A Control-Theoretical Perspective in Retail Telecommunication Industry Using Dynamic Simulation Model

Tiar Anindya Putri[1]
Department of Information Technology Management, Faculty of Magister of Technology Management
Institut Teknologi Sepuluh Nopember
Surabaya, Indonesia
tiaranindyap@gmail.com

Riyanarto Sarno[2]
Department of Informatics, Faculty of Information Technology and Communication
Institut Teknologi Sepuluh Nopember
Surabaya, Indonesia
riyanarto@if.its.ac.id

Erma Suryani[3]
Department of Information Systems, Faculty of Information Technology and Communication
Institut Teknologi Sepuluh Nopember
Surabaya, Indonesia
erma.suryani@gmail.com

***Abstract*—Preferably, the customers want their service to be set up without delay. The ability of the company to respond quickly to the request depends on the ability of employees and the availability of the components necessary to provide the service. The focus of our current study is to develop useful insights for inventory management to prevent stock-outs and unfilled orders under different scenarios, exclusively for retailers in a telecommunication fulfillment process area. The application of the theory of control to service systems may be very uncommon. One of the applications of controlling the principle to service systems grow to be the focal point on studies by the control issues and challenges which might be essential to service systems. The contribution of this study occurs in the most appropriate modeling when faced with conditions in which supply in retail businesses in the telecommunications sector and customer demand is uncertain. Furthermore, we demonstrate how control unfulfilled order can be applied to service structures thru three case scenarios. The result shows that workforce availability and tools and product availability affect the quantity sold, where the magnitude of the customer orders will affect the magnitude of the unfulfilled order.**

Keywords—control theory, dynamics simulation, optimization, system dynamics, telecommunication services

I. INTRODUCTION

Competition that occurs in this global era is getting tighter and tighter. Many competitor companies offer the same products or services at competitive prices. Therefore, companies need to maintain the continuity of their companies by increasing service to customers, especially for companies engaged in the field of suits. Products and services should be viewed as a unit. Because of good service, it is one of the factors that causes a product to sell well. As pointed out with the aid of National Academy of Engineering, the version and application of the structure and concepts of commercial techniques, methodologies and quality control processes for operator functions and organizations is one of the fundamental challenges for the service industry [1]. In developing countries, the trend towards services has also developed rapidly and the service sector has become a key area of business to replace agriculture and manufacturing.

By applying scientific approaches and methods, service science seeks to improve The service industry's productivity. The control theory seems to offer promising technology in particular to design robust solutions for service management that remember the dynamics and uncertainty of the system. The control theory was widely used in the manufacturing industry. There have been many examples of the use of the theory of control for computer systems in recent years, as well as the impact on commercial products [2]. Control theory can be very rarely applied to service systems. One of the applications of control principle to service systems grow to be the focal point on studies by providing the control issues and challenges which might be essential to service systems [3]. Other service relevant case is developed using dynamic simulation used to develop a flexible scenario for further electricity demand and supply [4]. This study observes the power demand estimation using dynamic simulation technique and compare with the previous technique to estimate the growth of power demand and decide which technique is better in estimate power demand.

This study uses data from one of Indonesia's leading telecommunications companies. The company provides customers with a wide range of telecommunications services. To support various business processes, such as customer orders, the company has used a sophisticated CRM system internally. The customer order fulfillment system begins with new or old customers who contact a call center or company application to order network, landline, internet or cable services. The company processes the application until the service is installed and ready for use. The overall performance of the service system can also be severely affected by modeling errors and unknown inputs, which may be unavoidable in sensitive systems [5]. However, depending on the circumstances of the customer, the availability of the network and also the availability of workers due to the large number of orders and the limited number of employees, the fulfillment of consumer requests can vary considerably. This type of process is extremely unstructured, as the company responds to the demands and conditions of the customer.

Customers preferably want to set up their service without delay. A company's ability to respond quickly to requests depends on the ability of staff and the availability of the components required to provide services. In the current business process, the company can set standard procedures for customer satisfaction. However, in the company database, buyer request records are rearranged and can be used to solve the problem. Based on previous research of strategic planning in telecommunications industry, raising the issue of market growth patterns, proven scenario analysis is still a promising planning technique to be used as a strategy maker company [6]. Supported by a journal of Dynamic Systems in Telecommunications-case study which explained dynamic systems applied in network capacity, cannot answer all existing problems, but can prevent expectations excessive [7].

