EVALUATION OF PERIODIC REVIEW TO REDUCE OVERSTOCK USING SYSTEM DYNAMICS

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Abstract

Maintaining inventory level is an important aspects in controlling the inventory cost. PT RST is a running single agent that hold Peugeot in Indonesia. PT RST is handling the sell of cars and handling the after sales service and spare parts. The company system of ordering the spare parts are done by historical data calculation that lead the company having an overstock problem and high inventory cost. Other researcher already given proposed order system by using the combination of ABC-XYZ classification and periodic review R,s,S and R,S. This final project is to provide an analysis by using system dynamic simulation whether the proposed system is affective or not. The process in making the dynamic simulation are identify the variable that related with the objective of the final project. Second is making the causal loop diagram to understand the relation in each variable. Last is making the stock and flow diagram to understand more comprehensive the model by quantitative data. A simulation based system is made to analyze the systems that has been made.

Keywords : Overstock, Inventory Cost, System Dynamic, Causal Loop Diagram, Stok and Flow Diagram.

I. Preliminary

PT RST is a running single agent that hold Peugeot in Indonesia. PT RST is handling the selling of cars and spare part that is completely build up from Peugeot automobile in France. Other business that run by PT RST is offering after sales service for their customer. One of after sales service that PT RST do is provide the spare parts. The sales data that shown in Figure I.1 show that PT RST have an increase and decrease of sales from 2011-2020. Even though the sales are up and down the average of increase in sales in wholesale is 26.95% and 25.98% in retail.

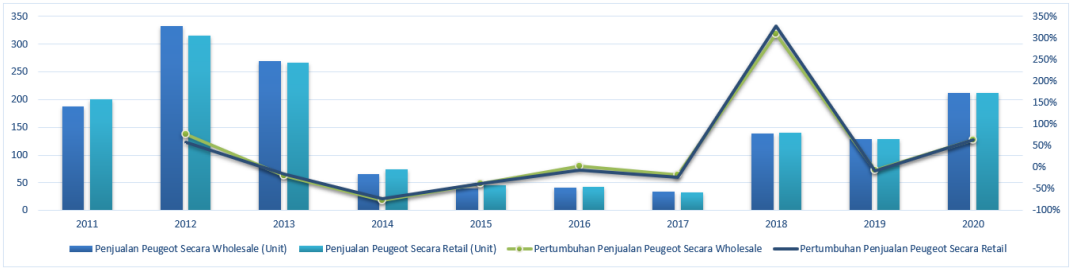

Figure I.1 Peugeot Sales Data in Wholesale and Retail

The modern car composed of round about 30.000 parts that may bust over time and need to be replace [1]. Therefore, the increasing in sales can lead to the increase of demand for spare parts because a modern car is composed of round 30.000 parts. The importance of fulfilling the spare parts demand can lead to a good after sales service and can increase the customer loyalty to the brand [2]. The after sales service can gain profit ten time larger than the sales of the car and the spare parts business can generate from 50% to 70% of the revenue [1].

To survive in automotive industry every company need to have a profitable sale. Main focus of PT RST are in sell cars and provide spare parts to the costumer. Since as stated before spare parts sales can gain more revenue to the company rather than the sells of car itself. To be able gain profit from the spare parts sales PT RST need a good system in managing the spare parts inventory system because inventory cost can have affect to the total profit of the company from 20% to 40% [3]. Without a good inventory management system it can lead to out of stock or pile up. PT RST are having a pile up inventory as shown in Figure I. 2 and can lead to overstock condition.

