JESOCIN

ANALYSIS OF DYNAMIC MODEL OF SHIPPING INCOME TARIFF SYSTEM FOR SHIPPING EXPEDITION SERVICES

Nurlaela Kumala Dewi[1], Irayanti Adriant[2], Ferry Cristian[3], Wahyudi Adi Prasetyo[4]

[1] Management Transportation Universities Logistic dan Bisnis International
[2]Magister Management Universitas Telkom
[3,4]Manajemen Logistic
e-mail: nurlaelakumala@ulbi.ac.id, irayantiadriant@telkomuniversity.ac.id, ferrychristian555@gmail.com,

ABSTRACT

The expedition service company PT.XYZ Bandung and Jakarta Branches is facing a decrease in the number of shipments and the weight of goods sent for the Jakarta - Bandung shipping route, which automatically affects the income received. This decline phenomenon can certainly have an impact on the financial condition and sustainability of the company. This study will try to conduct a trial by calculating using a system dynamics model. In previous studies, the tariff determination model was completed using the standard costing method, the actual costing method, the activity based costing method, calculating factory overhead costs, the full costing method and variable costing. The results of the study show that the model with system dynamics is better by showing that the model conditions allow the company PT.XYZ to understand the interactions between variables that form the structure of this model. The model shows the causal relationship between various variables to each other in the model, so that the causal relationship between these variables forms a dynamic system model for the operational model of shipping goods at PT. XYZ Branch Hub Bandung City. The company can understand the interactions of various business elements that occur and can analyze what factors form this model including the shipping of goods, the company's income and profit, and the company's operational costs.

Keywords: System Dynamics, Expedition Service Costs, Income Tariffs, Company Profit

Introduction

The expedition service company PT. XYZ is trying to rearrange its tariff calculations. In order to compete, PT.XYZ must be able to offer more competitive tariffs and compete with other shipping services. Business actors realize that for cheap, quality service products that can reach consumers faster, a new concept is needed that will make these service products competitive. Currently, the concept of supply chain management is being widely considered, because this concept in shipping services is trying to manage the flow of goods, information and services which will later be integrated from the point of origin of the initial delivery location to the hands of the final consumer efficiently and effectively. SCM in shipping services includes planning, procurement, production (packaging or if there are others), storage, distribution, shipping, and how to manage goods if there is a return of goods if this happens. This SCM concept certainly requires coordination when moving raw materials, semi-finished goods, and finished goods to all locations from upstream to all downstream locations in order to minimize costs.

(Arffien, Afferdhy, Iman Sudirman, 2024),(Alfariz et al., n.d.), (N. K. Dewi et al., 2022), (N. K. Dewi et al., 2024). Expedition services are part of SCM that are greatly needed by the community, both individuals (consumers) and the business world such as organizations and companies. Untimely delivery will cause delays in delivery. This will certainly affect consumer satisfaction with the delivery results.(Widowati et al., 2023). Service products in the context of distribution include various activities, from picking, packaging, and inventory to shipping goods to their final destination. These services operate through various modes of transportation, including land, sea, and air, and have a wide reach, including intercity and international shipping Boye Benedict Ayantoyinbo (2018). Expedition services are part of the urban logistics system that distributes goods in cities and aims to reduce congestion and environmental impacts caused by logistics and transportation activities. The urban logistics system has many stakeholders who take action to influence others and is a fairly complex system (Andruetto et al., 2024) According to (Dwi et al., 2023). The expedition service company is a business entity that is highly dependent on various factors to maintain its performance and profitability. One of the key factors in this business is the factor related to the volume of shipments, including the weight of the goods and the income earned (Pada et al., 2019)(Mulyati & Alif, 2014). As a shipping company, the Company strives to maintain growth and profitability by carrying out careful planning and management of these aspects. However, in July 2024. The Bandung City Branch Hub experienced a decrease in the number of shipments and the weight of goods sent for the Jakarta - Bandung shipping route which automatically affected the income received. The decrease in the number of shipments and the weight of goods sent needs to be a concern for the company, especially since it is known that the rates offered by PT.XYZ are no different from its competitors. This study will use a system dynamics model where this model is based on a cause-and-effect diagram that is expected to improve its performance system so that it can increase revenue which will also increase the company's profit. The relationship contained in the company's operational system in generating profits for the company in general can be seen using the help of a Causal Loop Diagram (CLD) where the related variables affect each other.