The focus of our current study is to develop useful insights for inventory management to prevent stock-outs and unfilled orders under different scenarios, exclusively for retailers in a telecommunication fulfillment process area. Inventory management in this area of research is categorized as a supporting component of the new telecommunications administration, internet connection, and cable tv. This study aims to develop processes and modeling service systems and techniques to solve a dispatch problem, how technicians can be formulated as control problems and solved by design and monitor feedback control using multivariate quality and variability statistical process control approaches. To prevent any new installation of the product at a telecommunications company cannot be met under different scenarios of fulfillment sector devoted to the retail area that is installed in homes or housing, shops and non-corporate businesses. Then, the success of fulfillment process is in efforts to fulfill customer orders by managing the right ones at the lowest possible cost. The focus of this research is that the most appropriate system occurs when faced with conditions where the supply of resources in retail businesses and customer demand is uncertain and research is carried out on retail businesses in the service sector.

The remainder of this paper is organized as follows. section 2 reviews the relevant literature, discusses the modeling tool, and explains the general outline of a hypothetical provider-customer setup. The outcomes from the simulation of the base case and several sets of alternative scenarios are offered in section three, observed through a discussion of insights that may be gained from those outcomes. finally, section 4 lists the contributions or boundaries of the current study and guidelines for future studies.

II. Literature and Method

A. Literature Review

Agrawal et al. [8] describe a mathematical modeling technique for managing capability, inventory and shipments for a collection of retail merchandise produced by more than one provider. Providers vary in lead times, prices and flexibility in production. The demand for products is uncertain and varies over time. They expand an optimization model to select production commitments to maximize the expected gross revenue of the retailer, taking into account demand forecasts and capacity and flexibility constraints of suppliers. This concept will be adjusted to the service provider on telecommunication provisioning area.

Cost parameters are aspects of providing telecommunications providers together with facility investment, location or non-location specific investments, and investments related to quality and so on. Applications for services will be submitted on the basis of certain socio-financial factors (household income, occupation) and demographic factors (income, age, circle size, population density, location). Other economic forces that can have an impact on demand are service prices, service quality and competition [9]. The relationship between the demand and supply components of the integrated techno-economic model is illustrated in Fig.1.

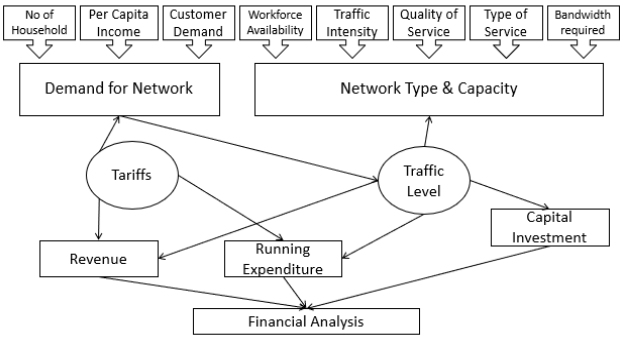

Fig. 1. Component of Techno-Economic Model of telco retailer fulfillment or provision filling order.

A study was carried out on the fulfillment of telecommunications. It provides the case company with insights into how the business process for customer fulfillment is actually carried out. This finding is expected to allow companies to develop standard basic procedures, conclude service level agreements and propose a possible planning process to meet customer demand better in the customer fulfillment process, which is usually unstructured in real telecommunications companies. [10]. Business planning is becoming common in the very hectic telecommunications market through scenario analysis. Business planning scenario analysis focuses on testing several strategic options in external scenarios for the company.

Dynamic systems are computer modeling and simulation to study and manage complex feedback systems, such as business, environmental systems, social systems, etc. This study was developed by Jay Forrester of MIT. The study was to model physical flows in industry sector such as modelling the personnel, money, material and equipment [11]. The system is a collection of elements that interact with each other, function together for certain purposes. In the feedback system it becomes very important. While dynamic means to contain quantities that always vary. Variations can be explained in a causal relationship. Cause and effect relationships can occur in closed systems that contain feedback loops.

