SUPPLY CHAIN PERFORMANCE MEASUREMENT USING SCOR RACETRACK ON SUMBER BAJA PERKASA METAL CASTING COMPANY (STUDY CASE: CV. SUMBER BAJA PERKASA, KLATEN)

UNDERGRADUATE THESIS

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AUTHENTICITY STATEMENT

For the sake of Allah SWT, I admit this work is the result of my own work except for the excerpts and summaries from which I have explained the source. If in the future it turns out that my confession is proven to be untrue and violates the legal regulations in the paper and intellectual property rights, then I am willing to get a diploma that I have received to be withdrawn by the Islamic University of Indonesia.

Yogyakarta, April 19, 2022

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UNDERGRADUATE THESIS APPROVAL OF SUPERVISOR

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Has been defended in front of Examination Committee in Partial Fulfillment of the Requirement for Bachelor Degree of Industrial Engineering Department Universitas Islam Indonesia

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DEDICATION PAGE

This undergraduate thesis that spent a lot of time and resources is dedicated to my family, especially Bapak, Ibu, Bude Nur, Mba, and Adek that always support me in any situation and condition.

To all my best friends who always share happiness and sadness to each other.

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Dr. Ir. Elisa Kusrini, M.T., CPIM., CSCP.

MOTTO

"Learning is not attained by chance, it must be sought for with ardor and attended to with diligence."— Abigail Adams

PREFACE

Assalamu'alaikum Warahmatullahi Wabarakatuh.

Alhamdullillah, all praise to Allah SWT, because only with his permission the author can finish the undergraduate thesis. Shalawat and greetings to the Prophet Muhammad SAW who has to save the mankind from the jahiliyyah era to the Islamiyah era and also give syafa'at into Yaumul Akhir.

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The author realizes this undergraduate thesis cannot be said as perfect, so the author appreciates if the reader gives critics and recommendation. The author hopes that this report can give many benefits to all parties.

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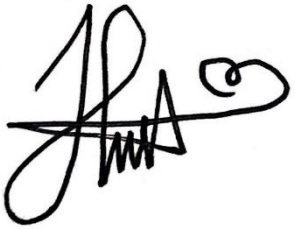
Yogyakarta, March 21, 2022



Alma Fitria Milania

ABSTRACT

The industrial sector has a great impact on the Indonesian GDP especially the metal industry. Metal casting companies must be able to compete in the market with an increasingly advanced industrial revolution that makes the market more competitive. There are lot of challenges and opportunities faced by the metal industry and one of those is the supply chain. The supply chain here is related to the flow of goods and information from upstream to downstream. With an effective and efficient supply chain, the company is able to compete with other companies and has a competitive advantage. This paper aims to assess the supply chain performance on the CV. Sumber Baja Perkasa, metal casting company, that located in Ceper, Klaten. In assesing the supply chain performance, the researchers used SCOR12 and SCOR Racetrack as a tool. By using SCOR12, the researcher can measure the supply chain performance based on several attributes and SCOR Racetrack as a tool and framework to calculate the gap between the actual and target. The researcher discovered an issue with product delivery delays and a discrepancy in the number of orders. The SCOR measurements indicate that there is a concern with reliability. According to the supply chain performance calculation on SCOR employing level 3 of the reliability attribute, there is 68.5 percent delivery quantity accuracy, 46.1 percent customer commit date achievement time customer receiving, and 92.4 percent delivery location accuracy. Human mistake, restricted manufacturing capacity, miscalculation, a scarcity of raw materials, and data difficulties are the primary causes of the gaps in those three elements. The issue that must be prioritized in this case are production capacity. Projects tha can be implemented is production planning such as forecasting, master production schedule, material need planning, and capacity available, which are proposed to overcome the production capacity.

Keywords: *metal casting company, supply chain, SCOR12, SCOR Racetrack.*

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INTRODUCTION

1.1 Background

The industrial sector still provided the largest contribution to the structure of the national gross domestic product (GDP) throughout the second quarter of 2020, reaching 19.87 percent (Kementrian Perindustrian Republik Indonesia, 2020). It is undeniable that industrialization provides a positive impact on the economy in Indonesia. In other words, industrial sector manufacturing has emerged as the dominant value-added contributor and has grown rapidly to keep pace with the growth rate of the agricultural sector (Kementrian Perindustrian Republik Indonesia, 2019). Furthermore, the metal industry expanded 5.57 percent last year and is predicted to rise 2.02 percent this year, according to Minister of Industry, Agus Gumiwang Kartasasmita. As a result, the government is resolved to continue protecting the metal home industry against the infiltration of foreign goods. The Ministry of Industry will boost the performance of the metal industry so that it can contribute significantly to the national economy. Furthermore, demand for metal is rising in both the domestic and international markets. The metal industry is said to be a high-resilience sector that has survived the Covid-19 epidemic and is set to strengthen its capabilities and performance this year. It can be seen that the industry has a great contribution even though it is in the midst of this COVID-19 pandemic (Ayu, 2021).

In Indonesia, there are many small and medium enterprises (SMEs) engaged in the steel industry, one of which is the metal casting industry. Opportunities and challenges faced by small and medium enterprises in the metal creative industry became increasingly complex as the industrial revolution advanced. It is essential to develop a strategy to maintain a properly integrated collaboration among parties to promote mutual goals (Sholeh, Wibowo, & Sari, 2020).

Ceper, Klaten became the center of the metal casting industry which was established in 1935. This made the metal casting industry sector a contributor to village income and became

the main livelihood for villagers. Based on data on the number of metal casting industries in the Ceper in 2019, the most metal casting industries are located in the Tegalrejo and the Ngawonggo village (Dinas Perindustrian dan Tenaga Kerja Kabupaten Klaten, 2019). From year to year the metal casting industry has decreased due to the difficulty of raw materials and the COVID-19 pandemic make it worse. One of the companies is CV. Sumber Baja Perkasa that located in Ngawonggo, Ceper.

CV. Sumber Baja Perkasa produces various kinds of goods. The variety of production goods reaches 1000 kinds of goods. Of the 1000 kinds of goods, such as pipe fittings, pulleys, and agricultural equipment spare parts. The company implemented a make-to-stock strategy where the company already produces the product before the order comes in.

CV. Sumber Baja Perkasa experienced a problem that often occurs every year, which is delay in delivery in product's delivery caused by production capacity. Since CV. Sumber Baja Perkasa only has the capacity of under 10,000 units per month while the number of demands is uncertain. So, when there is an order of more than 10,000 units, there will be a delay in delivery since the stock also cannot cover the demand. Not to mention the defective goods which made it worse, defective goods are sorted in almost every manufacturing process so that the defect is certainly not worthy of being sent to the customer. Of course, it reduces the number of finished goods. Therefore, to fulfill the number of orders, the delivery of goods must be delayed.

The competitive business environment requires companies to be able to improve their systems so that they are able to meet consumer demands on time and with predetermined quantity and quality. Furthermore, CV. Sumber Baja Perkasa is located in the metal foundry industry where competition for customers and project tenders is very high. This causes the company to improve work performance.

As the competition increases in the foundry area, CV. Sumber Baja Perkasa must improve the process by modelling the supply chain to see improvements for the efficiency and effectiveness of the supply chain. In supply chain management, performance management and continuous improvement are considered fundamental aspects. Therefore, the company needs a measurement system capable of evaluating supply chain performance.

