort to minimize the inefficient work method and simply the SOP to reduce the service time. Summary of comparing among three methods is shown in Table 4.37

Table 4.37 Summary of Proposed System Improvement

No	Proposed System	Improvement
1	Proposed System 3	Adding capacity location and reduce service time
2	Proposed System 1	Adding capacity location
3	Proposed System 2	Reducing service time by training an employee and simply the SOP

From the comparison, it could be concluded that the proposed system 3 as the best method, then proposed system 1, and the last proposed system 2.

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

To summarize this report, there are several points concluded, such as :

- From the current model, the total exit number of each entity in the current model, such as registration annually (46.12 peoples), five years registration (23.56 peoples), vehicle changing info (3.28 peoples), ex region registration (3 peoples), and new vehicle registration (5.2 peoples). It should be improved to increase the service performance.
- In the current model, the service time in each registration locket was considered too high. The service time should be reduced by giving training to the employee and simplifying the SOP to improve the service performance.
- After analyze and improve the service performance by several proposed system, from the three proposed system, the best method is proposed system 3, which can maximize the number of total exits. This method is considered a long-term method by adding capacity in several locations such as vehicle physical checking, registration locket, and taking plat locket; it also gives training to the employee and simplifies the SOP to minimize the service time.

5.2 Recommendation

There are several recommendations from this report, such as :

- To implement the proposed system, several aspects should be considered well, such as the budget to improve the system.
- The employee that will be hired should be qualified and fulfill the standard requirements.
- By simplifying the SOP, it does not mean change the whole of the process. It reduces the unneccesary activities and simplifies the process to reduce the standard time needed for the process.

REFERENCES

Banks, J., Carson II, J.S., Nelson, B.L., and Nicol, D.M. (2005). *Discrete-Event System Simulation 4th ed*. Pearson.

Freivalds, A. (2010). *Nieble's Methods, Standards, and Work Design*. New York: The Mc Graw Hill Companies, Inc.

Harrell, C., Ghosh, B. K., & Bowden, R. O. (2012). *Simulation Using ProModel*. New York: McGraw Hill.

Kendall, K. E., & Kendall, J. E. (2014). *System Analysis and Design*. New Jersey: Peasron Education, Inc.

Montgomery, D., & Runger, G. (2011). *Applied Statistics and Probability for Engineers*. Hoboken: John Wiley & Sons, Inc.

WHO. (2005). *Hospitals*. Retrieved October 17, 2017, from http://www.who.int/hospitals/en/

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IMPROVING SERVICE PERFORMANCE USING SIMULATION SYSTEM: A CASE STUDY

Anastasia Lidya Maukar
Erri Wahyu Puspitarini

This book presents the use of a simulation approach in evaluating and improving system performance. In general, this book presents the important steps in creating a simulation model, both for the current system and for the proposed system for improvement. Discussions about data collection and data analysis, as well as the use of ProModel software in developing simulation models are also discussed in this book.

This research was conducted at Samsat Cikarang. Through the simulation approach it was found that the current system performance still needs to be improved. After making improvement ideas and testing them in a simulation model, this study provides several inputs that can be used to improve services at Samsat Cikarang.

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