B. Causal Loop Diagram

The relationship between different system components is achieved by modeling it using the Forrester method. This is an expression as a differential equation or difference, after which the model is running as a computer simulation. The diagram of the causal loop is used to show dynamic reasons and the impact of the relationship between different device variables and the generated remarks loop. It is an image language that connects various variables in a loop diagram. The use of arrows will indicate variables that are cause and / or effect. The upstream arrow will show the cause, while the arrow tip shows the result. Each modeler must first understand the processes that occur in the real world (real world) so that a logical model can resemble the reality. The process of understanding can be done by distinguishing between cause and variable variables due to and or by distinguishing between dependent and independent variables.

C. Dynamic System Validation

Validation of dynamic systems can be done in two possible ways [12]:

1) Average comparison (Means Comparison), as in (1):

$$E_1 = \frac{\bar{S}-\bar{A}}{\bar{A}} \quad (1)$$

2) Amplitude version comparison (Amplitude Variations Comparison), as in (2):|

$$E_2 = \frac{|S_s-S_a|}{S_a} \quad (2)$$

In Equation (1), $\bar{S}$ is the average value in the simulation results, while $\bar{A}$ is the average value of the data results. In Equation (2), S_s is the standard deviation of the model, while S_a is the standard deviation of the data. The model is considered valid if the result of E_1 is less than equal to 5% or the result of E_2 is less than equal to 30%.

D. Dynamic System Scenario

Dynamic System has scenarios according to Barla's theory 1996 in general the types of scenarios [12]. The first is parameter scenario. It is done by changing the parameter value of the model. This type of scenario is easy to do because we only make changes to the model parameter values and see the impact on output. The other scenario is Structure scenario which are carried out by changing the structure of the model. This type of scenario requires sufficient knowledge about the system so that new structures proposed and experimented can improve system performance. The other scenario is Kalman filtering [13]. It is a recursive estimator, which means best the estimated state from the previous time step and the contemporary measurement are had to compute the estimate for the contemporary state as in (3)-(4).

$$f\ (x_{k-1}, u_{k-1}, t_{k-1}), x_{t0} = x_k \quad (3)$$

$$z_k = h\ (x_{k-1}, \vartheta_k), x_{t0} = x_0 \quad (4)$$

The mathematical method is usually formulated as follows: a provider has, at time k, x_k objects in stock. It then orders (and gets) u_k items.

E. Optimal Control And Optimization Of System Dynamics Models

The control of the service system in which people are included is similar to an IT system in which useful system resources, for better performance, it is possible to manage and relocate the CPU and memory. In systems of service, it is more difficult to control the variable resources and controls to be controlled because they consist of complex dynamics. Provider staff (e.g. technicians or customer service) have their own preferences and can respond with exceptional attitude, speed and flexibility to control instructions. The control system must explicitly remember the dynamics of people, expect feedback and see them or become sufficiently robust for unknown results. In addition to manipulation variables, the demand for control purposes in the service system also exists. Reference variables are not predetermined and a series of business objectives can be determined. This study can also negotiate and change reference values. Flexibility and variability raise questions about the best control objectives and lead to further measurements of the control design.

The dynamic model of system dynamics models will assume the form of differential equations [14]. For our purposes, the dynamical process model will be constituted as a set of specific, nonlinear differential equations, with preliminary conditions for every state (inventory), as follows (5).

$$\dot{x} = f\ (x, u, t), x_{t0} = x_0 \quad (5)$$

The x is a vector of states (inventory), u is a vector of control inputs, and t is the independent variable time. The control input u is chosen from a space M of possible control inputs. M places a limit on the control inputs, preventing unrealistic or not possible values from being chosen via the optimization algorithm.

III. Models Development

A. Method

The research phase is adjusted to the steps of system analysis of existing problems and the making of dynamic system model simulations from the beginning of the problem determination with the background to the conclusions of the final analysis and documentation with a control theory approach. The stages of research that will be carried out by the author are described in the scheme of the methodology presented at Fig.2.

