LRT Satisfaction

by Betty Susanti

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Customer Satisfaction Analysis of South Sumatera LRT (Indonesia)

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Abstract

Customer Satisfaction is an essential part that public service management must achieve in their services. KAI (Kereta Api Indonesia) management, as the civil service administrator, should make customer satisfaction as their top priority to ensure customer loyalty. The existence of this conditions requires the operator to measure some variable that would affect customer satisfaction to improve services. This journal will focus on the performance during the operation phase and its implications to KAI management. It is proposed to use Dynamic System modeling and simulation to explore the problem of user satisfaction. This study considers ways for the public service operator to improve users level of comfort. The writer collects data through questionnaire and interview surveys to obtain a causal diagram that will be translated into a stock diagram and flow for simulation. This model will be rigorously tested before being used for experimental policies on customer satisfaction. Based on the modeling results, the average value of customer satisfaction is 4,359 of the total scale (0-5) from Vensim modeling.

Keywords: LRT, model, customer satisfaction, system dynamics

INTRODUCTION

System dynamic modeling was developed by Jay Forrester of the Massachusetts Institute of Technology (MIT) in the early 1960s. Initially, dynamic systems were used to resolve the complexity of managerial problems that were often faced by industry around 1963. Following the success of systems dynamic dealing with problems in General Motors, this approach has been used exclusively in investigating issues in various companies. Since the launch of World Dynamic book in the early 1970s, system dynamic has begun to be used in many social and economic disciplines (Forrester 1980).

In 1972, system dynamics modelling was increasingly being used in various disciplines after Dennis Meadows launched the book called The Limits to Growth. The book is considered to be very phenomenal because it explains the ability and advantages of a dynamic system in building a simulation model of interaction between humans and the earth while it can also predict its sustainability in the future. The Limits to Growth is clear evidence that a system dynamic is really useful in modeling the development of the world today and its effects on the future. At present, the application of system dynamic has expanded in the fields of economics, management, organization, politics, population, environment, medicine, and engineering (Dennis Meadows, 1972).

According to Forrester (1989), dynamic systems is a methodology developed to study and manage the complexity of system feedback, such as in the many cases of business and social network. Radzicki and Taylor (2008) define dynamic systems as approaches to understand the complex behavior of systems over time through feedback mechanisms and changes in time functions that affect the behavior of the entire system. Dynamic system models are tools to examine the responses of key variables over time. Historical data and performance objectives provide a fundamental reference to determine whether a particular policy produces key variables that are better or worse when compared to baselines or other policies.

The research objective of this paper is to determine the level of customer satisfaction of South Sumatera LRT operated by PT. KAI. The object of study is the South Sumatera LRT train customers. The results of the study are expected to reveal various existing problems related to service, especially concerning the following matters:

1. Analysis of factors such as tangible, reliability, responsiveness, assurance, and empathy that will affect customer satisfaction.
2. Analysis of customer satisfaction level to attract more passenger to use South Sumatera LRT.

What distinguishes dynamic systems from other approaches is the use of feedback loops, stocks, and flows. These elements help to describe complex systems and contain elements of nonlinearity to appear simpler. Dynamic systems are used to solve problems simultaneously by updating all system variables in a time function with positive or negative feedback and the time delay in the interaction structure (Forrester 1994; Radzicki and Taylor 2008).

Dynamic system Philosophy

Dynamic systems are a methodology based on the approach of systemic thinking. Systemic thinking is an approach to integration that is based on the belief that the component of a system will act differently than when isolated from the system's environment or other parts of the system. Systemic ways of thinking provide a framework that analyzes and understands all system components and their interactions as an integrated system. It is the best way to get solutions (Radzicki and Taylor 2008's problems).

The integration of scientific disciplines shows that dynamic systems try to provide new changes or paradigms for the scientific world. Changes that harmonize various branch of study lead to a more integrated and holistic understanding. Changes that are oriented to the effectiveness of goal settings, creating and bringing systemic changes to the desired variables with universal laws (Muhammadi et al., 2001).

System Dynamic Element

The advantage of dynamic systems is their ability to build complex models based on their basic elements, namely feedback and stock flow diagrams (SFD). This element enables the dynamic system to construct the structure of the system, explain its behavior from time to time and to conclude what happens to the system.

Feedback

According to Marquez (2010), feedback is the part that provides information to other parts about the effects of behavior on system performance. Feedback is the main element in a dynamic system. Feedback shows an X situation that affects Y and vice versa through a chain of causation.