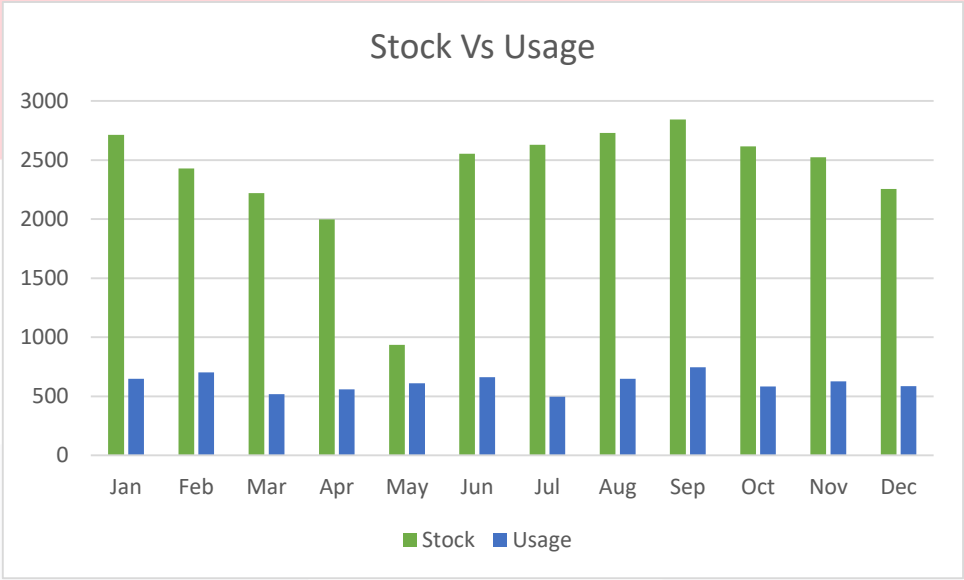

Figure I. 2 Comparison of Stock and Usage of Spare Parts

Due to the overstock problem the company also facing cost allocation problem. The inventory cost is higher than the actual company inventory cost allocation because company consider all spare parts have same importance level. High inventory cost also because the company restock their spart parts only According on the historical demand data. The cost allocation data can be seen in Figure I. 3.

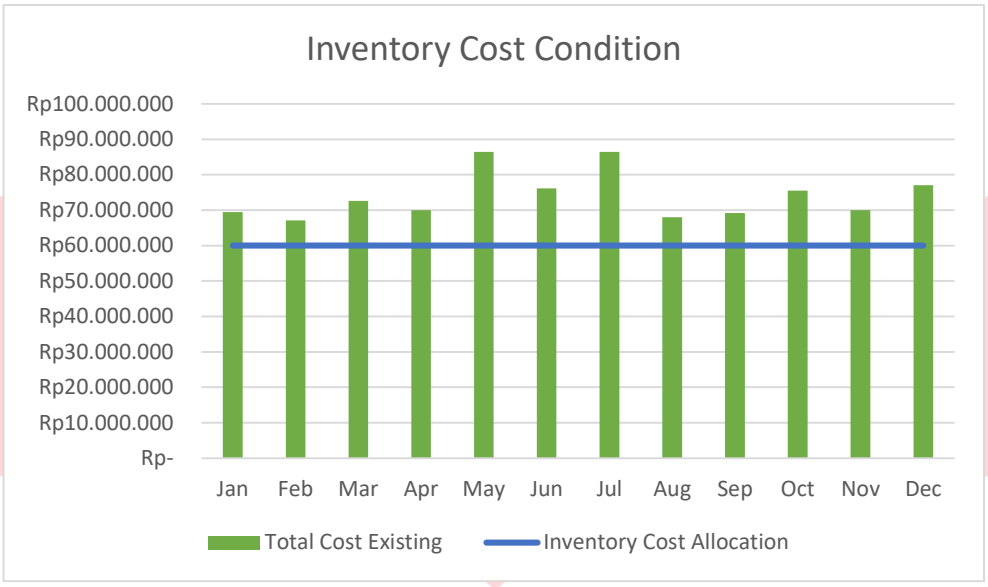

Figure I. 3 Inventory Cost Condition

To face the inventory cost problem the previous author proposed an inventory management system by using ABC-XYZ classification and make inventory policy using periodic review. The ABC-XYZ classification are to classify the spare parts based on their cost consumption and demand variability. The company have an agreement with their parent company to order based on their batch or once a month, this condition makes PT RST always order each spare part once a month. Because of that PT RST have an increasing on inventory cost due to the increasing of order cost, purchase cost, and holding cost. To face that problem the R,s,S and R,S periodic review so that the company doesn't have to order once a month and hoped that it can decrease the inventory cost.