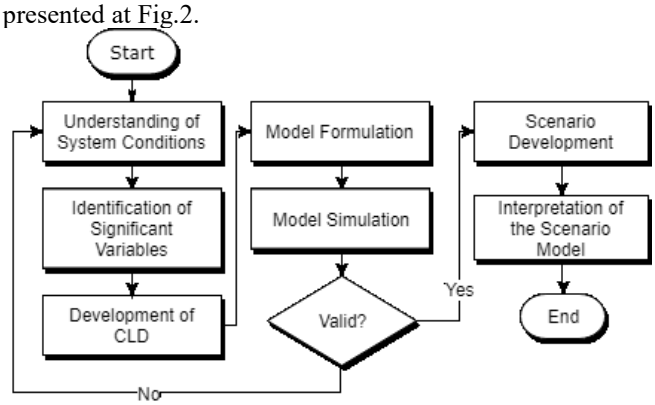

Fig. 2. Flowchart Methods

The study begins with the understanding the condition of the system, it included study of literature. The next step is identification of significant variable, it includes in data collection. Then, development of Causal Loop Diagram of the model if it has been in accordance with the real system then proceed with processing the data, and then make the formulation for the growth in the base model, and do the simulation. After that, validation is needed. If the model is valid, then proceed with the creation of scenarios and then the interpretation and conclusions of this study.

B. Data and Boundary

This study has a scope that will be a control. The data in business process used covers views of the following.

1) Order filling process and retailer inventory management
2) Preparation of production equipment and inventory resources.
3) Views of labor needed in retail businesses.

The boundary of this study includes the following.

1) Inventory needs to be managed because it is not possible to control various items accurately. So that

research is carried out only on the company's retail products internet, telephone and interactive TV service packages.

2) The method of dynamic simulation, which is used to modelling complex system problem can be combine with a method of qualitative analysis. Expert judgment carried out by interviewing to find out important variables was used in to achieve that method, so as to get a new CLD model that is in accordance with the case study.

3) This study uses Ms. Excel and Minitab 18 for primary data preprocessing, and Ventana Simulator (Vensim) for making models.

C. Business Process

One of the leading Telco Company in Indonesia determines eight phases main in meet order customers: *1) RE- register, 2) Fe- feasible, 3) Va - validate, 4) Create, 5) Design, 6) Pi- provision issued, 7) Act comp,* and *8) Prov comp.* Then, after the main process that is implemented, eating status at ISISKA will updated to bill customer already recorded at ISISKA. ISISKA is an In-house Enterprise Systems that manages information related customers, networks, products, services and bills customer in eight module that does function different in the process of Customer Relationship Management. The following is a business process flow diagram from the new pairs of retail telecommunications products listed in Fig.3.

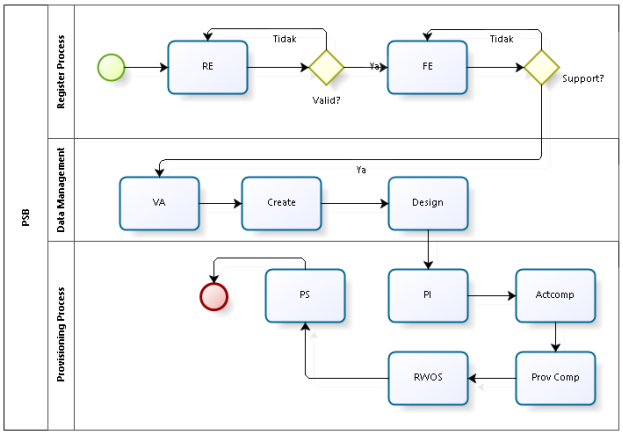

Fig. 3. Provisioning Business Process of Telecommunication Service Company Retail Products

In the RE- register stage demand customer accepted and registered in system with enter identity customer including name, address, contact, and demand service. In phase second, incoming data matched with availability tool production and what customer area address already support do install it new. In phase third demand considered valid, good customer data or tool production ready installation. Phase fourth and fifth is room back when demand handled and service status is " Entered to in service". This process includes Create status, where data is already entered to system for do provisioning. Then the Design status, where checking data straightness in the system is done. Phase sixth is an installation process that involves availability technician namely the PI- provision process issued. In PI-provision phase issued, service classified into five types related with components service the necessary technical and network for meet demand including: 1) Installation from ODP to House customer, 2) installation ONT devices, STBs on customers, 3) testing voice service, 4) testing internet service, and 5) testing Interactive TV service.

Every type service has two main statuses in space back: Print Work Order (WO) and Return Work Order (WO). WO Print Status means command work released for get the necessary components and doing the action requested for meet demand the customer. WO return means officer field restore command given work to her because various reason. Phase seventh is the comp Act, this status marks out progress from fulfillment demand certain meaning Already finished installation and activation service both internet, voice, interactive TV. Phase next is Prov comp, where when service already tested and already appear usage then the status will change to be prov comp. Activities in this process not have a strict order, which means there is many variants are possible based on combination components required by the service and their status in space the back. Then, after the main process that is implemented, eating status at ISISKA will updated to bill customer already recorded at ISISKA.

