
ENHANCEMENT OF SUPPLY CHAIN CONTROL TOWER TO REDUCE INVENTORY PARTS OF HEAVY EQUIPMENT AT PT XYZ

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ABSTRACT

Introduction: As a leading heavy equipment distributor in Indonesia, PT XYZ is very concerned about after-sales service as an advantage compared to competitors. Keeping the service level based on target was accompanied by a decrease in working capital as one of the goals of PT. XYZ was establishing a tower in its supply chain concept. This research was conducted at PT. XYZ owns the largest market share of heavy equipment in Indonesia. The purpose of this study was to analyze the increase in the supply chain control tower in reducing the inventory of heavy equipment spare parts at PT. XYZ. **Method:** This research uses mixed methods, a stage of research combining two types of research methodologies, namely qualitative and quantitative. **Result:** The analysis results at SCOR level 1 show that all strategic metrics are below the set targets. So that at SCOR level 2, an in-depth analysis is carried out with Geographic maps and Thread diagrams that show potential problems in Enable Process (sE2), Plan Source (sP2) and Delivery (sD1) activities. Finally, the results of SCOR level 3 analysis using a fishbone diagram reveal that the root cause of the problem is a leak in internal company supply chain management. We recommend the enhancement of the supply chain control tower at PT XYZ. **Conclusion:** This Research primarily aims to evaluate the element supply chain control tower at PT XYZ as a stocked business product with SCOR Model 12.0. The result shows that the performance of the Supply Chain Control Tower in Tower Tanjung Area (TAD) does not achieve the target.

Keywords: Supply Chain Control Tower; SCOR Model, Inventory Reducing, Parts of Heavy Equipment.

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INTRODUCTION

The heavy equipment spare parts industry will be correlated with two things, namely an increase in sales of heavy equipment, as well as an increase in commodity prices, of course, being one of the capitals in after-sales service that is so important and related to an increase in sales of parts which will have an impact on increasing revenue, increasing profits (Suwito, 2022) (MacCarthy et al., 2022). if appropriately managed, and is essential for achieving customer satisfaction (Persson & Saccani, 2007). PT XYZ has a special division for after-sales service, namely a parts division for sales and support of spare parts and a service division for unit repair services. PT XYZ's working capital management, namely the heavy equipment spare parts inventory, is very high and requires proper supply chain management. PT XYZ's supply chain management method to maintain time in the entire spare parts supply and keep days of inventory low is the supply chain control tower.

PT XYZ has implemented the supply chain control tower. One of the towers in the Company is TAD or Tower Tanjung Area. However, its impact on the inventory level has been insignificant. From the secondary data, we see that the Days of Inventory (DOI) at TAD is still high in the last three years

and need to achieve the target. Furthermore, the On Time in Full (OTIF) ratio has never reached 100% in all Lower-level areas, as seen in table 1.

Table 1 Performance Supply Chain Tower Tanjung Area

No	Performance Tower Tanjung Area	Plan	2021	2022 (COD June)
1	On-Time in Full	90%	85%	87%
2	Days of Inventory	50 Days	75 Days	70 Days

In this research, we will use Supply Chain Operation Reference (SCOR) model to analyze the performance of the supply chain control tower to reduce working capital inventory (Huang et al., 2005). Qualitative interviews and quantitative data from the company will support the SCOR analysis.

This research will answer two questions: what is the performance of the supply chain control tower at PT XYZ, and what improvement can be suggested from the supply chain control tower? Moreover, this research has two objectives: to evaluate the performance of the supply chain control tower at XYZ with the SCOR Model. In addition, the benefit of this research is to suggest improvement strategies in supply chain control towers

METHOD

This research utilizes a mixed method, which is a research phase that combines two types of research methodologies, namely qualitative and quantitative. Mixed research is a research method that mixes qualitative and quantitative data (Supriyati, 2015). Meanwhile, (Hermawan, 2019) defines mixed methods as research methods that combine two research methods, namely qualitative and quantitative, in a research activity to acquire more comprehensive, valid, trustworthy, and objective data (Creswell & Creswell, 2017). Using the Supply Chain Operation Reference (SCOR) Method version 12.0, this research examines the company's supply chain performance, particularly in the critical raw material procurement sector.