From the calculation of periodic review (R,s,S) and (R,s) the result of category 1 are reduction of order cost by 50,38%, holding cost by 16.53%. Even though there an increase in shortage the total inventory cost is reduce by 39,44%. For category 2 the result are decreasing in order cost by 50,38%, holding cost by 16,53%. Even though there an increase in shortage cost the total inventory cost is reduce by 34,94%. For the overall total inventory cost it is reduced by 37,78%.

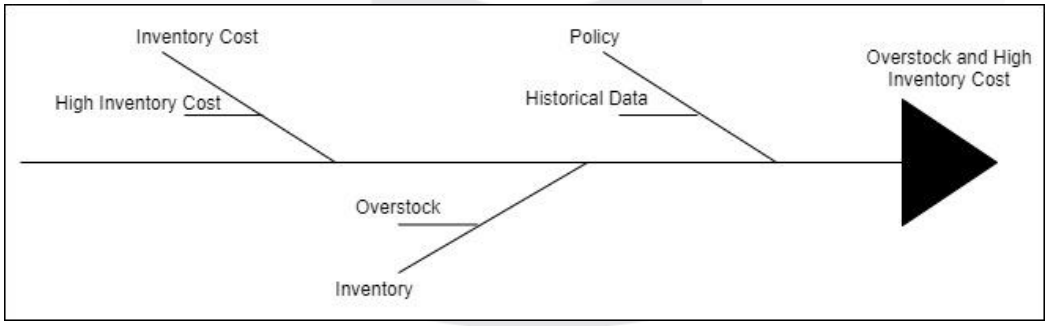

Figure I. 4 Fishbone Diagram

According on Figure I. 4, the problem that occur is an overstock inventory that caused in high total inventory cost. The previous author already done an ABC-XYZ and periodic review. The periodic review is not able to capture the dependencies within the variable. In this final project a simulation is conducted to validate a certain decision to evaluate and improve the policy [4]. The simulation that will be used in this final project to solve the problem is system dynamic modelling. The reason of using system dynamic is because by using simulation we can conduct apply trial and error to the system to improve and analyze the performance of the policy [5].

II. Theroritical Basis

II.1 Inventory

Inventory is a source of idle sources that wait to be processed. As a idle sources inventory can be seen as waste and can become an increase in cost in a business unit. In other side if inventory have an shortage it can effect the customer satisfaction level. Because of that inventory need to be balanced to keep the cost optimum while customer satisfaction level increase [6].

II.2 System Dynamic

System dynamic are first introduced by Jay W. Forrester in 1950s as a methodology to study non-linear system to determine how science and engineering can affect to the success of an industry [7]. System dynamics is an simulation technique to learn and understand the complexity of a system. System dynamic are able to mirror the actual system by discovering and representing the feedback process, stock and flow structures, time delays, and nonlinearities [7], [8]

II.2.1 Causal Loop Diagram

to Sterman [8] and Sapiri [7] to represent the feedback structure of a system causal loops diagram (CLDs) are used. By using CLD it enables us to see the interaction between each variables or elements. To understand the interaction between each elements or variables CLD are showing a group of nodes thar are interconnected by arrows that enable us to see the feedback loops that are created. Causal loop diagram are important tools in representing the feedbacks structure of system. It also simple to make but should be followed faithfully. Behind the simplicity causal loops diagram are excellent for quickly capturing the hypothesis about the cause of dynamics, eliciting and capturing the mental models of individuals or teams, and communicating the important feedbacks.

II.2.2 Stock and Flow Diagram

CLD have a drawback that is the inability in capturing the stock and flow of a system [8]. To understand the system even more it needed the development from the CLD to the stock and flow diagram (SFDs). To capture the quantitative effects between each elements or variables a SFD is made. Stock are accumulations of quantities that capture the system while flows control the changes to stock via it rates [7].