The performance of the manufacturing company chain system is the totality or unit performance consisting of suppliers, vendors and distributors (Kim, 2006). Responsiveness and efficiency are characteristics that describe dynamic supply chain performance so that they are able to adjust to any changes that occur in supply and demand. Harmonization between performance and supply chain management is important so that supply chain activities can work properly and correctly. Unsold inventory and unfulfilled client orders are the results of inefficient supply chains, putting a profitability of a company and competitive advantage at risk (Angeleanu, 2015) (Datta, 2017) (Kiroyska, Josifoyska, & Kiselicki, 2016) (Liotta, Stecca, & Kaihara, 2015).

Supply chain management has emerged as a critical approach for businesses seeking to increase profitability and remain competitive (Li, Ragu-Nathan, Ragu-Nathan, & Rao, 2006). Furthermore, Supply chain performance evaluation is an essential component of a company's management, without which it would be difficult to describe the effects of supply chain management decisions, the direction of its operational outcomes, and the actions that must be made to enhance the efficacy (Narkuniene & Ulbinaite, 2019). The most popular and most widely employed for measuring the performance is Economic Value Added (EVA), balanced scorecard (BSC), performance prism, seven sink, performance maturity, performance pyramid, six sigma, SCOR, and multicriteria performance measurement.

In this research, performance measurement will be carried out using the SCOR12 method in CV Sumber Baja Perkasa which supplies spare parts and agricultural equipment. Supply Chain Operations Reference (SCOR) is a chain performance measurement approach method supply especially in a company (Supply Chain Council, 2012). The Association for Operations Management (APICS) developed the SCOR Model, which tests SCOR by business process and performance (Kusrini, Caneca, Helia, & Miranda, Supply Chain Performance Measurement Using Supply Chain Operation Reference (SCOR) 12.0 Model: A Case Study in A A Leather SME in Indonesia, 2019). With the SCOR model, every activity in the company's business process may be measured in detail, from upstream to downstream. SCOR gives a fundamental process to assess supply chain operations for a firm (Persson, 2011). Furthermore, SCOR possesses the traits required to manage business activities in

order to fulfill customers' demands. SCOR is frequently updated to reflect changes in supply chain business processes. As a result, SCOR is more appropriate for various industries than other techniques of monitoring supply chain performance (Kusrini, Rifai, & Miranda, Performance Measurement using Supply Chain Operation Reference (SCOR) Model: A Case Study in a Small-Medium Enterprise (SME) in Indonesia, 2019).

SCOR offers a complete set of measures at three different levels. However, SCOR does not provide detailed instructions on how to calculate these metrics and how to use them in practice. This will lead to misunderstanding in the application of SCOR. Benchmarking results from different SCOR implementers may not be comparable due to differing metrics interpretations and, as a result, different computations.

From the shortcomings of the SCOR model method, APIC proposed a framework or procedure called SCOR Racetrack. SCOR Racetrack is a way that companies can communicate with a framework that describes the supply chain in detail, defines and categorizes the processes that build metrics or measurement indicators needed in measuring supply chain performance (APICS, 2017). SCOR Improvement Program Racetrack is an improvement program derived from SCOR 12.0 that serves as the foundation for constructing further improvement programs. By adding fishbone diagrams, the researcher can identify the root cause of the problems that making gap in supply chain performance and can be the reason in proposing the improvement project.

For CV. Sumber Baja Perkasa, by measuring the supply chain management performance using SCOR12, business and supply chain leaders, can solve the challenge of meeting the customer commitment date and increasing the supply chain productivity. By solving these problems, the goal of improving the company's performance will be achieved. In solving the existing problems, it is hoped that there will be output in the form of proposed detailed guidance and procedures on improving the company's performance as a suggestion. Thus, it obtained an integrated measurement between suppliers, internal companies, and consumers of the Supply Chain Management.

1.2 Problem Formulation

Based on the background, the problem formulation that can be made are:

1. What type of attributes on SCOR need to be improved by the CV. Sumber Baja Perkasa?
2. How to improve the supply chain performance at CV. Sumber Baja Perkasa based on SCOR findings?

1.3 Research Objective

Based on the problem formulation, the objectives to be achieved through this research:

1. Identifying the performance attributes on SCOR that need to be improved by the CV. Sumber Baja Perkasa.
2. Providing recommendations and suggestions for CV. Sumber Baja Perkasa on how to improve their supply chain performance based on SCOR findings.

1.4 Scope of Research

There are several limitations of internship that must be known as guidelines in carrying out this undergraduate research. the limitations of this undergraduate research are:

1. The research was conducted at CV. Sumber Baja Perkasa.
2. The method used is the SCOR Racetrack based on version model 12.0.
3. The KPI used is the following the current situation at the company.
4. The data were obtained through observation and interviews at CV. Sumber Baja Perkasa.
5. The data were taken from October to December 2021.

6. The analysis result will be provided as the recommendation and suggestions for CV. Sumber Baja Perkasa

1.5 Benefit of Research

The benefits of the research that will be obtained can be used by many parties with the following details:

1. For College Students, this research is expected to provide with applied theory and its relevance as a preparation before entering the world of work and as to measure the abilities or skills to gain new experience or skills.
2. For the government, this research is expected to be able to become a reference for improving the performance of a business or industry so that more people interested to build businesses and give impact on economic development in the community.
3. For the company, this research is expected to be able to help in solving existing problems in the company, according to the scientific capacity of the student concerned. and familiar with the scientific profession of Industrial Technology, especially in the field of Industrial Engineering.
4. For next researchers, this research is expected to become future reference and will be developed more by future researchers who have some interest with this undergraduate thesis.

1.6 Systematic of Research

this undergraduate research will be organized into several chapters which will be explained below:

CHAPTER I INTRODUCTION

The introduction contains the background for the undergraduate thesis and the problem formulation, besides that it also contains the

objectives of the research, the scope of the research, and the benefits of the research.

CHAPTER II LITERATURE REVIEW

This chapter 2 will summarize the findings from the prior studies and research which are relevant with this research. After reviewing the prior studies and research thoroughly, it will become reference for this undergraduate research to resolve the existing problem.

CHAPTER III METHODOLOGY

This section describes the framework, flow chart, and data collection method of this undergraduate research. This will help to make the research more structured and organized. Here, the flow of the research will be explained in detail so that the readers can understand the research methodology.

CHAPTER IV DATA COLLECTION AND PROCESSING

This chapter describes the data collection in the form of an overview of the company organization, problem issues, and sales quantitative data to be further processed based on the SCOR Racetrack model version 12.0 to become a proposed performance improvement project in the company.

CHAPTER V RESULT AND DISCUSSION

The outcomes of this research will be discussed in chapter 4. The result of the research will be analyzed subjectively using theoretical explanations and statistically based on the research findings and studies. The findings needed to satisfy the research objectives. Based on the analysis in this chapter, there will be recommendations on how to improve the supply chain of the metal casting company.

CHAPTER VI CONCLUSION AND SUGGESTION

Chapter 6 is a closing that contains conclusions and suggestions regarding the undergraduate thesis. The conclusion is made based on the result and discussion, also must answer the objective of the research.