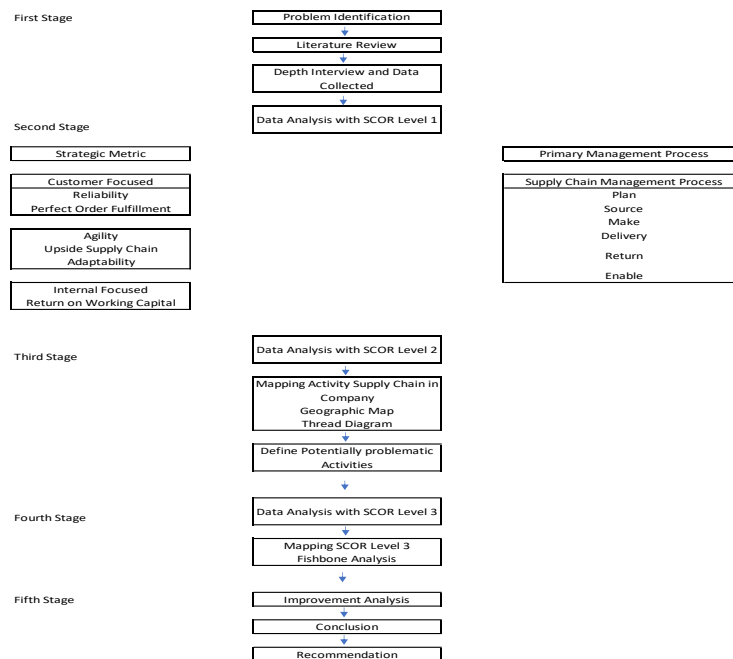


Figure 1. Research Design (Source from Researcher)

According to the core structure of the Supply chain excellence phase (Kunovjanek et al., 2022), this study is organized into five major stages, which are as follows:

- Stage I

At this initial stage, problems are identified and formulated following the topic of the study, namely the evaluation of supply chain performance. The literature review referred to predetermined topics, ranging from Operations Management, Supply Chain Management, Supply Chain Performance Measurement, Supply Chain Operation Reference (SCOR) Methods, and Inventory Management to the heavy equipment Industry, which is the object of this research. Data collection is carried out according to the main stages of SCOR from levels 1 to 3.

- Stage II

In this second stage, an analysis began to be carried out referring to the SCOR level method, starting from the company's Supply Chain Management Process referring to the 6 Primary Management Processes and the corresponding Strategic Metric Level 1. This study uses three Performance Attributes, namely Reliability, Responsiveness and Asset Management Efficiency, with four Strategic Metric, namely Perfect Order Fulfillment (POF) and Order Fulfillment Cycle (OFC), which focuses on consumers, as well as Cash-to-cash Cycle Time (C2C) and Return on Working Capital (RWC) using metric level 2, namely Inventory, which focuses on the internal conditions of the company (Rachmatri, 2021).

- Stage III

This third stage describes the company's supply chain activities according to the stages of SCOR Level 2, using a Geographic Map and Thread Diagram. Based on the description of the company's supply chain activities, it is determined which activities have the potential for problems in its supply chain management.

- Stage IV

Referring to the activities that could be problematic in mapping SCOR Level 2, a more detailed analysis of SCOR Level 3 was carried out, focusing on Inputs, Processes, and Outputs. Analysis of the factors that cause the problem was carried out using Fishbone Analysis.

- Stage V

In this last stage, based on the analysis of the previous three stages of SCOR, an analysis of improvements and alternative solutions was carried out that could be used as recommendations for the company (Kunovjanek et al., 2022).

SCOR Level 1

SCOR Level 1 describes the scope and configuration of the upper level of the supply chain (Marimin & Slamet, 2010). At level 1, the performance target of a supply chain is determined as the basis for competition.

SCOR Level 1 describes the scope and configuration of the upper level of the supply chain. At level 1, the performance target of a supply chain is determined as the basis for competition. The scope of discussion of SCOR Level 1 includes the six primary management processes as follows (SCC, 2012):

1. Plan

The planning process describes planning activities related to the supply chain operation. This includes collecting consumer needs and information from available resources and balancing needs and resources to define planned capabilities and resource gaps. This is followed by the process of identifying corrective steps against existing gaps.

2. Source

The source process describes ordering or scheduling activities and receiving goods or services. This process includes issuing Purchase Orders, scheduling shipments, receiving, validating, and storing and receiving supplier invoices.