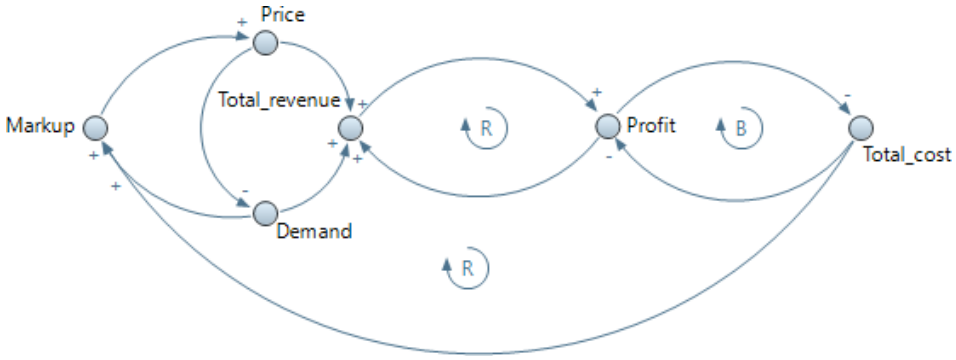

Figure 1 Causal Loop Diagram of the Relationship Between Demand and Profit
Source:(Kar & Datta, 2020)

As can be seen in Figure 1 above, the relationship between demand, profit, and tariffs is known, there are three (4) loops that can explain the relationship between demand and price (Kar & Datta, 2024)

Research Method

From several previous studies to calculate tariffs or production costs, an approach is carried out that depends on the type of cost and the purpose of calculating the tariff by the company. Several factors that underlie the calculation of shipping service tariffs for expedition services are generally; based on shipping distance, weight of goods, volume of goods, and type of shipping service. The main methods commonly used are:

1. Standard Costing Method (Standard Cost)
   This method is used to calculate tariffs based on previously set standard cost estimates for raw material components, labor, and production overhead. (Rudianto et al., 2014), (Junita, 2017),(Mthembu & Chasomeris, 2024)
2. Actual Costing Method (Actual Cost)
   This method calculates rates based on actual costs incurred during the production process, without using a budget or standard. Material, labor, and overhead costs are recorded according to actual expenses, so that the cost per unit is calculated based on real data during a certain period. This method is useful for evaluating actual costs and controlling costs
3. Activity Based Costing (ABC) Method
   This method calculates rates based on activities that cause costs. Overhead costs are allocated to products based on the activities used by the product, such as machine hours, labor hours, or raw material usage. This method is more accurate in allocating overhead costs than traditional methods. (Lalamentik et al., 2023), (Pku & Mamajang, 2022),(Mursyid & Hidayat, 2025)(Pku & Mamajang, 2022).
4. Factory Overhead Cost Method
   The factory overhead cost method is a technique for analyzing tariff calculations by using Factory Overhead Cost (BOP) allocation to products offered based on certain activities or measurement bases. This method helps companies understand production costs more accurately and make more informed decisions
5. Full Costing and Variable Costing Methods
   This method uses the full costing concept by including all variable production costs such as: direct labor, fixed and variable overhead, raw material costs and other costs into product costs. The use of variable costing is only to include variable costs such as variable overhead, fuel, direct labor, raw materials and other costs into the product cost
6. Method of Calculating Electricity Tariffs
   This method refers to the calculation of electricity costs, where the tariff is calculated by multiplying electricity consumption (kWh) by the electricity tariff per KWh according to the applicable tariff group, plus other additional costs such as fixed load costs and taxes.

System Dynamics Method

The method used is simulation using a dynamic system in AnyLogic software. Simulation using a dynamic system approach aims to model and simulate a dynamic system (changes over time). By using this approach, all existing or created variables will affect the system. There are three (3) methods in simulating a model, namely dynamic systems, discrete event modeling, and agent-based modeling. (N. Dewi et al., 2015), These three methods provide their own range or level of abstraction. The dynamic system (modeling) method is considered to have a very high level of abstraction so that it is often used to meet strategic modeling needs. While the discrete event modeling method is assumed to be very suitable for abstraction at the intermediate and intermediate-low levels. Meanwhile, agent-based modeling methods can vary from very detailed

models (where the agents represent physical objects) to models that have a high level of abstraction. According to (Putri et al., n.d.) (2021) system thinking is a form of looking deeper into a problem and finding the right solution so that the root of the problem can be resolved.