CHAPTER 2
LITERATURE REVIEW

2.1 Empirical Study

2.1.1 Supply Chain

A supply chain is a series of networks of companies that work together to create and deliver a product to the end-user. The companies in question are a supplier, factory, distributor, shop or company retail, as well as supporting companies such as logistics service providers.

Meanwhile, according to Tyagi, 2014, a supply chain is a system in which the organization distributes its goods and services to its customers or end-user. This chain is also a network or network-formed of various interconnected organizations that have the same goal, namely as best as possible to organize procurement and distribution the item.

Furthermore, Chopra and Meindl (2013: 13) argue that the supply chain consists of all parties involved to meet customer demands and generate profits. The supply chain consists of manufacturers, suppliers, transporters, warehousing, retailers and customers themselves. The supply chain has a dynamic nature but involves three constant flows, namely the flow of information, products and money.

So, it can be concluded that a supply chain is a chain that connects upstream parties to downstream parties, from the raw materials up to finished goods, that consists of suppliers, manufacturers, warehousing, transporters, retailers/distributors, and end customers.

2.1.2 The Component of Supply Chain

According to Turban, Reiner, & Porter, 2004, there are 3 kinds of supply chain component, namely:

1. Upstream Supply Chain

The actions of a company's manufacturers with its distributors (which might be manufacturers, assemblers, or both) and their links to their suppliers are included in the upstream supply chain (second-trier dealers). Supplier ties can be extended over multiple layers, all the way down to the material's origin. Procurement is one of the most important operations in the upstream supply chain.

2. Internal Supply Chain Management

   All of the processes for entering items into the warehouse that are utilized to turn inputs from suppliers into the organization's outputs are considered part of the internal supply chain. This goes beyond the amount of time spent in the organization. Production management, manufacturing, and inventory control are the most important concerns in the internal supply chain.

3. Downstream Supply Chain

   All operations that entail transporting the product to the end client are included in the downstream (estuary) supply chain. Distribution, warehousing, shipping, and after-sales support are all important parts of the downstream supply chain.

2.1.3 Supply Chain Management

According to Pujawan (2005), the concept of supply chain management is an integrated approach to managing the flow of products, information, and money that involves parties from upstream to downstream, including suppliers, factories, distribution networks, and logistics services to the hands of end consumers. According to Lu (2011), supply chain management is a collection of interconnected enterprise involvement that provides value to the flow of constantly changing inputs. Their origins may be traced back to the final product or service that the intended end user requires. A supply chain is established and can only be formed if there are several companies involved.

2.1.4 The Purpose of Supply Chain Management

The main purpose of the existing supply chain management according to APICS (2015), is to assist companies in:

1. Add value for customers and stakeholders
2. Improve customer service
3. Effective use of resources
4. Efficient use of resources
5. Increase partner strength

2.1.5 Benefits of Supply Chain Management

According to Jebarus (2001) cited by Widyarto (2012) the application of the SCM concept in the company will provide the following benefits:

1. Customer Satisfaction

   Consumers, or product consumers, are the primary focus of the company's manufacturing process operations for each product it produces. The consumers or customers mentioned in this context are, of course, long-term devoted clients. Consumers must first be happy with the company's services in order to become loyal.
2. Increased Profits

   The more devoted customers and partners a firm has, the more revenue it generates, ensuring that the company's products are not "wasted" since they are in demand.
3. Increased Income

   The company's earnings will rise as the number of devoted customers and users of the product increases.
4. Decrease Cost

   Reduced expenses on distribution channels are another benefit of integrating the product flow from the manufacturer to the ultimate or final customer.
5. Asset utilization is getting higher

Human resources, in particular, will be more trained and competent in terms of knowledge and abilities. Human power will be able to enable the use of advanced technology, which is necessary for SCM deployment.

6. The company is getting bigger

   Companies that benefit from the process of distributing their products gradually will become big, and grow stronger.

2.1.6 Supply Chain Performance Measurement

Measuring supply chain performance is crucial when creating a supply chain. Supply chain performance measurement is the process of determining the efficiency and effectiveness of the supply chain (Sillanpaa, 2011). Furthermore, Supply Chain Performance Measurement is a scheme that helps a formal definition of the Supply Chain performance model based on mutually agreed upon goals, measures, and measurement methods that specify procedures, responsibilities, and accountability of Supply Chain participants, as well as Supply Chain participant regulation of the measurement system (Eccles & Pyburn, 1992).

Performance measurement gives the information required for management feedback to decision-makers. Performance measurement is a method of determining the success and potential of management methods as well as enhancing comprehension of the issue. It aids in focusing management attention, updating company objectives, and reengineering business processes. SCM may be improved with the use of performance measurement (Chan, 2003).

2.1.7 Supply Chain Operation Reference (SCOR)

In 1996, the Association for Operations Management (APICS) developed the SCOR Model, which measures the business process and performance. The process is defined by plan, source, make, deliver, return, and enable operations, while performance is defined by corporate dependability, responsiveness, agility, cost, and asset management level (APICS, 2017). This SCOR Model is an approach for measuring supply chain performance in an industry, as well as for management, business processes, and how a firm responds to market

demand. The variables and features of the SCOR Model have also changed as a result of alterations to the industrial realities or circumstances (Kusrini, Caneca, Helia, & Miranda, Supply Chain Performance Measurement Using Supply Chain Operation Reference (SCOR) 12.0 Model: A Case Study in A A Leather SME in Indonesia, 2019)

2.1.8 SCOR Performance

SCOR's performance segment focuses on the measurement and evaluation of supply chain process execution results. Three components comprise a complete method for analyzing, evaluating, and diagnosing supply chain performance: Performance Attributes, Metrics, and Process / Practice Maturity. Elements, as opposed to Levels in the Process and Metrics hierarchy, define many elements or dimensions of performance (APICS, 2017):

1. Performance Attributes
   Strategic supply chain performance characteristics are used to prioritize and integrate supply chain performance with company strategy.
2. Metrics
   Distinct performance measurements are made up of layers of linked hierarchy.
3. Process/Practice Maturity
   A reference tool was used to evaluate how well supply chain processes and practices integrate and implement acknowledged optimum process models and leading practices.

Table 2.1 Performance Attribute

Performance Attribute	**Definition**
Reliability	The capacity to complete things in the desired manner. The predictability of a process's outcome is the emphasis on reliability. On-time delivery, the appropriate quantity, and the proper quality are common indicators of dependability characteristic.

Performance Attribute	Definition
Responsiveness	The rate at which tasks are completed. The rate at which a supply network delivers goods to a client. Cycle-time measurements are one example.
Agility	The capacity to adapt to external factors, as well as changes in the marketplace, in order to achieve or retain a competitive edge. Adaptability and Overall Value at Risk are two SCOR Agility measures.
Costs	The cost of running supply chain procedures. This comprises labor, material, managerial, and transportation expenditures. The cost of Goods Sold is a common cost measure.
Asset Management Efficiency (Assets)	The capacity to make efficient use of assets. Inventory minimization and in-sourcing vs. outsourcing are two asset management techniques in a supply chain. Inventory days of supply and capacity utilization are two metrics.