In a dynamic system, feedback is represented using causal diagrams or causal loop diagrams. Marquez (2010) explains that causal diagrams are diagrams that help to illustrate how the relationship of variables affects other system variables. This diagram provides an easy understanding of the conceptual model that is built on how the mechanism of the system under study works. Moreover, causal diagrams are the language of images to communicate interactions and patterns change in the values of system variables while providing an overview of the system structure.

Relations between variables (causal ln) can be positive (+) or negative (-). A positive relationship means that two vertices run in the same direction so that when the node is increasing, then the resulting node will also increase. A negative relationship has the opposite meaning in which if the node is due to increase, the node due will decrease and vice versa. It's not because it can have a direct effect on the node due at the same time, but the effect can also occur after some time later or delayed. The relationship between these variables forms a closed system called loops. Causal loops can be positive (reinforcing) denoted by (+) or negative (balancing) denoted by (-).

For example, in the pattern of population growth, there is one positive loop and one negative loop. The positive point is the relationship between birth and the population. In a case where more birth occurs, the population will increase. The example of negative point is the relationship between death and the population, in a case where the death happens more frequently, then the population will decrease, as shown in Figure 1.1.

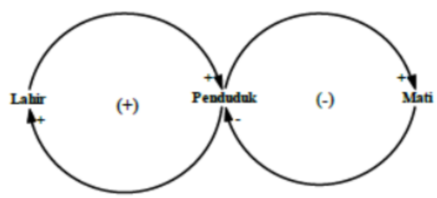

Figure 1.1. Population growth causal diagram (source: Muhammadi et al., 2001)

Stock and flow diagram (SFD)

One advantage of using dynamic systems is their ability to represent the complexity and dynamics of real systems in simple symbols, namely stock and flow. Flow is a decision variable which affect flow process that is always connected with stock. Flow is symbolized by an inflow or outflow of stock. The flow of objects that can be carried by flow are goods, money, people, etc. that can be observed and measured by the stock. Flow can be regulated through variable rates endogenously or exogenously as constants or functions. Stock functions is to hold everything as a result of flow. The nature of stock is to accumulate the results of flow and function to represent the subject matter of concern (Muhammadi et al., 2001). The simple model of the relationship between stock and flow or SFD can be seen in Figure 1.2.

Figure 1.2. Stock and flow relationship model (source: Marquez, 2010)

The Basic pattern of System Behavior

The introduction of system behavior patterns is useful as a diagnostic tool to get the basic nature of system problems. Understanding of system behavior patterns allows a policy maker to predict events or events that will occur from time to time and provide the best solution for effective handling. According to Kirkwood (1998) there are 4 basic patterns of dynamic systems, namely exponential growth patterns, goal seeking, waves (oscillation) and growth limits (the limit to growth).

The exponential growth pattern, known as the snowball effect, is a causal relationship that enlarges each other's variable values. The variable relationship feeds back to itself continuously to strengthen growth (positive growth) on itself or negative growth. This pattern is characterized by then growth or decay which is initially slow then moves faster exponentially. For example, population growth where the population birth rate is increasing. Another example is the amount of money deposited in a bank where the amount of interest received will grew exponentially over time as can be seen in Figure 1.3.

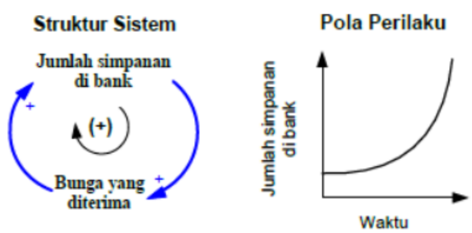

Figure 1.3. Exponential growth pattern

The goal seeking pattern, also called balancing, is a relationship that produces growth to achieve a goal which is described in the form of an increasing trend reaching a maximum point or decreasing to near zero. The performance of the system in this pattern includes adaptation and balance (equilibrium), which means that in achieving the system objectives that are dynamic, they can adjust to achieve stability. The characteristic of this pattern is characterized by a gap or gap, namely the difference between the target condition and the actual condition. The disparity between the current condition and target condition will encourage an activity to improve the current condition until there are no more gaps left. An example of a goal seeking pattern is the temperature setting as shown in Figure 1.4.