Basically, there are six important steps in building a system dynamics model. Starting from identifying and defining the problem, followed by conceptualizing a model, formulating the model, testing and evaluating the model, using the model, implementing and disseminating it, and designing learning/strategy/infrastructure. Therefore, the steps needed to create a model and simulation on a complex system based on the systems thinking methodology are:
1. Identifying the problem
2. Developing a dynamic hypothesis that explains the cause of a problem
3. Creating the basic structure of the cause and effect graph
4. Enlarging the cause and effect graph with more information
5. Changing the cause and effect graph that has been created into a system dynamics flow graph
6. Translating the system dynamics flow graph into a software program or mathematical equation.

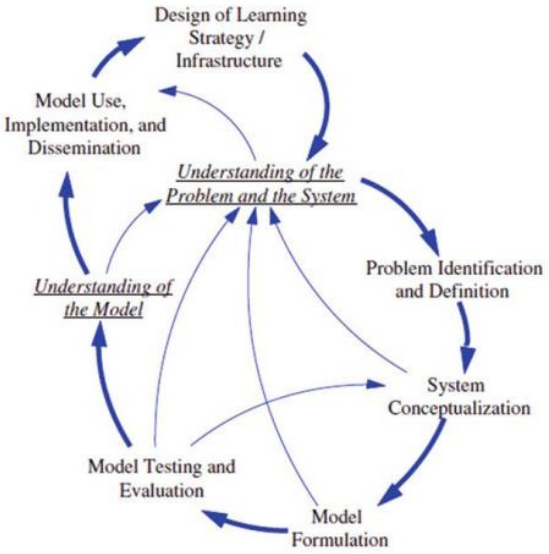

Figure 2. Dynamic System Modeling Approach
Source: (Bala et al., n.d.)

According to(Khakifirooz et al., 2024) the system dynamics model in this study because it has dynamic and complex problems and contains components or variables with complex and complex causal relationships that are produced in various feedback loops (Laimon et al., 2020). System dynamics explores the dynamic characteristics of the transportation fare system and considers the factors that influence the operation of transportation services (N. K. Dewi et al., 2017), (Nassar et al., 2023). This dynamic system model is used to create a model that has a dynamic relationship to each influential variable. This simulation is used to identify how the variables that form the system model affect business performance and revenue receipts at PT. XYZ Branch Hub Kota Bandung on the Jakarta - Bandung route.

Discussion

Rich Picture Diagram or RPD can be used as a tool to explain problem situations with the help of interactive images. Expressing a problem situation in the form of a rich picture diagram is just one method of making a summary of a situation to be able to describe the problem and the relationship between images with predetermined limitations.
In the existing conditions seen in the image below, starting from a sale and purchase transaction by consumers on a platform. After the transaction is completed, the consumer will select a shipping service to facilitate the delivery of goods from the seller to the consumer/buyer. Shipping services can consist of several companies that provide them, one of which is PT. XYZ. After completing the selection of shipping services, the shipping process will be carried out from Jakarta to Bandung and vice versa for consumers in the two (2) cities. And the shipping process will be completed after the product or goods sent have reached the hands of the consumer/buyer. Based on the delivery of the goods, the historical data of the delivery of the goods will be known. And it is known from the historical data that there is a phenomenon of decreasing demand for shipping goods. Competition between competitors on shipping rates and the pattern of demand for seasonal shipping services can be factors causing this phenomenon.