II.2.3 Validation

According to Hoover and Perry (1990) on [1], validation is the process of determining whether the model is a meaningful and accurate representation of the real system. Validation is concerned to make the right model. One way to validate the model is by doing behavior validity test because it can help us to evaluate the adequacy of the model structure.

II.2.4 Verification

According to [1], verification is the process of determining whether the model operates as intended or correctly. In this process the modeler will try to detect unintended error in the model and try to fix them. Some verification method that can be used are conduct model code reviews, check the output for reasonableness, watch the animation for correct behavior, and use the trace and debug facilities provided with the software.

III. Research Methodology Method

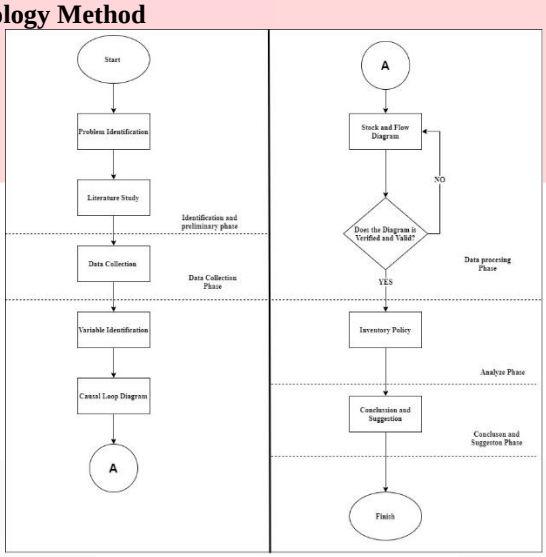

Figure III. 1 Problem Solving Systematic

Figure III. 1 show the process of this research. First identification and preliminary phase the author is try to understand and determine the problem identification. After problem identification the author are gathering several literature study such as books, journals, final project, etc. that related with the problem. Then, data collection phase are the process of gathering the data that is needed in this final project. The data collection in this final project are secondary data. Third Data processing phase is the process of processing the data that are gathered in the data collection phase to achieve the goal of the final project. Forth, The stock and flow diagram is made by Vensim application. In Vensim the author can see how the stock and flow diagram is working and able to find is there's any problem that not solve the problem. After finding the problem the author can modify the stock and flow diagram so that it can solve the problem. And last is In the conclusion and suggestion phase will be stated the conclusion of the system dynamic method and also the suggestion for further research.

IV. Result and Discussion

IV.1. Causal Loop Diagram

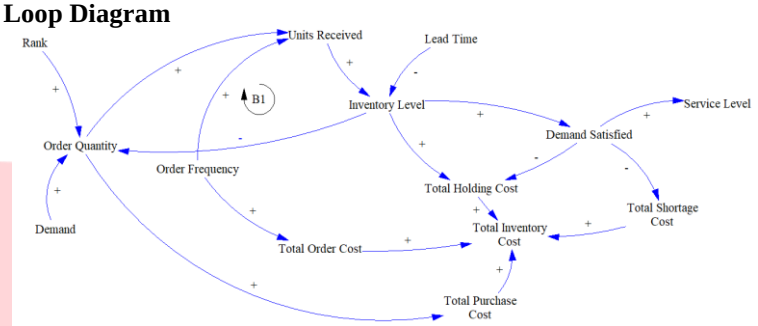

Figure IV. 1 Causal Loop Diagram Existing System

One important thing in system dynamic are to understand the interaction between each elements or variables. In order to see the interaction between each elements or variables causal loop is made. The causal loop diagram can explain the behavior of a system by showing a group of nodes that are interconnected by arrows and the feedback loops created by the connection [2]. The causal loop diagram of existing system and periodic review can be seen in Figure IV. 1 and Figure IV. 2.