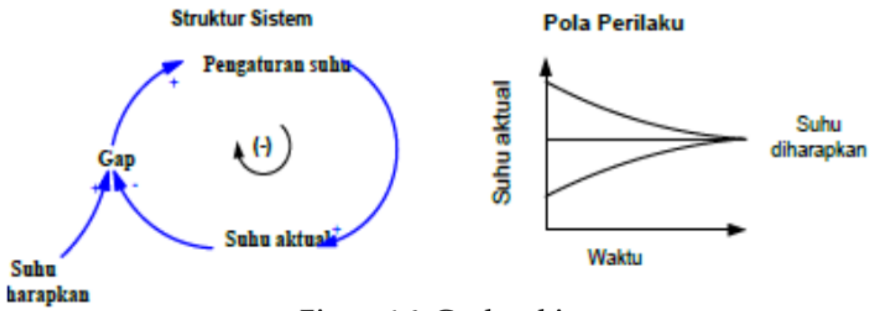

Figure 1.4. Goal seeking

The pattern of wave behavior or oscillation is a model with a negative feedback structure that contains an important response of time delay function. The occurrence of lags in time causes information repair to be delayed so that the gap increases. The situation in time delay function is the reshaped with more significant improvement as well, causing a sharp decline in the gap, the behavior of which occurs continuously so as to form the wave function. Examples of wave behavior patterns occur in industrial production systems as shown in Figure 1.5.

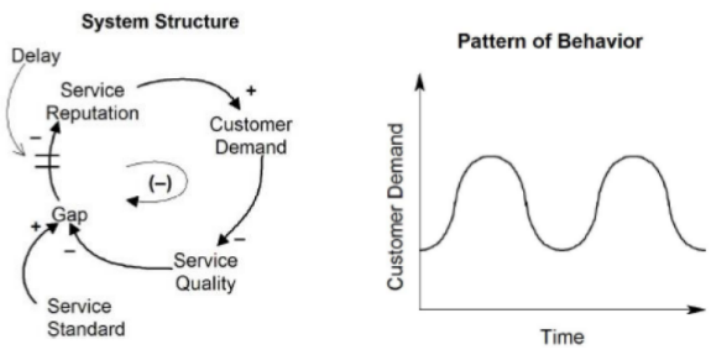

Figure 1.5. Pattern of sine (oscillation) wave behavior

The patterned behavior of the growth boundary or the shape of the "S" (S-shape) curve has strength characteristics and balance characteristics. At first, the growth is exponential and then slows down to balance. This pattern is a combination of positive loop and negative loop. When positive loops dominate at the beginning of growth, exponential growth will occur. However, after the delay in time, the negative loop becomes more dominant towards the behavior of the system resulting in a curve shape "S". In the end, the negative loop will direct the system towards its destination. The S-shape behavior pattern is shown in Figure 1.6.

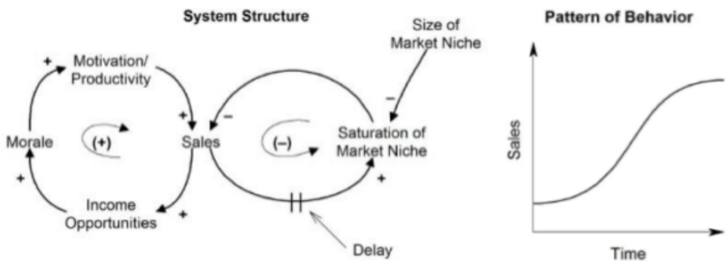

Figure 1.6. The growth boundary behavior pattern or "S" curve

MODELING LITERATURE

Models can be defined as depiction, simplification, miniature, or imitation. Modeling is drawing components or forming variables using logical and mathematical representations. Modeling is also one branch of scientific analysis. Modeling activities include concept making, organizing, communication, understanding, analysis, measurement testing, and optimization of decision making. Scientists can use the application of modeling in various scientific developments, methodologies, and logical analysis to solve problems.

Dynamic system simulation is a continuous simulation developed by Jay Forrester (MIT) in the 1960s, which focused on the structure and behavior of systems consisting of variables and feedback loops. Relationships and interactions between variables are expressed in the form of diagrams centered. The feedback process can be grouped into two parts, namely (Syriac, 2006: 63-64):

Positive Feedback

This type of feedback creates a growth process in which one event can result in a continuous increase in other events. This feedback can cause instability, imbalance, and continuous growth in events. For example: population growth system.

Negative Feedback

This type of feedback seeks to create balance by providing corrections so that the goals of the process can be achieved. Example: room temperature control system.