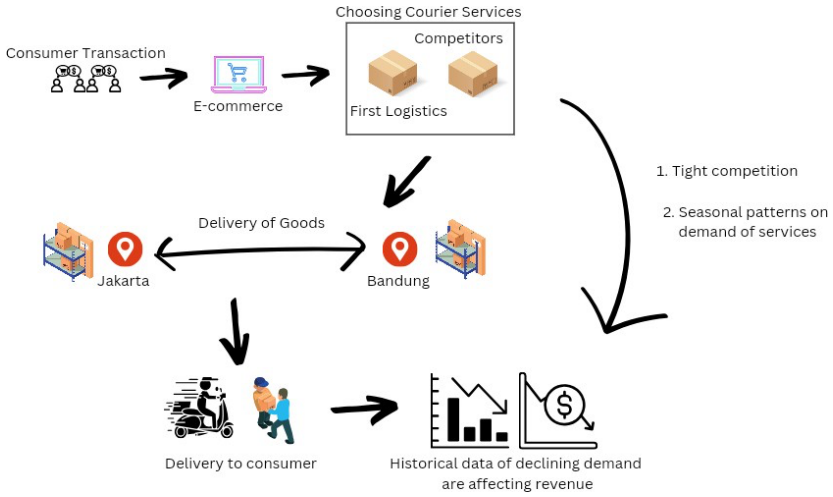

Figure 3 Rich Picture Diagram PT. XYZ

A Causal Loop Diagram (CLD) can describe the cause-and-effect relationship between various aspects, entities, or variables to each other. The cause-and-effect relationship that is formed will become a loop or circle between variables and can explain the influence of each variable. Figure 4 below is a display of the Causal Loop Diagram (CLD) in the existing model at PT. XYZ Branch Hub Bandung City.

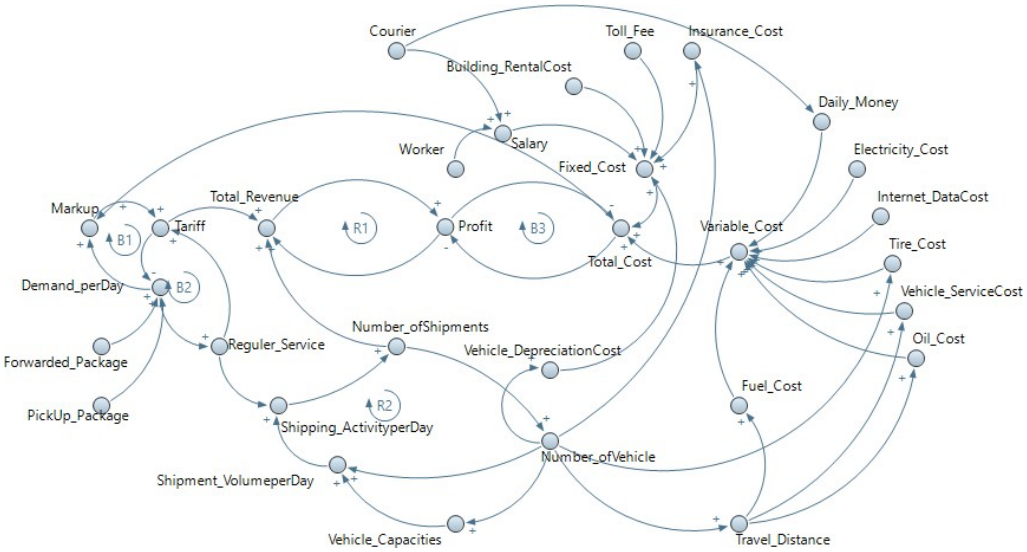

Figure 4. Causal Loop Diagram of Existing Model
Source: Author's Processing

As seen in Figure 4 above, a Causal Loop Diagram (CLD) can be seen for the existing model at PT. XYZ Branch Hub Bandung City. What is depicted in the Causal Loop Diagram above, it can be seen that the Total Cost component consists of two (2) variables that form and influence it, namely Fixed Costs and Variable Costs. Fixed Costs are positively influenced by Salaries and Wages, Building Rental Costs, Toll Costs, Insurance Costs, and Vehicle Depreciation Costs. Variable Costs are also positively influenced by Electricity Costs, Quota Costs, Daily Allowances, Tire Costs, Vehicle Service Costs, Oil Costs, and Fuel Costs. So if Fixed Costs and Variable Costs are high, then the Total Costs that must be incurred by the company will also be high.
Salaries and Wages will be positively influenced by existing Couriers and Employees, so the more Couriers and Employees employed by the company, the higher the Salary and Wages costs that must be incurred by the company. Distance Traveled positively affects Fuel Cost, Vehicle Service Cost, and Oil Cost. The further the distance traveled by a vehicle, the more Fuel Cost, Vehicle Service Cost, and Oil Cost that need to be spent. In addition, the number of vehicles will affect Vehicle Depreciation Cost, Insurance Cost, Tire Cost, Distance Traveled, Vehicle Capacity and Total Capacity per Day. As for Daily Demand is influenced or consists of Forwarding Packages and Pick Up Packages, the influence that will occur is positive, which means that the more Forwarding Packages and Pick Up Packages will result in an increase in Daily Demand.