IV. Result and Discussion

The data used in the problem of study are the Number of Customer's Order, Service Quality, Product Quality, and Number of Customer Rates. A remarks loop can produce one in all styles of outcomes, a snowball impact where an alternate in the country generates a movement that causes greater trade in the Strengthening loop or a balancing effect if an alternative in the state produces action to absorb the alternative balancing loop, as shown in Fig.4. The course of change that an exchange inside the reason induces inside the effect was indicated by the polarity of a hyperlink (±) indicates. The time delay among purpose and impact was indicated by a couple of parallel strains on a hyperlink.

Customers place orders for products with the customer carries out a new tide registration, then enters the customer's file input: name, telephone number, address, contact, etc. Then the incoming data is matched with the availability of production equipment and whether the customer's area address has been supported by a new installation. When the data is validated, both customer data and tools and products are ready for installation, the system will check the data straightness.

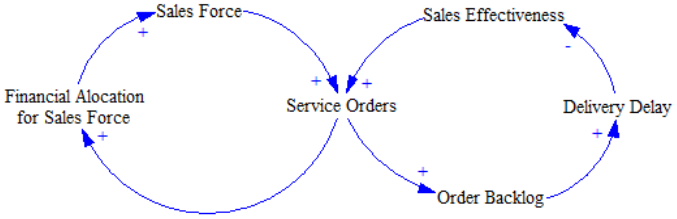

Fig. 4. Redrawn Feedback loops from Dutta and Roy [15] (Reinforcing loop (left) and Balancing loop (right))

However, this process will be traversed by dealing with workers. Workers will conduct a new technical installation process to the customer's home and carry out various installations, from installation from ODP to customer homes, installation of ONT devices, STB in customers, voice service testing, internet service testing, and testing of cable TV

services. If it has been tested and the usage has appeared, the status will be put in service.

A. Causal Loop Diagram

System dynamics structure for the retailers consists of Order Filling Process. It begins with customer order receipt and inward material receipt. The unit time is within one day completion time. Customer's order will affect the quantity sold. It depends on several factor such as, desired order which is controlled by exponential smoothing structure which is smoothing factor alpha that has been set by 0.25. As the Tool and product availability views, the change in customer order will affect the result of forecast order rate and order shipment rate. Then required workforce will need standard workdays to normalize the data structure.

Productivity will be counted as unit per person multiplied by work hours. This variable will affect the schedule pressure which is the desired schedule provision rate divided by standard schedule provision rate. When the schedule pressure is more than one, then shortage of workforce. Meanwhile, when the schedule pressure is less than one, it means it excess of workforce. Schedule pressure will adjust in workforce level. Fig.5 illustrates the system dynamics process using Causal Loop Diagram of Order Filling Process of Fulfillment Order at Telecommunication Industry.

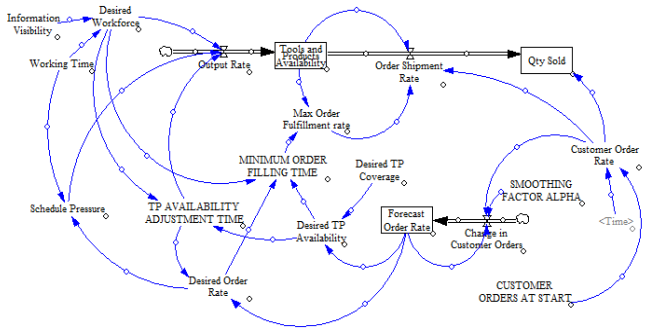

Fig. 5. Causal Loop Diagram of Order Filling Process of Fulfillment Order at Telecommunication Industry.

The model of system dynamics proposed in this study summarizes all applicable technical financial variables affecting basic telecommunications companies. The model validates the truth and can be used as a tool to select the effects on growing customers of various variables.