In the Tangkitsiri (2013) study, on the BTS (Bangkok Mass Transit System) line using modeling with Dynamic Systems. The integration of the System Dynamics (SD) concept and project management implementation can be used to resolve a number of these problems and to analyze the results. An approach to Operation and Maintenance (OM) management using clear strategic policies will be determined. In particular, experience from OM and System Dynamics must positively influence the design of decision making to ensure stakeholder satisfaction (Sterman, 2000). Therefore, the Dynamic System is used as a methodology and tool for modeling. In his research, the Dynamic System was used as an instrument to create a Casual Loop Diagram.

Customer Satisfaction Modeling Using Dynamic Systems

Statistical analysis is needed as an input for dynamic system modeling. It was conducted to check expectations and perceptions of the overall satisfaction level with LRT transportation services. In addition to highlighting differences in expectations and perceptions, it is also needed for dynamic system modeling inputs.

The satisfaction levels needed are the perceptual and expected values of each variable, the priority of each detail in the satisfaction level variable, and variable weighting in Dynamic system modeling of South Sumatra LRT.

The value of perceptions and expectations of each variable is acquired from the mean value (M) and standard deviation (SD) of the assessment in the field survey. The priority of each variable detail is obtained from AHP (Analytical Hierarchy Process) of several stakeholders involved in the South Sumatra LRT. Variable weighting is acquired from multiple linear regression with analysis using IBM SPSS version 21 to get the priority needed.

Perception Value and Expectations for each Variable

The value of perceptions and expectations of each variable is obtained by field surveys with demographics can be seen in table 1.1. following:

Table 1.1. Demographic data

Demographic data	n	%
Gender		
Male	55	53.92%
Female	47	46.08%
Age		
18-25 years old	25	24.51%
25-35 years old	19	18.63%
34-45 years old	19	18.63%
45-55 years old	19	18.63%
>55	20	19.61%
Type of Work		
Student	22	23.91%
Civil Servants/BUMN	19	20.65%
Private Employee	14	15.22%
Teacher/Lecturer	14	15.22%

Entrepreneur	5	5.43%
Housewife	18	19.57%
Income Level		
<Rp. 500.000 per month	22	21.57%
<Rp. 500.000 per month	25	24.51%
Rp. 1.500.000 – Rp. 2.500.000	20	19.61%
Rp. 2.500.000 – Rp. 5.000.000	17	16.67%
>Rp. 5.000.000	18	17.65%

Customer information	n	%
Travel Destination		
Work	13	12.75%
Visiting family's house	19	18.63%
Recreation	35	34.31%
Go to school	25	24.51%
Others	10	9.80%
Type of Transportation		
Taxi	0	0.00%
Shuttle Bus	29	28.43%
Motorcycle	28	27.45%
Car	19	18.63%
Others	26	25.49%
Reason to use South Sumatera LRT		
Faster travel time	19	18.63%
Lower Cost	20	19.61%
Safety and amenities	13	12.75%
Distance to the Station	22	21.57%
Conformity with the Schedule	19	18.63%
Others	9	8.82%
Way to go to the Station		
By Walk	13	12.75%
Car	24	23.53%

Motorcycle	14	13.73%
Angkot	29	28.43%
Others	22	21.57%
Leaving Station		
By Walk	17	16.67%
Car	19	18.63%
Motorcycle	26	25.49%
Angkot	21	20.59%
Others	19	18.63%
Frequency LRT Usage		
Everyday	17	16.67%
Weekend	20	19.61%
Once a week	25	24.51%
Work days	23	22.55%
Others	17	16.67%

From survey reports recorded by men (53.08%) and women (46.92%) the results of feasibility studies were obtained. The customer satisfaction table can be seen in table 1.2 as follows:

Table 1.2. Customer Satisfaction Perception and Expectations

Customer Satisfaction	1	2	3	4	5	Perception		Exectation		Gap Score
						Mean	SD	Mean	SD	
LRT ROUTING	0	19	25	29	29	3,667	1,084	3,990	0,838	-0,324
LRT STATION CLEANLINESS	0	0	35	43	24	3,892	0,757	4,529	0,502	-0,637
DEPARTURE/ARRIVAL PUNCTUALITY	0	0	0	50	52	4,510	0,502	4,588	0,495	-0,078
EFFICIENCY OF ENTRANCE/EXIT OF LRT STATIONS	0	0	0	57	45	4,441	0,499	4,451	0,500	-0,010
ON BOARD PASSENGER ANNOUNCEMENTS	0	0	35	40	27	3,922	0,780	3,931	0,859	-0,010
PASSENGER MANAGEMENT IN EACH STATION	0	0	28	38	36	4,078	0,792	4,392	0,491	-0,314
LRT SAFETY SYSTEM RELIABILITY	0	0	33	42	27	3,941	0,768	4,549	0,500	-0,608
LRT SPEED	0	0	28	33	41	4,127	0,817	4,569	0,498	-0,441
DOORS OPENING/CLOSING ALERT SYSTEM	0	0	0	57	45	4,441	0,499	4,480	0,502	-0,039
SAFETY ENTRANCE/EXIT OF LRT STATION	0	0	0	55	47	4,461	0,501	4,490	0,502	-0,029
SECURITY GUARDS	0	0	27	41	34	4,069	0,774	4,480	0,502	-0,412
WARNING SIGNS	0	24	31	25	22	3,441	1,077	3,971	0,850	-0,529
LRT FARE	0	0	0	63	39	4,382	0,488	4,441	0,499	-0,059
CONVENIENCE FROM START POINTS TO LRT STATIONS	0	31	26	18	27	3,402	1,180	4,480	0,502	-1,078
FREE LRT SHUTTLE BUS SERVICE	0	0	33	34	35	4,020	0,820	4,225	0,831	-0,206
EASE OF PURCHASING TICKETS AND BOARDING TRAINS	0	0	0	58	44	4,431	0,498	4,461	0,501	-0,029
SERVICE TIME	0	0	0	55	47	4,461	0,501	4,510	0,502	-0,049
SERVICES AND SHOPS IN LRT AREAS	0	34	39	29	0	2,951	0,788	2,961	0,843	-0,010

From the field survey data, the average values for services and expectations are obtained in each variable detail according to table 1.2.

Determination of Variable Priority Scale with AHP (Analytical Hierarchy Process)

By using the AHP method, we can obtain the following weighting results after averaged from the stakeholders weighting. This weighting is given as a variable for each aspect, can be seen in table 1.3. following:

Table 1.3. Quantity

Aspect	Quantity
Efficiency of LRT operation	
Lrt routing	0.271
Lrt station cleanliness	0.154
Departure/arrival punctuality	0.216
Efficiency of entrance/exit of lrt stations	0.069
On board passenger announcements	0.068
Passenger management in each station	0.223
Level of safety	
Lrt safety system reliability	0.225
Lrt speed	0.118
Doors opening/closing alert system	0.133
Safety entrance/exit of lrt station	0.168
Security guards	0.140
Warning signs	0.216
Level of service provided	
Lrt fare	0.262
Convenience from start points to lrt stations	0.269
Free lrt shuttle bus service	0.151
Ease of purchasing tickets and boarding trains	0.116
Service time	0.145
Services and shops in lrt areas	0.057
Physical/psychological health	
Lrt fare	0.334
Lrt safety system reliability	0.137
Travel cost	0.282
Travel time	0.247
City traffic problems	
Lrt fare	0.569
Lrt routing	0.203
Service time	0.228
Travel cost	
Lrt fare	0.795
Ease of purchasing tickets and boarding trains	0.205

Travel Time	
Lrt routing	0.149
Lrt speed	0.128
Convenience from start points to lrt stations	0.270
Departure/arrival punctuality	0.145
Ease of purchasing tickets and boarding trains	0.086
Passenger management in each station	0.222

From the results of the weighting, the equation in the dynamic system is obtained using the dynamic system diagram in Figure 1 as follows.

Modeling Satisfaction Using System Dynamics

Dynamic System Modeling in the South Sumatra LRT Project can be used as an effective tool for monitoring and risk control. Modeling can be used to identify the initial signs of risk. Implementation of risks and their consequences can be monitored by analyzing aspects of the causes that arise on both sides, both the management system and the user. Effectiveness can be evaluated using Dynamic System modeling (Ogunlana et al., 2003), which is essential for certain levels of management to determine the right decision at the right time. By including some additional forms of analysis that have been taken to identify risk conditions.

User satisfaction has been modeled by Che et al. (2010). The concept of service quality as the main thing of user satisfaction. The process determines user satisfaction during Operation & Maintenance in the South Sumatra LRT project. By defining users are people who use the South Sumatra LRT. The aim is to know and develop South Sumatra LRT. The context of this study is adjusted to the work that was completed by Che et al. and modifications to existing adjustments in the South Sumatra LRT.