Conclusion

1. Causal Loop Diagram shows the cause-and-effect relationship between various variables to each other. The cause-and-effect relationship between these variables is the formation of a dynamic system model for the operational model of goods delivery at PT. XYZ Branch Hub Bandung City. The model includes the delivery of goods, the company's income and profit, and the company's operational costs.

2. Variables in the goods delivery section shown in the Causal Loop Diagram include the number of vehicles, number of deliveries, vehicle capacity, total vehicle capacity per day,

deliveries per day, regular service, pickup packages, forwarding packages, service requests per day, markup, and rates. While the variables for the company's operational cost section are divided into two variables, namely variable costs and fixed costs which are then influenced by other variables such as distance traveled, fuel costs, vehicle depreciation costs, oil costs, vehicle service costs, tire costs, quota costs, electricity costs, workers, salaries and wages, building rental costs, toll costs, insurance costs, and daily money as well as total income, profit, and total cost variables.

Reference

Alfariz, M. R., Dewi, N. K., & Pakpahan, H. M. (N.D.). *Number Of Passengers In 2023*. *1*(9).

Andruetto, C., Stenemo, E., & Pernestål, A. (2024). Transportation Research Interdisciplinary Perspectives Towards Sustainable Urban Logistics : Exploring The Implementation Of City Hubs Through System Dynamics. *Transportation Research Interdisciplinary Perspectives*, *27*(July), 101204. Https://Doi.Org/10.1016/J.Trip.2024.101204

Arffien, Afferdhy, Iman Sudirman, A. T. J. (2024). *Ilomata International Journal Of Tax & Accounting*. *5*(1), 28–43.

Bala, B. K., Arshad, F. M., & Noh, K. M. (N.D.). *System Dynamics*.

Dewi, N. K., Arffien, A., Nurhayana, H. F., Saefudin, A., Management, T., & Java, W. (2024). *Jurnal Sosial Ekonomi Dan Kebijakan Pertanian*. *8*(November), 756–770.

Dewi, N. K., Dindasari, E., Transportasi, S. M., Tinggi, S., & Logistik, M. (2022). *ANALISIS TARIF IDEAL UNTUK LAYANAN JASA TRUCKING STUDI KASUS : PT . X PADA RUTE TANJUNG PRIOK – JABODETABEK*. *8*(April), 13–25.

Dewi, N. K., Pradono, P., Miharja, M., & Yudoko, G. (2017). A Model Of Manau Rattan Distribution Cost In Sumatra. *International Journal Of Supply Chain Management*, *6*(3), 226–231.

Dewi, N., Miharja, M., & Yudoko, G. (2015). Analisis Kebijakan Distribusi Bahan Baku Rotan Dengan Pendekatan Dinamik Sistem Studi Kasus Rotan Indonesia. *Jurnal Perencanaan Wilayah Dan Kota*, *26*(3), 177–191. Https://Doi.Org/10.5614/Jpwk.2015.26.3.3

Dwi, S., Putri, A., Zubair, A., Studi, P., Informasi, S., Informasi, F. T., & Malang, U. M. (2023). *Analisis Prediktif Perubahan Nilai Profit Berdasarkan Klasifikasi Pengguna Pada Usaha Jasa Logistik Predictive Analysis Of Profit Value Changes Based On User Classification In Logistics*. *1*(1), 1–10. Https://Doi.Org/10.26905/Jisad.V1i1.9865

Junita, A. (2017). *Penetapan Biaya Standar Dan Analisa Penyimpangan Biaya Produksi (Suatu Kajian Pustaka)*. *1*(1), 34–43.