3. Make

The making process describes activities related to changing material or creating content from a service. It focuses on material conversion rather than production/manufacturing because Make represents all types of material conversion, such as assembly, chemical processes, maintenance, repair, overhaul, recycling, refurbishment, remanufacturing, and all other forms of material conversion processes.

The general guideline of this process is the presence of inputs and outputs.

4. Delivery

The delivery process describes creating, maintaining, and fulfilling consumer orders. This includes receiving, validating, creating consumer orders, scheduling order shipments, packaging, and billing processes to consumers.

5. Return

The return process describes activities related to the reverse flow of products in consumers. This includes identifying the need for returns, disposition, scheduling returns, and sending and receiving products returned by consumers.

6. Enable

Enable process is associated with creating, maintaining, and monitoring information, relationships, resources, assets, business regulation, regulatory compliance, and commercial contracts to operate the supply chain.

In SCOR Level 1, Performance Attributes and Strategic Metrics will also be determined. Reliability is used as one of the attributes for customer-focused Performance Attributes, with Perfect Order Fulfillment (POF) as its Strategic Metric. Another attribute that is also customer-focused is Responsiveness and Agility, with Order Fulfillment Cycle Time (OFCT) and Upside Supply Chain Adaptability (UPSA) as its Strategic Metric. For Internal-focused Performance Attributes, Asset Management Efficiency is used as the last attribute, Inventory as metric level 2 of Return on Working Capital (RWC) as its Strategic Metric. The calculation formulas for preset strategic measures and their modifications for PT XYZ are shown in Table 2.

Table 2. SCOR Strategic Metrics

SCORE 12.0				PT. XYZ		
Performance Attributes	Strategic Metric – Lv 1	Formulation	Strategic Metric – Lv 1	Formulation	Definition	
Reliability	Perfect Order Fulfillment [RL. 1.1]	$\frac{[\text{Total Perfect Orders}]}{[\text{Total Number of Orders}]} \times 100\%$	POF (%)	$\frac{[\text{Total quantity of TMBP received on-time}]}{[\text{Total quantity shipment plan}]} \times 100\%$	The percentage of the actual amount of UT parts receipts arrived on time, according to the shipment plan, without a split shipment	
Responsiveness	order fulfilment Cycle Time [RS. 1.1]	$\frac{[\text{Sum Actual Cycle Times for All Orders Delivered}]}{[\text{Total Number of Orders Delivered}]} \text{ in days}$	OFCT (days)	$[\text{Actual Received Data UT}] - [\text{On Order Lower Level}]$	Total time required starting from publishing story order lower level to Tower arrive at the warehouse	
Agility	Upside Supply Chain Adaptability	$\frac{[\text{Inventory Days of Suplly}] + \{[\text{Days Sales Outstanding}] - [\text{Days Payable Outstanding}]\}}{\text{in Days}}$	UPSA (%)	$\frac{[\text{Total Receive Item on Order}]}{[\text{Total Item on Order}]} \times 100\%$	The total item receives in the warehouse per total item on the order	
Asset Management Efficiency	Return on Working Capital [AM, 1.3]	$\frac{([\text{Supply Chain Revenue}] - [\text{Total Cost to Serve}])}{([\text{Inventory}] + [\text{Account Receivable}] - [\text{Accounts Payable}])}$	Inventory (MT)	Ratio [Actual All Tower Stock]/ [Revenue Area]	The amount of Tower and Lower-level Inventory expressed in amount form compared to revenue of all lower level	

SCOR Level 2

At SCOR Level 2, a more detailed configuration of the SCOR level 1 process is carried out, and a determination of the capabilities of the supply chain is carried out: Source Stocked, Stocked Product, Make-to-Stock, Make-to-Order, or Engineer-to-Order (Ruamsuke & Ongkunaruk, 2021). Especially in this research which focuses on the process of procuring the primary raw materials, then for SCOR Level 2, the discussion will focus on the configuration of the Plan and Source process (Shintira, 2021). The following is an explanation of each process configuration for Plan and Source:

1. Plan

The planning process is described into five types of planning, namely Plan Supply Chain (sP1), Plan Source (sP2), Plan Make (sP3), Plan Deliver (sP4), and Plan Return (sP5) (Jian et al., 2017).