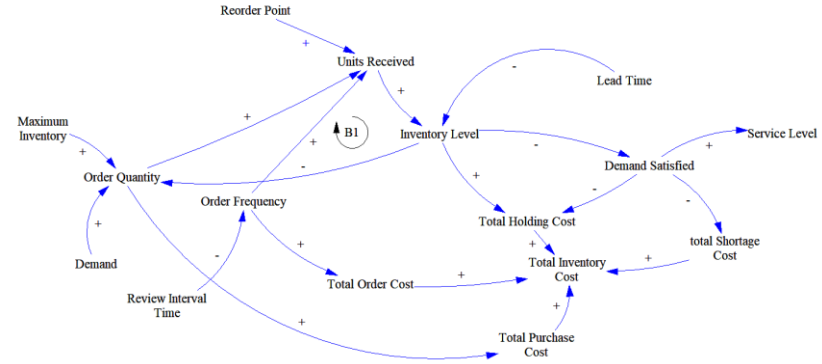

Figure IV. 2 Causal Loop Diagram Periodic Review

IV.II.Stock and Flow Diagram

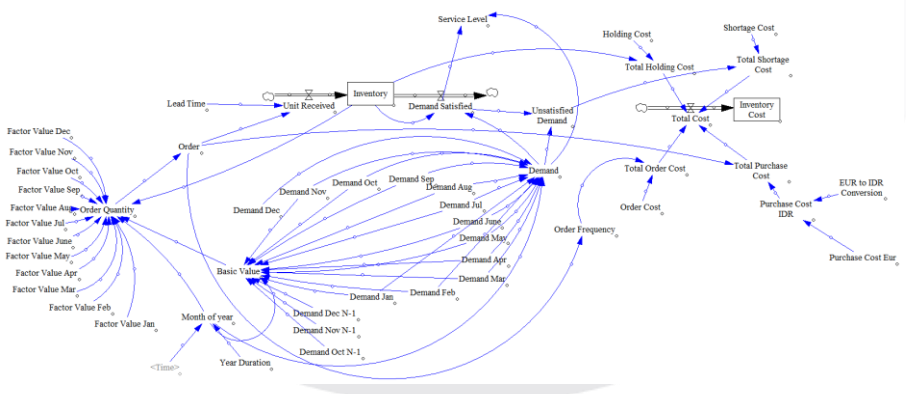

Figure IV. 3 Stock and Flow Diagram Existing System

The causal loop can never be comprehensive and never be final since it can evolve based on the user understanding about the problem and objective. The causal loop diagram also can't capture the stock and flow structure of the system. Stock and flow with the feedback are the two central concept of dynamic system theory [3]. Stock represent accumulation of quantities that capture the state of a system. To control the stock will be need a flow because flow can control the changes to stock via its rates [2]. The stock and flow diagram will be presented by using one part for periodic review R,s,S and one part for periodic review R,S.

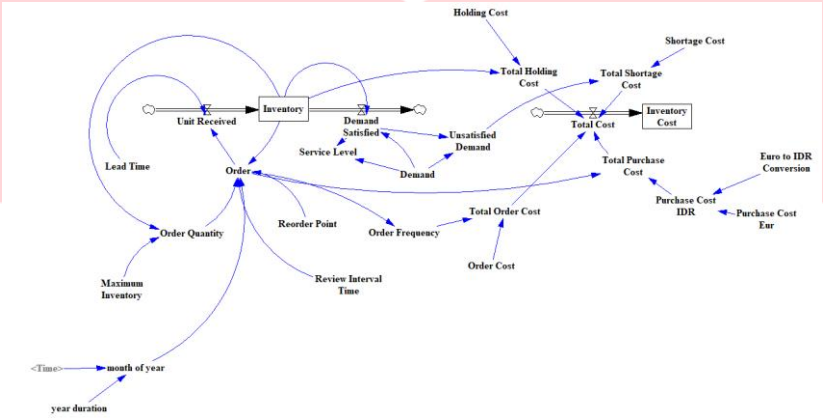

Figure IV. 4 Stock and Flow Diagram Periodic Review

IV.III PeriodicReview R,s,S

From the simulation that has been conducted the simulation shows that the periodic review R,s,S able to solve the inventory stock problem but not able to solve the inventory cost. The inventory cost is still higher than the existing system in the company. The comparison between inventory condition in PT RST can be seen in Figure IV. 5. Due to the inventory stock is lower, in periodic review come a new problem that is a decrease in demand fulfilled. The deecreas of demand fulfilled lead to a high shortage cost and high inventory cost. The total comparison can be seen in Figure IV. 6.