There are one or more level-1/strategic metrics for each Performance Attribute. These level-1 metrics are the calculations that a business may use to determine how effective it is in reaching its target market positioning. SCOR metrics are arranged in a hierarchical order. SCOR defines measurements at three levels: level1, level2, and level 3. The interactions between these levels are diagnostic. Level-2 metrics act as checkpoints for level-1 measurements. This means that performance gaps or gains for level-1 metrics may be explained by looking at the performance of level-2 measures. This sort of supply chain performance analysis is known as metric decomposition or root-cause analysis. Level-3 metrics, similarly, act as diagnostics for level-2 metrics. The level of a measure is contained in the metric's codification.

2.1.9 SCOR Race Track

The SCOR Racetrack model explains how to put together a SCOR improvement program that incorporates the SCOR process and supporting methods. The approach is broken down into five separate steps (APICS, 2017):

1. Pre-SCOR (Pre-Scoring) Program

   Prepare the organization for the SCOR improvement program, which is mission important.
2. Set the scope of the project

   For a SCOR improvement initiative, understand the business environment and determine the extent of the supply chain.
3. Configure the Supply Chain

   Determine the SCOR improvement program's performance metrics and methods.
4. Optimize Projects

   Create a project portfolio that includes the process scope, priority, and expected benefits.
5. Ready for Implementation

   Implement the portfolio's initiatives and start reaping the advantages.

Figure 2.1 SCOR Racetrack

(Source: APICS, 2017)

2.1.10 Fishbone Diagram

A Fishbone diagram is also called a cause-and-effect diagram (Scavarda, A. J.; et al, 2004). A cause-and-effect diagram, also known as a Fishbone diagram, is a visual approach that may be used to locate and evaluate influencing elements when determining the features of job output quality. This diagram can be useful for figuring out what's causing an issue (San, Tjitro, & Santoso, 2003). The emphasis of a cause-and-effect diagram is on an issue or a symptom of a problem. This diagram may also be used to highlight the sources of an issue by grouping them together (Slameto, 2016).

Fishbone diagrams are also often referred to as Ishikawa diagrams. This diagram is called the Ishikawa Diagram because it was developed by Dr. Kaoru Ishikawa in the 1960s. When looking at the diagram, the fishbone's shape resembles that of a fish, which has a head (as an effect) and a body made up of bones, which are depicted as sources of recognized issues (Slameto, 2016).

2.2 Inductive Study

The inductive review consists of previous literature that correlate with this current research that talks about supply chain performance measurement using SCOR Race Track in manufacturing company. So, here is the inductive review of previous literature:

Table 2.2 Inductive Study

No	Author	Title	Research Method	Result
1	Haydar Yalcin, Wanying Shi, and Zafrin Rahman	A Review and Scientometric Analysis of	The scientometric. Supply chain management.	In this study, a literature review related to supply chain management was carried out and was published between 1998 and 2017. SCM is an

No	Author	Title	Research Method	Result
		Supply Chain Management		interesting topic because of its enormous impact on a business. Based on the literature review, the optimal SCM can increase the productivity of a business which can ultimately increase profits.
2	Aziz Muysinaliyev and Sherzod Aktamov	Supply Chain Management Concepts: Literature Review	Conceptual and empirical work. Supply chain management.	According to a review of the literature, SCM theory and practice research has increased significantly. The components of supply and distribution management are integrated and informed. As a result of this integration, the concept of extended enterprise has formed, and the supply chain has evolved into a collaborative supply chain that transcends inter-company borders in order to maximize value throughout the whole supply chain. According to

No	Author	Title	Research Method	Result
				a review of the literature, SCM theory and practice research are on the rise. The concept of extended enterprise has evolved as a result of this integration, and the supply chain is now portrayed as a collaborative supply chain that transcends intercompany borders to optimize value across the supply chain.
3	Arawati Agus	Supply Chain Management: The Influence of SCM on Production Performance and Product Quality	Reliability and validity tets, smart PLS model. Manufacturing business.	SCM has a large and beneficial impact on production performance. Furthermore, SCM has a substantial and beneficial impact on product quality. The findings also show that the production performance construct mediates the connection between SCM and product quality to some extent. 'New technology and innovation,' followed by

No	Author	Title	Research Method	Result
				'strategic supplier relationship,' and 'quality information sharing,' emerge as the most significant element that improves the production performance and product quality among SCM methods
4	Sudaryanto and Rudiana Bahari	Performance Evaluation of Supply Chain Using SCOR Model: The Case of PT. Yuasa, Indonesia	SCOR model. PT. Yuasa, Indonesia.	The empirical findings of the supply chain performance measurement using the case of PT. Yuasa Indonesia show that the firm is the best in its class in terms of dependability (delivery performance, fill rate) and the warranty return cost. Two qualities, namely production flexibility and value-added employees, are still performing moderately, while the remaining attributes are performing well.

No	Author	Title	Research Method	Result
5	Agustina Bidarti, Dwidjono Hadi Darwanto, Slamet Hartono, Jamhari	Supplier Structure and Performance Evaluation of Supplier Network Phase Rice Supply Chain Management in South Sumatra	SCOR model and OMAX. Rice Supply Chain in South Sumatra.	The total index value is7.28, or in the yellow category, based on the weighting result of the OMAX scoring system, indicating that the performance of LICM rice-industry company in South Sumatra has not met expectations in terms of the rice supply chain, despite the fact that the result is close to the pre-determined target.
6	Nadifa Yusrianafi and Said Salim Dahda	Performance Measurement in Kerudung SME Using Supply Chain Operator Reference (SCOR) Model and AHP	SCOR model and AHP. Kerudung SME.	t. For KPIs, there are 30 matrix indicators (Key Performance Indicator). Using the Expert Choice 11 Software, create an acceptable starting hierarchical model for SMEs Kerudung, then calculate the normalization and calculate the AHP to determine the weight. The source performance value

No	Author	Title	Research Method	Result
				of 28.65918439 has the most effect on the core process, while the enable performance value of 4.7 has the least.
7	Rahmat Akmal	Arrangement and Supply Chain Performance Measurement Using SCOR Method and AHP in PT. BSI Indonesia	SCOR and AHP. PT. BSI Indonesia.	The supply chain performance measurement, which took place from July to December 2014 and was weighted using AHP, yielded a total score of 86.26 on a scale of 0 to 100. This result indicates that PT BlueScope Steel Indonesia's overall performance is strong since it has good cooperation in all areas.
8	Wafiah Murniati, Wahyu Ismail Kurnia, Sela Handayani, Suar Ishak	Supply Chain Performance Measurement on Craft Industry SME (Case Study: Ketak Craft	SCOR Model and Analytic Hierarchy Process (AHP) Ketak Craft Industry.	The Perfect Order Fulfillment indicator has a value of 83.40 percent, with a wide percentage difference of 17.60 percent between it and the goal value of 100 percent. The presence of orders issued

No	Author	Title	Research Method	Result
		Industry, Central Lombok, West Nusa Tenggara, Indonesia)		not in accordance with the number of orders, the existence of orders received by customers, the presence of damaged goods received by consumers, and the return of items due to damaged and defective products are the most significant indications.
9	Mario Coccia	The Fishbone Diagram to Identify, Systematize and Analyze the Sources of General Purpose Technologies	Fishbone diagram. Genral Purpose Technologies (GPTs)	The fishbone diagram appears to be an acceptable and broad graphical representation approach for exploring and categorizing the probable underlying causes of technological innovation progression for proper technology management
10	Slameto	The Application of Fishbone Diagram Analysis to Improve	Fishbone diagram and descriptive analysis.	The school quality improvement program fish bone analysis went through six stages of development, and the research product based on

No	Author	Title	Research Method	Result
		School Quality	School Quality.	the fish bone diagram proved to be easy, relevant, important, controllable, and adaptable. It is also communicative, therefore it is proven successful and efficient in helping the school enhance its instructional quality.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Research Object

The research object is to improve the performance of the supply chain process using the Supply Chain Operations Reference (SCOR) Racetrack with newest model of SCOR, SCOR 12.0. The data used in this research is obtained from interviews and observations of the supply chain process in CV. Sumber Baja Perkasa. This research aims to improve the performance of supply chain processes in CV. Sumber Baja Perkasa that located in industrial area, Ngawonggo, Ceper, Klaten.