- Plan Supply Chain (sP1) is developing and building a supply chain management plan for a certain period that shows the projected use of supply chain resources to meet supply chain needs for a long time, considering the limited supply of resources.
- Plan Source (sP2) is the process of developing and building a plan at a certain period that shows the projected suitability of material resources to meet supply chain needs.
- Plan Make (sP3) is the process of developing and building a plan in a certain period that shows the projection of the suitability of production resources to meet production needs.
- Plan Deliver (sP4) is the process of developing and building a plan at a certain period that shows the projected suitability of resource delivery to meet delivery needs.
- Plan Return (sP5) is a strategic or tactical process for building and adjusting planning in a given period that shows the projected suitability of the return of resources and assets to meet the demands of returns, whether anticipated or not anticipated.

2. Source

The source process is described into three main processes, namely Source Stocked Product (sS1), Source Make-to-Order Product (sS2), and Source Engineer-to-Order Product (sS3) (Pause & Blum, 2018).

- Source Stocked Product (sS1) is the process of ordering, receiving and transferring raw materials, sub-assemblies, products and services based on aggregate demand needs.
- Source Make-to-Order Product (sS2) is the process of ordering and receiving an ordered (or possibly configured) product or material only when there is an order request from a consumer.
- Source Engineer-to-Order Product (sS3) is the process of identifying and selecting sources of supply, negotiation, validation, scheduling, ordering, and receiving parts, assemblies or unique products/ services designed, ordered, or built on the needs and specifications of a particular consumer order.
- The following is a summary of the problems that occur in the threading diagram,

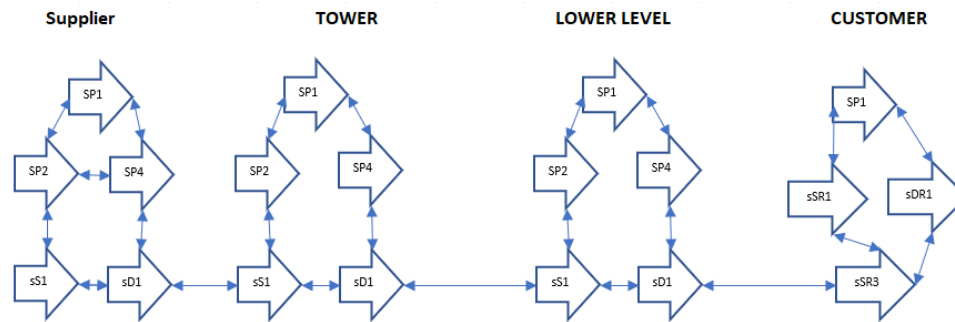


Figure 2. Thread Diagram Problem Identification

The problem occurs in 3 elements; the first is the stock availability in the principal, marked with sS1 in the Supplier. The second problem is forecasting, where Tower needs to be intervened in forecasting by contract items from customers, marked with sP2. Then sS1 or low stock availability in principle. SD1 in the Tower means there are problems due to mixed deliveries for regular LIB needs and overhaul needs, which still need to be planned. Problems at the lower level also follow what happened in the Tower. In this study, SCOR Level 3 will focus on problems in the internal XYZ Tower and Lower level to provide solutions to reduce working capital in terms of forecasting and lead time delivery.

SCOR Level 3

Based on SCOR Level 2, a more detailed analysis was re-conducted on potentially problematic activities. SCOR Level 3 mapping includes detailed activities, including inputs, processes, and outputs. For the analysis of the factors that cause the problem, fishbone analysis is used with all related elements, namely Man, Machine, Material, Method, and Environment (Purwani & Sudiro, 2022). Based on the SCOR Level 3 analysis, it can be determined that an analysis of improvements can be carried out to overcome the problem.