Kar, A., & Datta, P. R. (2020). *Logistics Cost Dynamics In International Business : A Causal Approach*. Https://Doi.Org/10.1177/0015732520947861

Kar, A., & Datta, P. R. (2024). *Logistics Cost Dynamics In International Business : A Logistics Cost Dynamics In International Business : A Causal Approach*. *November 2020*. Https://Doi.Org/10.1177/0015732520947861

Khakifirooz, M., Fathi, M., & Du, L. (2024). Transportation Research Interdisciplinary Perspectives Reliability Assessment Of Vehicle-To-Vehicle Communication Networks Through Headway Distribution And Information Propagation Delay. *Transportation Research Interdisciplinary Perspectives*, *24*(September 2023), 101053. Https://Doi.Org/10.1016/J.Trip.2024.101053

Laimon, M., Mai, T., Goh, S., & Yusaf, T. (2020). *Applied Sciences Energy Sector Development :*

System Dynamics Analysis. 1–19.

Lalamentik, Y. H., Saerang, D. P. E., Akuntansi, J., Ekonomi, F., Sam, U., & Bahu, J. K. (2023). *Analisis Perhitungan Tarif Jasa Atas Pemeriksaan Laboratorium Dengan Menggunakan Metode Activity Based Costing Pada PT . Wenang Wahana Bhakti Husada Cabang Manado Analysis Of Calculation Of Service Rates For Laboratory*. *6*(2), 1477–1488.

Mthembu, S. E., & Chasomeris, M. (2024). Revisiting Marine Services Pricing In South Africa's Ports. *WMU Journal Of Maritime Affairs*, *23*(1), 5–24. Https://Doi.Org/10.1007/S13437-023-00320-7

Mulyati, E., & Alif, I. (2014). *PERENCANAAN TARIF IDEAL PENGIRIMAN BARANG BERDASARKAN METODE PERHITUNGAN BIAYA OPERASIONAL KENDARAAN (BOK)*. *54*, 213–222.

Mursyid, A., & Hidayat, A. (2025). *Analisis Biaya Satuan Pendidikan Dengan Metode Activity Based Costing*. *5*(1), 16–30.

Nassar, R. F., Ghisolfi, V., Annema, J. A., Van Binsbergen, A., & Tavasszy, L. A. (2023). A System Dynamics Model For Analyzing Modal Shift Policies Towards Decarbonization In Freight Transportation. *Research In Transportation Business And Management*, *48*(December 2021). Https://Doi.Org/10.1016/J.Rtbm.2023.100966

Pku, S., & Mamajang, M. (2022). *TINJAUAN TARIF RAWAT INAP MENGGUNAKAN METODE ACTIVITY BASED COSTING PADA RUMAH SAKIT PKU MUHAMMADIYAH MAMAJANG DI DAERAH MAKASSAR Review Of Hospitalization Rates Using Activity Based Costing Method At Rumah*. *5*, 233–237.

Putri, A. R., Nuha, M. U., Dilicahyani, I. A., Dhany, R., Pratiwi, R., Wahid, U., Semarang, H., Tengah, J., Mental, M., Sistem, B., & Profesional, K. (N.D.). *PERANAN MENTAL MODEL DAN SYSTEM THINKING PADA*. 1–10.

Rudianto, M., Sudjana, N., Administrasi, F. I., & Brawijaya, U. (2014). *Analisis Perhitungan Biaya Standar Guna Meningkatkan Efisiensi Biaya Produksi 6wxgl 3dgd 3huxvdkddq 0dndqdq 5lqjdq ³0dzdu´ 0dodqj*. *8*(1), 1–8.

Widowati, I., Pratiwi, K. I., Studi, P., Industri, M., Tinggi, S., Wastukancana, T., & Barat, J. (2023). *Journal Of Management And Industrial Engineering (JMIE) Sekolah Tinggi Teknologi Nusantara Lampung ANALISA KUALITAS PELAYANAN JASA PENGIRIMAN BARANG DENGAN METODE SERVQUAL DI PT SICEPAT Journal Of Management And Industrial Engineering (JMIE) Sekolah Tinggi Teknologi Nusantara Lampung*. *2*, 104–117.