3.2 Research Instrument

The research instrument that will be used in this research is a questionnaire. The questionnaire will be used to interview the owner and manager at CV. Sumber Baja Perkasa. The Questionnaire will be an instrument to obtain the data that will be needed, supply chain assets.

3.3 Data Collection Method

There are two types of data used to support this research, primary and secondary data. Those two types of data have different data collection method. The following explains regarding the data used and the data collection method.

3.3.1 Primary Data

According to Ajayi, 2017, priary data is information gathered for the first time by the researcher to solve the problem at hand. Surveys, observations, tests, questionnaires, and personal interviews are also examples of key data sources. The researcher will conduct an interview with the owner and manager of CV. Sumber Baja Perkasa to obtain some

information and data that is needed for this research. The scope of the interview covers supply chain assets, business process, and sales data. The data and information are already obtained will be transferred from qualitative into quantitative data.

3.3.2 Secondary Data

According to Martins & Serra, 2018, secondary data refers to information that has already been gathered, produced, and accessed by other researchers. Previous literature such as books, journals, articles, and other publications used to support this research.

3.4 Data Processing Method

SCOR Racetrack Model describes how to utilize the SCOR mechanism and associated methods to organize a SCOR improvement campaign. This technique includes five phases: Pre-SCOR, Set the Scope, Configure the Supply Chain, Optimize Project, and Ready for Implementation (APICS, 2017).

1. Based on observations and interviews at CV. Sumber Baja Perkasa, identify the backdrop of the company's challenges, expectations, efforts undertaken, an overview, and organizational structure.
2. Create a business context summary backed by a SWOT analysis to establish where the SMEs stand in relation to the market.
3. Assemble the Supply Chain Definition Matrix based on quantitative data such as selling capability, production, suppliers, and demand, among other things.
4. Create a geographical map of the SME, including the locations of suppliers, manufacturing, customers, warehouses, and other facilities.
5. Based on the issues that arose in SMEs, the performance attribute selection was carried out by first selecting the SCOR level 1 performance metrics and then constructing the level 2 metrics of the selected performance characteristics.
6. Develop detailed metrics data gathering methods that rely on observation and interviews.

7. Perform the benchmarking on business data, corporate objectives, or specific data for a more thorough gap analysis accompanied by a thread diagram.
8. Modeling should be done in the form of a level 3 process workflow.
9. Using a fishbone diagram, determine the sources of gaps.
10. By using the Pareto diagram, create comprehensive metric gaps using a quantitative technique to obtain performance improvement choices.
11. Discover performance issues in the performance issue worksheet and grouping issues that are related or have the same character to get a list of improvement projects from the grouping.
12. Perform a production planning from forecasting the demand and then into the aggregate planning to know which strategy that is appropriate to be implemented by the company to meet the demand of the customer. Then come in to the production capacity such as Master Production Schedule (MPS), Material Requirement Planning (MRP), and Capacity Requirement Planning (MRP).
13. Perform estimations in the form of suggestions for priorities, infrastructure, and other items that will aid in the execution of the planned improvement initiatives. The performance estimate serves as the foundation for the proposed project. The best project alternative will be executed in CV. Sumber Baja Perkasa to close the gap that has previously been recognized.

3.5 Data Analysis Method

The descriptive analysis technique is a statistic used to analyze data by describing or summarizing the data that obtained as they are without the intention of drawing generalizable conclusions or making generalizations (Sugiyono, 2014). Some data in this study may be gathered qualitatively, but it is frequently examined quantitatively, with frequencies, percentages, averages, or other statistical analyses used to identify correlations. The qualitative input will subsequently be translated into numerical data for comparison and assessment.

3.6 Research Flowchart

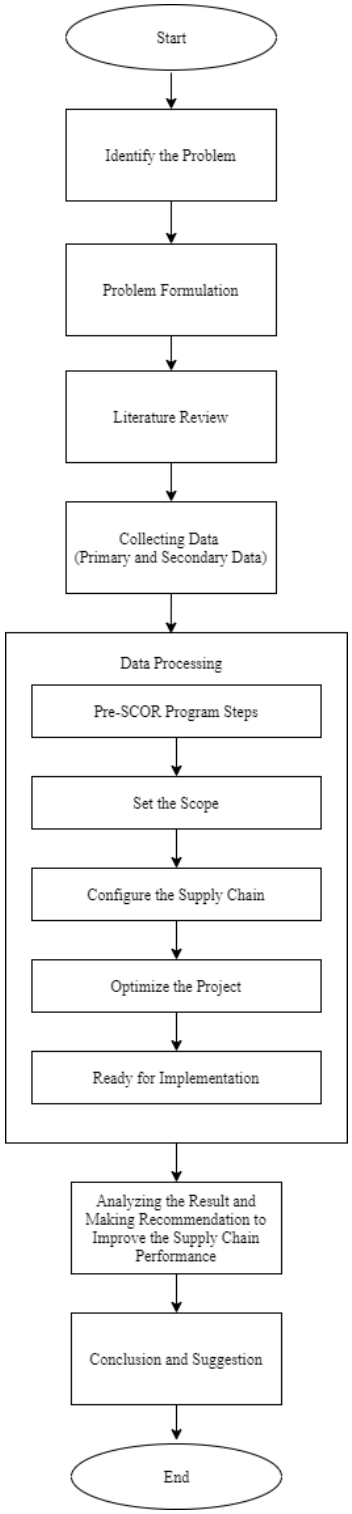

Figure 3.1 Research Flowchart

Based on Figure 3.1, the research flow will be explained further:

1. Problem Identification

   The identified problem can be found out through preliminary observations and interviews. The identified problem is the issue that will be researched and focused on this research to solve.

2. Problem Formulation

   Determining the problem aligned with the arising problem or identified problem regarding the supply chain in CV. Sumber Baja Perkasa. The problem formulation is the issue that need to be resolved and answered in this research.

3. Literature Review

   Finding the research as a reference about this arising problem. The literature reviews support the research by citing the recent research related to the supply chain performance measurement. The literature review can be books, journals, and recent research. The study case can be an empirical study and inductive study.

4. Data Collection

   For data collection, this study uses two types of data, namely primary and secondary data. Primary data are obtained directly by observing the object, interviews, and questionnaires. For the interview itself, the data obtained will be in the form of qualitative data. While secondary data are obtained from reviewing or quoting literature or previous research relevant to this research. Data collection starts from company profiles to supply chain activities in the company. This supply chain activity data is the main key in this research.