B. Scenario Model

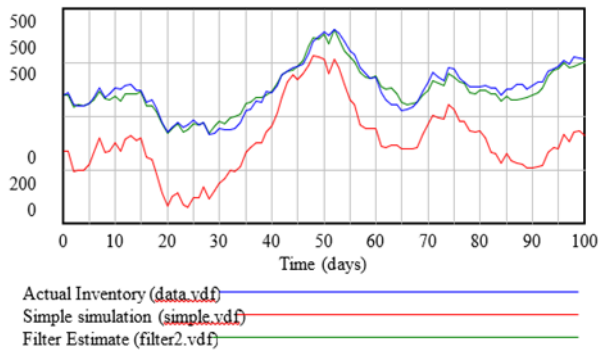

Fig. 6. Scenario result of fulfilled order quantities.

The least fulfilled orders indicate high unfulfilled orders of simulation indicate that simulated orders are near actual data. After the calibration the usage of beyond facts, an additional version that the customer base estimate will be simulated for the next 10 days. It is estimated that under the prevailing conditions, the customer base in the examined circle will be doubled from that in the range of one hundred days. Fig.6 shows the scenario that has been used using two different scenario. The first is the simple simulation. Its is the scenario that has been used by change the parameter control. The second scenario used Kalman filtering from (3)(4).

Table 1 gives details of diverse order scenarios simulated. The preliminary values for the essential Tool and Product Availability and coverage parameters of the store and the supplier within the model. Running time for the simulation is a hundred days.

TABLE I. SIMULATED SCENARIOS

Scenarios	Description
Base case	No adjustments in customer orders of units/days, information visibility turned off
Simple Simulation	Vary the Customer orders and std.deviation
Kalman Filtering	recognised control inputs to that system, and multiple sequential measurement to form an estimate of the system's varying portions (its state)

The weaknesses in the system that are designed are it is unable to control the correctness of the value of a data. It also spends a lot of time (time consuming) for sourcing and preprocessing data. Prediction models do not consider variables for which data is not owned by telecommunication company.

C. Model Validation

This Scenario than used as the validation of the method to the problem in (1)(2). based on the results from this study, it now seems to be legitimate from a system dynamics perspective as well. This model's E1 indicates a high predictive high of 4.29 percent. The model is considered valid if the result of E1 is less than equal to 5%. The E2 of the model is 29.8%. The E2 is slightly high. The model validation E2 is less than equal to 30% to be considered as good. This can be later considered as the future study to be corrected.

V. CONCLUSSION

A. Conclussion

For the reason that services cycle time cannot be crashed past a point due to inherent transformation delays, each store and provider are fine served while these companions in a deliver chain proportion statistic in actual time to get rid of all of the avoidable information delays that would compound the cycle time put off. in addition, the have a look at also shows that both parties ought to apprehend the dynamics involved in material glide. From the simulation, Workforce availability and Tools and Product Availability affects the Quantity Sold, where the magnitude of the Customer orders will affect the magnitude of the unfulfilled order.

The observe additionally confirmed that multiple objectives might be combined as a single overall performance through carefully compose the suitable weights to the goals based totally on their precedence and the behavior of possible alternate off possibilities. in the end, the study determined

that minimization of unfilled orders to decrease the want for equipment and Product Availability at the store for maximum eventualities the quite rational. If the company can usually matter directly to offer goods when ordered, then the store is required rather than scenarios in which the provider does not assure imparting items whilst wished. financial gains from selecting the proper guidelines range by way of the enterprise and related inventory charges. The most challenging of all is closed-loop control, where new trends in the concept are had to accommodate nonlinear dynamical fashions with generalized nonlinear performance indexes.

B. Limitasion

Even though the version captures the typical store behavior found inside the actual world. The model is parsimonious in that it captures the dynamic essence of the everyday retailer with minimum structure. Telecom customers are impacted by means of occasions that spread round them and that they respond in approaches that almost continually cause a few pressures on the telecom community. This situation was not included in this study.

C. Future Studies

Similarly, study will cognizance on obtaining greater beneficial insights into different possible situations involving one of a kind patterns of client orders, like cyclic or seasonal patterns, coupled with developments. Moreover, destiny studies could consciousness on minimizing the manipulate attempt required to decrease the alternative goals.

ACKNOWLEDGMENT

The authors would like to appreciate the support given to this study by the Department of Information Technology Management, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia.

REFERENCES

[1] C. National Academy of Engineering, Engineering Research and America's Future: Meeting the Challenges of a Global Economy, Washington DC: National Academies Press, 2005.