The dynamic system diagram that forms the basis of the South Sumatra LRT modeling has been developed previously at Customer Satisfaction at BTS Tangkitsiri and Ogunlana (2004), then carried out further with the adjusted South Sumatra LRT users. This diagram is represented in Figure 1, which forms the cause and effect tree illustrated in Figure 2. The main loop is made around the main points to determine satisfaction in the system, namely (i) City Traffic Problem, (ii) Efficiency of LRT Operation, (iii) Level of safety, (iv) Level of service provided.

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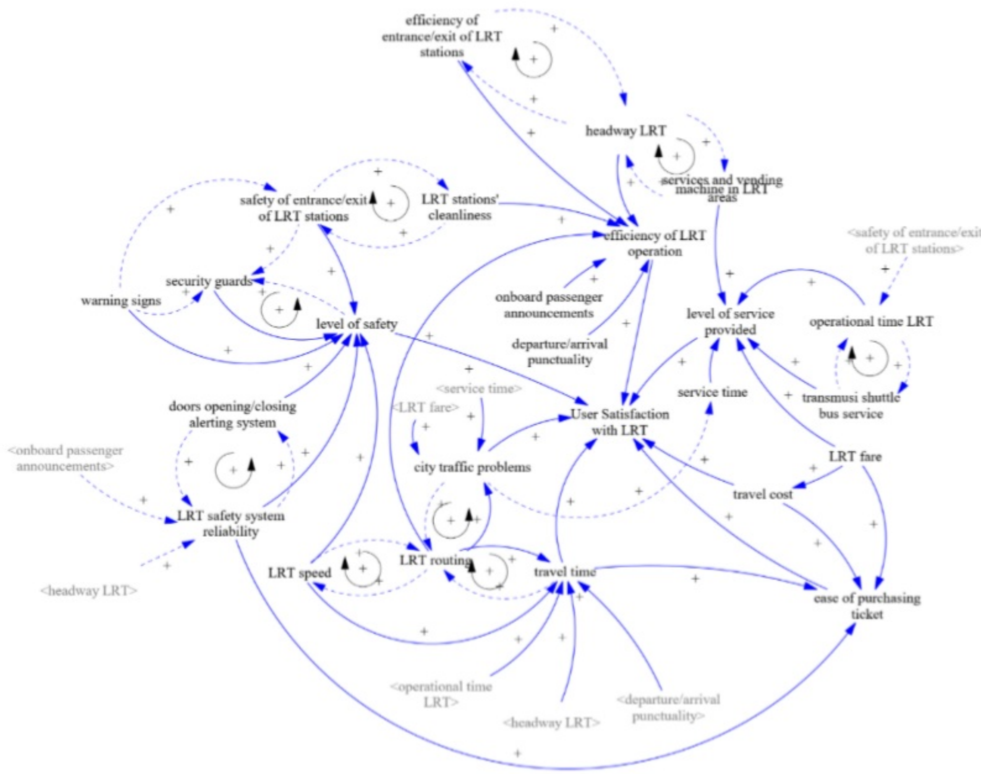

Figure 1.9. Dynamic System of Diagram of Service Level for LRT Users Using Vensim
source: analysis results (2019)

Figure 1.10. Tree Diagram of Service Level Problem with LRT Users
source: analysis results (2019)

CONCLUSIONS

From the research above it can be concluded that:

1. The distance to LRT station is the highest reason why passengers are attracted to use South Sumatera LRT scoring at 21,57%.
2. The frequency of LRT usage is dominated by passengers that used LRT once a week as their mode of transportation at 24,51%.
3. From 17 attributes of perception and expectation, the efficiency of LRT station's entrance/exit has the lowest gap at -0,010.
4. The level of customer satisfaction is valued at 4.359 on a scale from 0 to 5 based on dynamic system modeling. The main variable that influencing the most on the system is the efficiency of LRT operation while LRT fare, LRT routing and the ease of access from start point to LRT station affecting the efficiency of LRT operation the most.

RECOMMENDATIONS

The recommendations that can be given based on the finding above is as follows:

1. Further research can be done on customer satisfaction level after improvement has been made by PT KAI to increase the level of services.
2. Dynamic system modeling can be used as an indicator by PT KAI management to check the quality of services in order attract more passenger to use South Sumatera LRT.

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