5. Data Processing

   a. Pre-Score Program Steps

      In the pre-score program, these steps are the preparation stage before entering the SCOR Racetrack. Here the researcher will identify the company profile, activities and problems that exist in CV. Sumber Baja Perkasa in terms of performance in its supply chain. This step will be broken down into three phases:

      1) Identify Improvement Motivation

In the first stage in the pre SCOR the researcher altogether with the main board of the company of CV. Sumber Baja Perkasa determine what needs to be developed. At this stage it will also determine what method will be used during the project. This process will be analyzed regarding the conditions that occur at CV. Sumber Baja Perkasa and classify them into each category so it is easy to determine what performance should be developed, improved, and improved. Besides the performance analysis, at this stage, the material about SCOR 12.0 and how to run a project based on SCOR Racetrack approach are also delivered. These activities can be in the form of workshops or seminars to owners and employees at CV. Sumber Baja Perkasa.

2) Identify the SCOR Program Organization

The next stage is the development of an organization to handle the project when the main boards and employees fully grasp SCOR 12.0 and how to work on projects utilizing SCOR Racetrack. All components of CV. Sumber Baja Perkasa are represented in the organization in line with their respective fields and skills. The result of the organization's creation is to ensure the project's success as planned and serve as a supervisory role during the project's design, execution, and assessment.

3) Plan for the Next Phase

When the concept and supporting organizations have been established, the next stage is to determine whether or not the project will be realized. Some of the components that must be examined while making a decision are as follows:

- Calculation of the total cost (Cost Estimation).
- Scheduling for each project component (Scheduling).
- Resources and tools required (Resource and Requirement)

Decisions in determining the aforementioned components must be carefully calculated to help identify them utilizing the Project

Management technique. It is hoped that following rigorous study and computations, a decision about the viability of the project at CV. Sumber Baja Perkasa would be made.

b. Set the Scope

At this stage, an overview of the business environment and the extent of the supply chain for the SCOR improvement program are carried out. There are many major activities that must be completed while identifying the scope of the supply chain, namely:

1) Business Summary

The high-level summary of the business context and supply chain (from the company's perspective) the competitive rivalry that exists in it can use SWOT data to assess the business position or supply chain position, the business strengths, the company’s part is more dominant, the source of the data. Data can be obtained from stakeholders, financial statements, business plans, competitive analysis, and even credible sources when describing the business context, implying that the company wants to know how the current supply chain conditions in the company are.

2) Supply Chain Mapping

Identifying or visually mapping the supply chain, such as who the customer and market are; any products and services; who the supplier and channel partner are; what the marketing organization structure looks like, the procurement organizational structure, and the type of product service requested by the customer. The information was gathered from the following sources:

- Customers and markets are sourced from marketing, business development, and other customer-focused companies.
- Products and services derived from ERP and product management systems

- Suppliers and channel partners: who are the suppliers and where are they situated, according to the strategic sourcing and business development organization. This information is derived from master suppliers such as ERP, SRM, and logistics systems.

3) Prioritizing the Supply Chain

   The goal is for the SCOR team to recognize that not all supply chains will provide value or profit to a company; for example, there are a few supply chain networks that generate very high revenue, but there are also some that do not, so there must be a primary focus to sort according to significance. So, you may use quantitative supply chain criteria to decide ranking (Size; revenue; volume and margin; Complexity SKUs or number of goods sold; Strategic relevance, such as launching a branch market in another nation; cash consumption; risk; volume fluctuation).

4) Geographical Mapping

   Geographical representation of maps with the goal of:

   - Visualizing the complete extent of company activities.
   - Facilitating inventory visualization and information transfer among supply chain participants.
   - Making it possible to identify which items or service bundles are sold to which channel entities.
   - Including financial data can help determine where in the supply chain the highest sales revenue and profitability occur.
   - Linking SCOR procedures to supply chain entities.

5) Performance Data

   Collecting performance data (high-level data) related to the Supply Chain Improvement Program, as well as identifying performance GAPs and determining where the gap is determined to be in which position.

6) Defining Scope

The agreement that results from the present supply chain situation is defining the scope of the improvement program and obtaining an agreement as desired. The present supply chain situation is derived from the current performance matrix, and the gap is calculated from there.

7) Agreement

At each phase, you must determine whether or not what was discovered during the scope defining process, whether or not the research team agreed (go, no go choice), to make a decision for additional study or not because it has discovered areas for improvement.

c. Configure the Supply Chain

At this stage, the SCOR improvement program's performance metrics and methods are determined, with six-core activities and seven deliverables. The following are the six primary tasks:

1) Program for Improvement Commencement (meeting)

The purpose is to instill desire and passion in the company, as well as providing a broad overview of the SCOR program. The scope was established in the previous step. At this point, the game began. The kickoff meeting will consist of presentations on topics such as motivation, reasons for making SCOR, commitment, structure, and creating a scope overview, which we will then express to management during the kickoff meeting.

2) Select the SCOR performance attribute that will be used to assess supply chain performance.

The objective is to gain the support and commitment of both internal and external teams. The SCOR performance characteristic, which is used to quantify supply chain performance, is then chosen. After the kickoff, the next stage is to pick the performance from SCOR, the researcher may make a selection from the performance gaps (which we previously found), so that when choosing performance gaps, the

researcher can choose a gap based on consensus or standards. The purpose is to determine and select which measures will be used for improvement.

The first step is to educate the team. Metrics in SCOR 12.0 and those in the company's supply chain may differ. As a result, the definition, how to calculate, and the SCOR 12.0 model must first be understood so that when taking measurements, you have the correct baseline. The crew next compared the SCOR criteria to the field circumstances. As a result, there is an agreement between the company's measurements and those in the SCOR model. If it is not suitable, it must be modified, for example, since SCOR is of a universal type and cannot be customized.

Second, while determining performance, comparisons with rivals are conducted by comparing data with benchmarks or established standards. It is advised, however, that the measure to be improved be no more than 3 at level 1. Then a measure will be chosen, either based on the competitive position of the supply chain in which you wish to succeed or on management advice and team consensus. Aside from that, you may utilize benchmarks from related businesses to determine which gap is the most significant and which one you want to close. Data from level 2 must be acquired at the time of selection. Level 1 is selected, then level 2 is measured. Level 2 is measured to determine what the percentage of level 1 is.

3) Gather specific information.

   Identify the data owner, collect level 2 data, and then calculate the percentage value from level 1 that is displayed in the Metrics Data Collection table. The level 1 value is subtracted from the lowest level 2 value.

4) Benchmarking

Following the collection of data, the next stage is a benchmarking process against rivals or other standards, with the purpose of establishing targets and performance comparisons in an organization with comparable industrial organizations and the same type of process. Then, based on competitive analysis, the target metrics are set, namely parity (same) with 50 percent percentile, advantage (excellent) with 70 percent percentile, and superior (quality/very good) with 90 percent percentile.

5) Analyze the gaps

This stage is used to determine the present supply chain's status in relation to the aim; the purpose is to carry out the process of identifying priority metrics that will be carried out by the improvement process. Furthermore, the illustration method employs Thread Diagrams, modeling level 3 process workflow, fishbone diagrams to discover the sources of gaps, accumulating thorough gaps metrics, and deciding alternatives using Pareto diagrams.