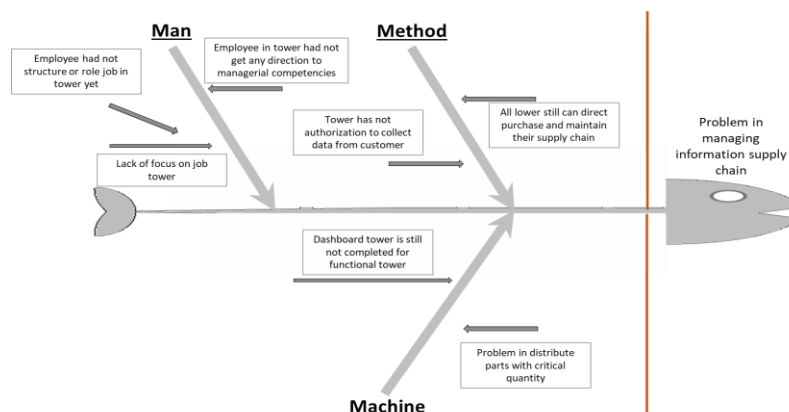


Figure 3. Fishbone Element SE Enable Manage Performance

In Figure 3, there is a problem from the method side that the Tower needs to be able to accommodate the needs of the lower level. Problems also occur because there is no standard

structure in the Tower, and officially registered with the company, so there is an authority bias. Meanwhile, in terms of technology, digitalization is still not complete. It needs to be completed in terms of managing the information supply chain.

In causal figure 4, there is still a mix of steady demand with demand overhaul, hampers the delivery lead time.

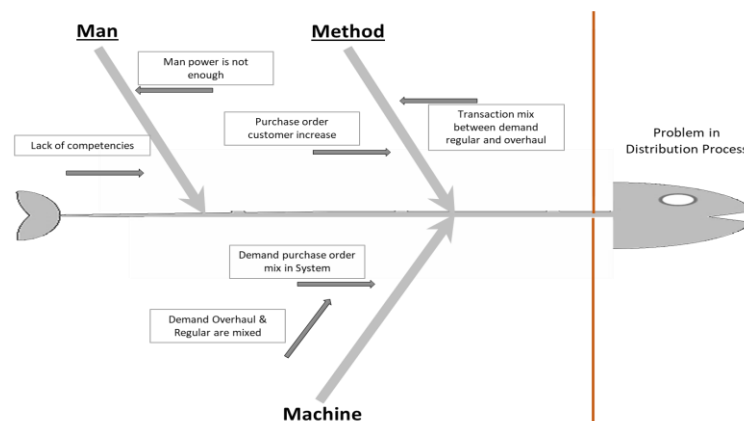


Figure 4. Fishbone Element Delivered Stocked Product (sD1)

Following the mapping of activities in the Source Stocked Product process, an analysis was carried out using a relation diagram to find out the root causes that caused the planning process to be not optimal. A causal diagram is obtained based on observations and interviews with internal users such as logistics, SPM, Tower, and Lower Level.

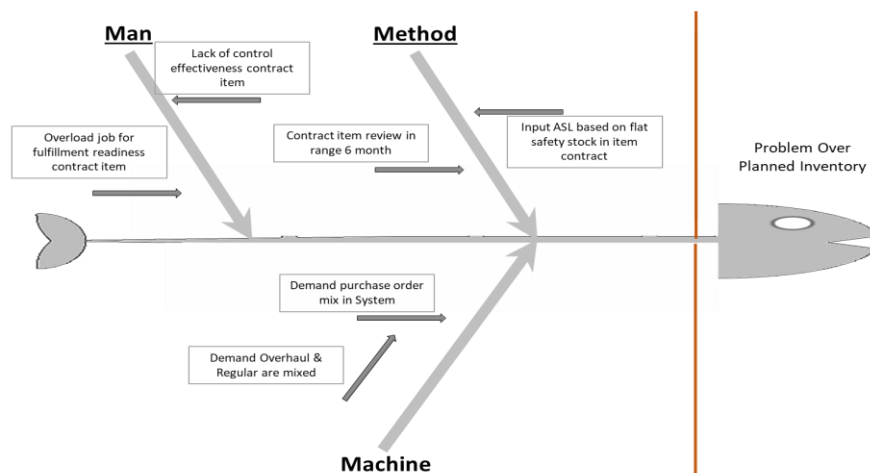


Figure 5. Fishbone Element Plan Source (sP2)

The results of interviews and discussions regarding the causes and effects of the problem of high Inventory in the Tower and the lower level are centred on the high demand along with the increase in coal prices and the decrease in Covid-19 cases, causing the demand for orders for unit repairs, project maintenance and overhauls to be very high compared to customer needs related to parts. Heavy equipment normally. The Tower should manage this periodic need and can be

maintained and supplied only to the lower level when needed. The unavailability of stock at KMSI so that the readiness stock in the Tower causes perfect order fulfilment at specific lower-level sites not to be achieved. This is exacerbated by the inhibition of stock distribution between sites because the workforce warehouse cannot provide optimal performance because of competence and the amount that must be balanced with daily transactions in all warehouse towers and lower levels.