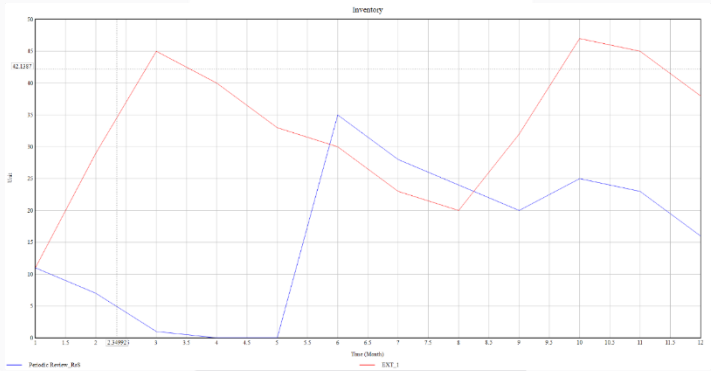

Figure IV. 5 Inventory Graph Comparison in Periodic Review R,s,S

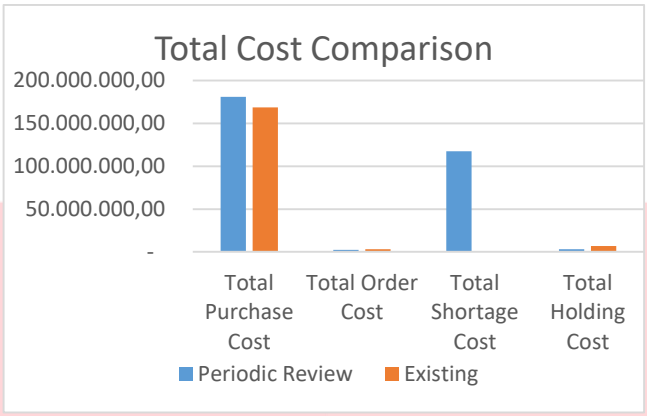

Figure IV. 6 Total Cost Comparison

Figure IV. 6 it shows that in the existing system there's no shortage cost and in the peridic review there an increase in sortage cost. The holding cost in existing is slightly higher due to in existing system it suffer from overstock condition. The shortage cost of the spare parts is much bigger than the holding cost, in this condition the company must decide to use the periodic review or not. Because in existing system the holding cost is high but the price is quite low different with the shortage cost the prie is much higher. A slight change in shortage cost can lead to an increase of total inventory stoick drastically. By using system dynamic the modeler able to see other perspective for example in this research the proposed system is ow will have effect to the income. The income comparioson can be seen in Figure IV. 7. Even though both system are have negative income but the existing system is better.