6) Prepare for the next stage

At this point, the team must conduct a thorough decision-making process and approve the activities and resources that need to be enhanced.

d. Optimize the Project

At this stage, a list of all improvement projects completed in the previous stage is identified in order to assess the benefit costs of these projects, then identify the SCOR level 3 processes, then link the performance gaps to projects, and finally document the potential benefits or opportunities of each project. The next goal is to prioritize projects that need to be improved. This stage's outputs or deliverables are as follows:

1) The first project portfolio.
2) Projects for your portfolio.
3) The plan's last step is now ready for implementation.

The following are the implementation steps:

1) Make a note of any process faults or flaws that were discovered in the previous step.
2) Using a mix of SCOR methods, divide performance concerns into implementation tasks.
3) Connecting the advantages of each project.
4) Sort the projects using the impact, improvement, return to complexity, effort, and risk matrix from those with the greatest advantages to be picked and improved first.
5) Authorization and preparation for the next level, ready for implementation.

e. Ready for Implementation

Develop fundamental metrics chosen as best practices by merging level 3 and level 4 processes, then solve them in the form of designs chosen to be implemented as test, pilot, and roll out solutions. The team enters the implementation preparedness stage when the project has been decided upon by the project team, which primarily has advantages and has a high effect, and already has a timeline and priorities. The following are the stages:

1) Kicking off a project (a project that has been determined by the team).
2) Discussion based on the project charter (this activity is more specific than set the scope). Like the improvement project charter, which is more specific than setting the scope, because the improvement project is guaranteed at this point.
3) Create a project schedule.
4) Assembly in accordance with SCOR level 3 and level 4 processes based on best practices. If you already have a best practice method for project improvement, define it at level 3. The next section will go into further depth on level 4 processes that use best practices in existing successful sectors. Level 4 processes will be utilized as activities for process improvement.

5) Then, from the forecasting the demand for Pulley in CV. Sumber Baja Perkasa, it comes up with several methods. The method with minimum errors will be chosen.
6) Then, make several strategies for aggregate planning that have been consulted with the owner and manager of CV. Sumber Baja Perkasa. Choose the strategy of aggregate planning with the least cost.
7) Then, make master production schedule and material requirement planning to meet the demand. After that make capacity requirement planning to know the capability of production of the CV. Sumber Baja Perkasa.
8) Construct, test, pilot, and deploy solutions.
9) Just get started on the next project.

6. Discussion and Analysis

   Discussion and analysis will be carried out based on the result of the data processing. The analysis then will be used to make improvements to the supply chain performance. The improvement program will be the project in the SCOR Racetrack method.

7. Conclusion and Suggestions

   The conclusion is made to answer the objective of the research that has already been determined at the start. At the same time, the suggestions are accommodated as consideration and recommendations for future research regarding the same topics.

CHAPTER 4

4.1 Pre-SCOR Program Steps

4.1.1 Company Profile

Figure 4.1 CV. Sumber Baja Perkasa

Here is the company profile:

Company Name	:	CV. Sumber Baja Perkasa
Owner	:	H. Zainal Fanani
Form of Business Entity	:	CV
Product	:	Pulley, pipe fittings, and agricultural equipment spare parts
Raw Material	:	Scrapped metal, putty, paint, metal FC 20-25, Resin coated sand 8300
Production Location	:	Sentono 35/14 Ngawonggo, Ceper, Klaten Central Java 57465
Total Workers	:	110 workers

CV. Sumber Baja Perkasa is a National Private Company that was originally established in 1968 and is currently engaged in metal casting, producing a variety of Pulley, Pipe fitting with specifications for Cast Iron and Round Graphite Cast Iron (ductile). The

company was founded by H. Zainal Fanani who started as an agricultural and household service production company. Until now, the company has been able to market products throughout Indonesia. This company is located in Sentono, Ngawonggo, RT. 35 RW. 14 Ceper, Klaten.

4.1.2 Product

CV. Sumber Baja Perkasa produces various kinds of metal products such as the pulley, pipe fittings, tee, manhole covers and frames. CV. Sumber Baja Perkasa's pipe fittings products vary widely. Starting from bend, flange, collar, tee, reducer, joint, street box, meter box, clamp saddle, screen, bell mouth, DOP, adapter, dismantling joint, tapping sleeve, to other supporting accessories.

Those products still can be divided based on the model, function and specifications. For example, tee products have variants such as tee all socket, tee all flange, tee socket spigot with socket branch, tee socket spigot with flange branch, tee socket with flange branch and tee invert socket with flange branch.

In addition to the PDAM pipe connection products mentioned above, CV. Sumber Baja Perkasa also produces non-pipe fittings. One of the non-pipe fittings products is manhole cover and frame. For Pulley production, CV. Sumber Baja Perkasa also produces several types of the pulley, such as A1, B1, B2, and B3, with different sizes of ash and diameter.

4.1.3 Production System

The presence of a system and production management for the firm is a crucial step while carrying out the manufacturing process in order to ensure compliance with the company's procedures. The following is the workflow or phases of CV. Sumber Baja Perkasa production process:

1. Forecasting

   A forecast is a phase in which an event that will occur in the future is predicted. The previous information (data) can be used to determine the likelihood of a prediction. CV. Sumber Baja Perkasa forecast the demand for bends, tees, flanges, reducers, manhole covers and frames, and other Joint goods using a prediction method based on the average number of sales versus past product demands is one of the forecasting tasks performed. The prediction system used by CV. Sumber Baja Perkasa is used in all manufacturing operations, from raw material acquisition to machine maintenance.

   Forecasting methods conducted by CV. Sumber Baja Perkasa are quantitative and qualitative methods. The quantitative method itself is a moving average method. In practice, the results of the calculation of demand forecasting by the marketing department are submitted to the planning and production department to control and evaluate demand, market conditions, resources, the amount of safety stock that needs to be stored and to schedule production.

   CV. Sumber Baja Perkasaplans production capacity based on the capacity of the production machine and the quantity of consumer demand. A spin plan is a plan that is carried out to determine the number of products that have been produced for each week. The company cooperates with home metal craftsmen to overcome if there is an increase in demand in accordance with product specifications determined by the customer.

   In determining material planning, CV. Sumber Baja Perkasa does material planning based on aggregate planning data and the number of product requests. Procurement of materials or raw materials is one of the supporting processes for operational production activities. Responsible for the procurement of materials, namely the planning department. The planning department carries out ordering of raw materials with the approval of the Production Manager. The raw materials needed in the production process of CV. Sumber Baja Perkasa such as, Ferro Silicon, AS MDN thinner 20 Liter, Silica Sand, and Evamarine Paint.