RESULTS AND DISCUSSION

From the Fishbone diagram in SCOR Level 3, this research found three problems with the supply chain at PT XYZ, shown in Table 4. The creativity for the problem is to set up the authority of the person in charge (PIC) Supply chain control tower, replace contract item quantity to the customer with on time in the entire contract, and make zero inventory overhaul demand for the lower level.

Table 3. Summary Problem and Suggestion Solution

Problem	Root Cause (What)	Solution (What)	Objective (Why)	where	When	How
Man	M1 – No Organizational Structure yet in Tower	Make Organizational Structure PSCE in Tower separated with lower level	Structure PCSE under the parts division head office	Head Office	Continue	Speed up process blueprint planning place of PSCE in team supply chain
Method	M2 – High Safety stock item contract	Remove item contract concept, safety stock use calculation actual lead time and circle order with standard distribution simulation.	Stock level maximum inventory area based on simulation PSCE and supply chain	Lower Level & Tower	In 2023	Propose to the customer to remove item contract readiness; UT will send measure performance supply chain in OTIF (On time in full)
Material	M3 – Mixed Deman Overhaul & Regular in the warehouse process	Zero stock lower level for overhaul demand	Overhaul demand prepared by Tower	Tower	In 2023	Overhaul demand prepared and delivered by Tower (Dropship Concept)

1. Authority of PIC Supply Chain Control Tower

The person in Charge (PIC) leader supply chain control tower is a specialist or expert, and the organizational structure is still below a lower level. The solution to remove bias and manage the information supply chain more independently is to make PIC Supply Chain Control Tower independent and below the head office, not the lower level. The authority and role position should be changed from expertise specialist to generalist or managerial with the function manage the supply chain upstream and downstream more effectively and impactful (Derwik et al., 2016).

Adapted from CCL; Ram Charan, Steve Drotter, Jim Noel, "The Leadership Pipeline", 2004-2012, PIC Supply Chain started from a specialist (managing self) and moved to the manager of others shown in the figure.

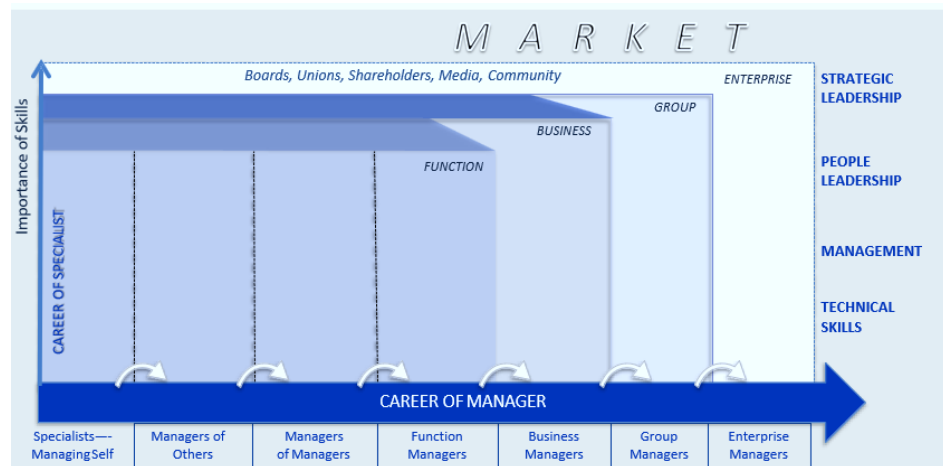


Figure 6 Transition of Leadership Source: PPM Management

2. Replace Contract Item Quantity to Customer with On Time In Full Contract

Comparison between the contract item quantity and average calculation with normal distribution gives a lot of Inventory. Contract items use flat safety stock, and distribution everyday uses actual safety stock. The complete simulation saving Inventory with distribution normal for sampling three parts of heavy equipment is 148.348.452 IDR. The sampling parts use ABC Analysis to choose heavy equipment parts with three classification amounts. A Class is High impact amount but minimum item, B Class is a medium impact amount and medium item, and C Class is low impact amount inventory. Simulation safety stock with regular distribution is also proven with historical data that calculation always gives short stock or stock consistently enough for backup purchase order customers.