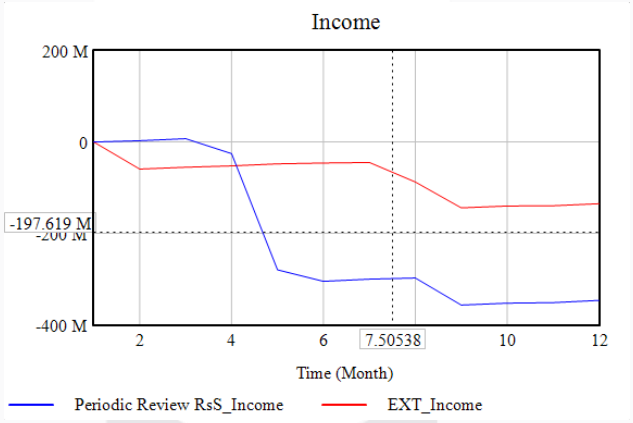

Figure IV. 7 Income Coparison Periodic Rrview R,s,S

IV.IV Periodic Review R,S

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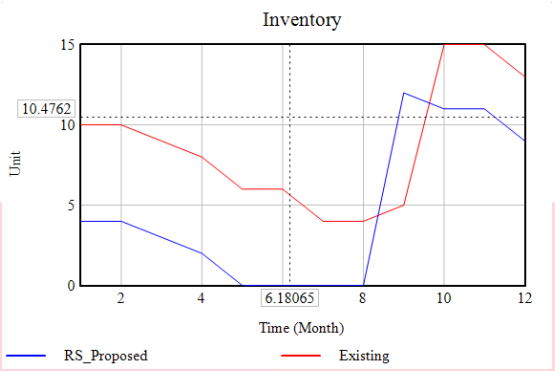

Figure IV. 8 Inventory Graph Comparison in Periodic Review R,S

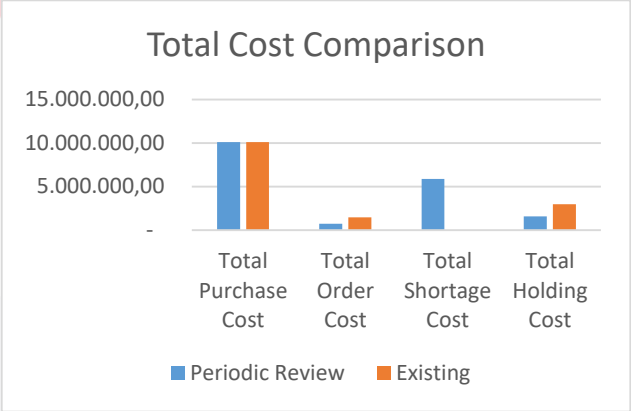

Figure IV. 9 Total Cost Comparison

From Figure IV. 9 it shows that in the existing system there's no shortage cost and in the peridic review there an increase in sortage cost. The holding cost in existing is slightly higher due to in existing system it suffer from overstock condition. The shortage cost of the spare parts is much bigger than the holding cost, in this condition the company must decide to use the periodic review or not. Because in existing system the holding cost is high but the price is quite low different with the shortage cost the prie is much higher. A slight change in shortage cost can lead to an increase of total inventory stoick drastically. By using system dynamic the modeler able to see other perspective for example in this research the proposed system is ow will have effect to the income. The income comparison can be seen in Figure IV. 10. The existing condition is have high income value to the company rather than the proposed system. This condoiton is because the high difference in shortage cost and holding cost. The company should consider this in making the decision of ordering spare parts.

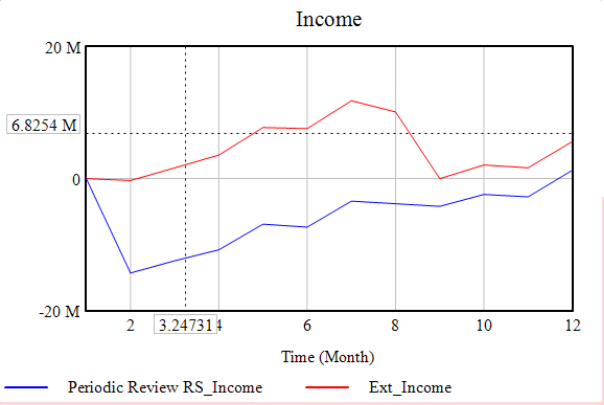

Figure IV. 10 Income Comparison

V. Conclusion

The output of this final project is system dynamic simulation. By using the system dynamic simulation, the author able to test the previous proposed system and to know does the proposed system is able to solved the problem or not. From the result of the system dynamic simulation the proposed system able to solve one problem that is the inventory overstock problem. By using the periodic review R,s,S and R,S the simulation shows that the inventory stock is decreasing from the existing system. Based on the simulation also the periodic review R,s,S and R,S is not able to reduce the inventory cost. Due to reduction of inventory the simulation shows that there's an increasing of shortage cost and lead to increase in total inventory cost.

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