[2] B. Janamanchi and J. R. Burns, "Control Theory Concepts Applied to Retail Supply Chain: A System Dynamics Modeling Environment Study," in *Hindawi Modelling and Simulationin Engineering*, India, 2013.

[3] Y. Diao, "Using Control Theory to Improve Productivity of Service Systems," in *IEEE International Conference on Services Computing (SCC 2007)*, Salt Lake City, 2007.

[4] A. D. Ningpramuda, R. Sarno, S. Erma, Fauzan and A. Charis, "Dynamic Simulation of Electricity Supply and Demand for Industry Sector in East Java," *3rd International Conference on Science in Information Technology (ICSITech),* pp. 290-295, 2017.

[5] X. Liu and S. Yuan, "Reduced-order fault detection filter design for switched nonlinear systems with time delay," *Nonlinear Dynamics,* vol. 67, no. 1, p. 601–617, 2012.

[6] C. A. Smits, "Strategic planning in the Dutch Telecommunications Industry," KPN Research , Netherlands, Netherlands.

[7] S. Montán and e. al, "System Dynamics in Telecommunications," Kipling Information Technology , Sweden, 2000.

[8] A. N, S. S.A. and T. A.A., "Multi-vendor Sourcing in a Retail Supply Chain," *Production and Operations Management,* vol. 11, no. 2, p. 157–181, 2002.

[9] S. P, E. Mosekilde, A. Moscardini, K. Lawler and I. French, "Using System Dynamics to Analyze Interactions in Duopoly Competition.," *System Dynamics Review,* vol. 16, no. 2, pp. 113 - 133, 2000.

[10] M. Er, H. Maria Astuti and A. Nastiti, "Analysis of Customer Fulfilment with Process Mining: A Case Study in a Telecommunication Company," in *Procedia Computer Science*, Surabaya, 2015.

[11] J. W. Forrester, "System dynamics - a personal view of the first fifty years," *System Dynamics Review,* vol. 23, no. 2-3, pp. 345-358, 2007.

[12] B. Y, "System Dynamics Review," *Formal Aspects of Model Validity and Validation in System Dynamics,* vol. 12, no. 3, pp. 183-210, 1996.

[13] M. R. Karamta and J. Jamnani, "Implementation of Extended Kalman Filter based Dynamic State Estimation on SMIB system incorporating UPFC Dynamics," in *International COnference Power and Energy Systems Engineering*, Kitakyushu, 2016.

[14] J. R Burns and B. Janamanchi, "OPTIMAL CONTROL AND OPTIMIZATION OF SYSTEM DYNAMICS MODELS: SOME EXPERIENCES AND RECOMMENDATIONS," in *Proceedings of the SWDSI Conference*, San Diego, 2019.

[15] A. Dutta and R. Roy, "System Dynamics Tutorial provides a primer on a set of tools and techniques aimed at improving decision-making in integrated value chain," *OR MS TODAY 2002,* vol. 29, no. 3, p. 30–35, 2002.

[16] Y. Sutanto and R. Sarno, "Inventory Management Optimization Model with Database Synchronization through Internet Network (A Simulation Study)," in *International Conference on Electrical Engineering and Informatics (ICEEI)*, Bali, 2015.

[17] A. P. Putra and R. Sarno, "Dynamics Simulation Model of Demand and Supply Electricity Energy Public Facilities and Social Sector Case Study East Java," in *International Conference on Information & Communication Technology and Systems (ICTS)*, Surabaya, 2016.

[18] I. R. Tangkawarow, R. Sarno and F. A. Charis, "Evaluation the Performance of Tax Determination Using Discrete Event Simulation," in *2018 2nd International Conference on Informatics and Computational Sciences (ICICoS)*, Semarang, 2018.

[19] R. Setiawan, R. Sarno and A. C. Fauzan, "Evaluation of Container Forecasting Methods for Analyzing Port Container Terminal Performance Using Agent-Based Simulation," in *International Conference on Information and Communications Technology (ICOIACT)*, Semarang, 2018.

[20] A. Fajar, R. Sarno and A. C. Fauzan, "Comparison of Discrete Event Simulation and Agent Based Simulation for Evaluating the Performance of Port Container Terminal," in *International Conference on Information and Communications Technology (ICOIACT)*, Semarang, 2018.