3. Zero Inventory Overhaul Demand for Lower Level

Current condition, lower level has Inventory for overhaul or maintenance planning. Maintenance planning is a demand that can be planned and usually has many items and parts. The lower level also should be prepared big warehouse to accommodate the maintenance demand planning. This research suggests that the company uses a "ship to a bill to" transaction or a popular name e-way bill drop ship transaction. As shown in figure 6, the current condition and suggestion business process.



Figure 7. Different Method Back up Demand Planning.

CONCLUSION

This research primarily aims to evaluate the element supply chain control tower at PT XYZ as a stocked business product with SCOR Model 12.0. As a company with many working capital inventories, maintaining a supply chain is necessary for good profit while maintaining customer service. SCOR Method is used as a method in this research. The result shows that the performance of the Supply Chain Control Tower in Tower Tanjung Area (TAD) does not achieve the target. However, the researcher found some strategies to enhance the supply chain control tower in Tower Tanjung Area (TAD), which can apply to the whole supply chain control tower in PT XYZ. For future research, it is necessary to focus on the downstream element because the business has the main goal of achieving service level to the customer with fluctuation of lead time and complexity of three parties logistic company transportation.

REFERENCES

- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Hermawan, I. (2019). *Metodologi Penelitian Pendidikan (Kualitatif, Kuantitatif dan Mixed Method)*. Hidayatul Quran.
- Huang, S. H., Sheoran, S. K., & Keskar, H. (2005). Computer-assisted supply chain configuration based on supply chain operations reference (SCOR) model. *Computers & Industrial Engineering*, 48(2), 377–394. <https://doi.org/https://doi.org/10.1016/j.cie.2005.01.001>
- Jian, W., Yang, H., & ZiYang, W. (2017). Research on modeling and simulation of distributed supply chain based on HAS. *International Conference on Intelligent Robotics and Applications*, 401–412.
- Kunovjanek, M., Knofius, N., & Reiner, G. (2022). Additive manufacturing and supply chains—a systematic review. *Production Planning & Control*, 33(13), 1231–1251.
- MacCarthy, B. L., Ahmed, W. A. H., & Demirel, G. (2022). Mapping the supply chain: Why, what and how? *International Journal of Production Economics*, 108688. <https://doi.org/https://doi.org/10.1016/j.ijpe.2022.108688>
- Marimin, M., & Slamet, A. S. (2010). Analisis pengambilan keputusan manajemen rantai pasok bisnis komoditi dan produk pertanian. *Jurnal Pangan*, 19(2), 169–188.
- Pause, D., & Blum, M. (2018). Conceptual Design of a Digital Shadow for the Procurement of Stocked Products. *IFIP International Conference on Advances in Production Management Systems*, 288–295.
- Persson, F., & Saccani, N. (2007). Managing the After Sales Logistic Network—A Simulation Study of a Spare Parts Supply Chain. In *Advances in production management systems* (pp. 313–320). Springer.
- Purwani, A., & Sudiro, S. (2022). Analisis Keseimbangan Lintasan Pada Carousel line di PT XYZ. *Journal of Research and Technology Studies*, 1(1), 57–72.
- RACHMATRI, A. Y. (2021). *Penerapan Scor Model 12.0 Racetrack Dalam Upaya Peningkatan Supply Chain Performance Perusahaan Jasa Training And Consulting Pt. Xyz*.
- Ruamsuke, T., & Ongkunaruk, P. (2021). Supply chain analysis of import fresh fruit business in Thailand using the supply chain operations reference (scor) model. *E3S Web of Conferences*, 316, 2014.
- Shintira, B. R. (2021). *Analisis Proses Dan Performansi Blood-Supply Chain Dengan Pendekatan Supply Chain Operation Reference (Scor) 12.0 Pada Pmi Kabupaten Bantul*.
- Supriyati, N. (2015). Metode Penelitian Gabungan (Mixed Methods). *Widyaiswara BDK*, 4(1), 1–24.

SUWITO, W. H. (2022). *Peningkatan Kinerja Asset Management Efficiency Dengan Model Supply Chain Operations Reference (Scor) 12.0 (Studi Kasus: Pt. Kobexindo Tractors, Tbk)*.



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