2. Scheduling

   Scheduling is one of the activities that aims to ensure that every production activity, from the planning process to the delivery process, can run according to the time and

priorities that have been set. Scheduling carried out at CV. Sumber Baja Perkasa in the form of scheduling raw materials, scheduling production, and schedules machine maintenance. Raw material scheduling and production scheduling are made according to product demand at the beginning of the month and controlled every day. Scheduling of maintenance and machines is carried out in several periods, depending on the need for checking the machine. The following is the Standard Operating Procedure for planning scheduling production at CV. Sumber Baja Perkasa:

Table 4.1 Production Planning Procedure

	Production Planning Procedure		
	Document Number 1	Revision Number 0	Page 1/1
Standard Operational Procedure	Date of issue: 01/11/2021		
1. The marketing department submits a customer order in the form of an order letter/PO/Fax/Telephone to the production manager which is then forwarded to the head of the planning department. 2. The head of the planning section and the production manager check product specification data/product standards/technical drawings/product samples from customers. 3. The head of the planning section prepares for making patterns according to orders received if needed, makes new patterns for new orders. 4. The head of the planning department records orders received in the order book to prepare a production schedule as agreed. 5. The head of the planning department submits the production schedule to the production manager for approval. 6. Based on the agreed production schedule, the head of the planning section makes an order processing form, which is then given to the head of the			

foundry section, the cast operator on duty and the head of the machining section.

7. The head of the planning department monitors the casting process so that the casting process is in accordance with the order processing form.

3. Quality Management

CV. Sumber Baja Perkasa has a section called Quality Control (QC) which is responsible for checking all stages in the production process, reporting every result of the inspection to the director, and supervising any repair of the workpiece that does not work in accordance. This is done with the aim of every activity of checking raw materials, products, and finished goods that will be sent are guaranteed quality and have complied with specified requirements.

4. Procurement

There are several procurement processes or the procurement of raw materials carried out by CV. Sumber Baja Perkasa. The procurement process is carried out by the purchasing department after receiving order quantity information from the marketing department. After that do planning for purchasing raw materials is performed after getting a Purchase Order (PO) from the customer. After planning the purchase of raw materials, there is a supplier selection process, and list of suppliers for the purchase of raw materials. After that, evaluate the supplier performance, and monitor the Purchase Order to subsequently receive the sign form from the supplier. CV. Sumber Baja Perkasahas a special SOP for procurement of raw materials and supplier determination which can be seen in the table below:

Table 4.2 Standard Operation Process for Procurement

PROCUREMENT OF GOODS AND SERVICE		
Document Number 1	Revision Number 0	Page 1/1

Standard Operational Procedure	Date of issue: 01/11/2021

1. The head of the purchasing department receives a request for the procurement of goods/services from the part that needs it and is recorded in the request for goods.
2. The head of the purchasing department and the purchasing staff, check the status of the goods ordered in the stock card to ensure that the requested goods are not available in the warehouse.
3. The head of the purchasing department and staff record procurement requests in the purchase requisition form.
4. The head of the purchasing department and staff summarizes the purchase request in the purchase order (PO) form to the financial administration manager and director for approval.
5. Based on the approved purchase order (PO), the head of the purchasing department contacts the supplier in accordance with the order. Suppliers are selected based on a list of selected suppliers that are set.
6. The head of the purchasing department negotiates with the supplier for the goods to be ordered. If there is an agreement, then a purchase order (PO) is sent to the supplier.
7. Purchasing staff checks information about the arrival of goods at the material warehouse or auxiliary materials warehouse
8. The purchasing staff receives a receipt form from the material warehouse or auxiliary materials warehouse as proof of receipt of goods at the warehouse.
9. The head of the purchasing department records the ordered goods received in the PO monitoring book.

Selection and Evaluation of Supplier

1. The head of the purchasing department selects suppliers based on the company profile received or based on transaction data that has been carried out which includes: price, quality, method of payment and volume of goods.

2. The head of the purchasing department records the selection results in the supplier selection form
3. The head of the purchasing department records the results of the supplier selection in the list of selected suppliers which is used as a guide in carrying out the procurement of goods or services.
4. The head of the purchasing department evaluates the transactions made by the supplier. The supplier evaluation is carried out periodically every 6 months, the results of which are recorded in the supplier's performance evaluation.
5. The head of the purchasing department reports procurement activities as well as supplier selection and evaluation to the administrative and finance manager to be forwarded to the director for approval.

5. Maintenance

   The existence of machine/facility maintenance aims that in every production process at CV. Sumber Baja Perkasa continues to run effectively and efficiently, so it has no impact on the quality of the resulting product, which results in decreased customer satisfaction. Machine maintenance is carried out routinely according to a predetermined schedule and also according to the needs of each machine. Types of treatment are performed, such as lubrication, cleaning and repairing. For induction casting machine, the maintenance is carried out once per two weeks. While for machining, it is regularly checked once a week.

6. Warehousing

   Warehousing at CV. Sumber Baja Perkasa is divided into 2, namely receiving, storing and releasing raw materials, as well as receiving, storing, and releasing auxiliary materials and finished goods. CV. Sumber Baja Perkasa implements a First In First Out (FIFO) system so that the quality of the material to be used does not decrease if it is stored for too long.

7. Operational hour

   CV. Sumber Baja Perkasa has different operating hours between office hours with employee hours. Employees work every Monday to Saturday with the main working hours for 8 hours and overtime hours for a maximum 1.5 hours per day. The working hours of these employees can be seen in the table below:

Table 4.3 Operational Hour

Working days	Monday-Saturday
Working hours	08.00-16.00
Overtime hour	16.00-17.30

The working hours in the table shows that there is overtime work even though it does not happen every day. The main working hours in one day is 8 hours while the overtime hours are maximum of 1.5 hours, which ends at 17.30. The overtime hours are maximum of 1.5 hours caused by the price of electricity in the afternoon and evening is different from the morning, it is more expensive, and there is a peak load. And then break time is set from 12.00-13.00.

4.1.4 Business Process

Here is the business process happens in CV. Sumber Baja Perkasa:

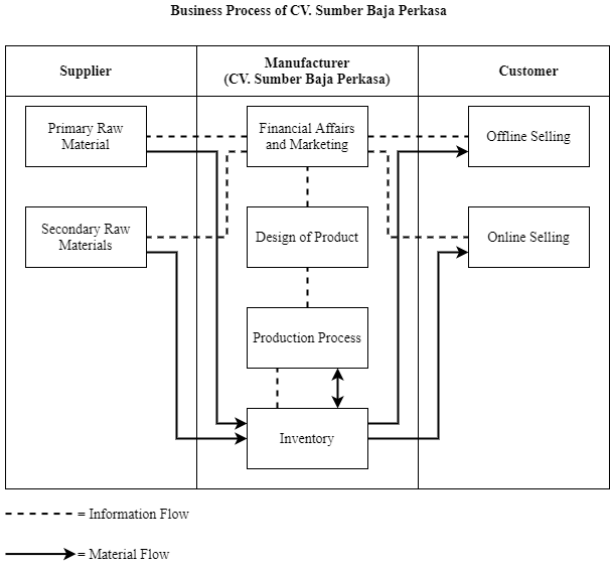

Figure 4.2 Business Proces of CV. Sumber Baja Perkasa

Figure 4.1 shows the business process of CV. Sumber Baja Perkasa, in general, the supply chain of CV. Sumber Baja Perkasa started by selecting raw materials for the production

process. The main raw material has several suppliers since the main raw material for making metal products is scrap metal. For the scrap metal come, the scrap metal collectors comes from around the company area. Supporting raw materials consists of paint, coal, FC. CV. Sumber Baja Perkasa ordered the material based on the calculation from the PPIC department. There is a flow of information between the main and supporting raw materials to the financial affairs and marketing division of the company. If a supply of raw materials is necessary, this information pertains to transaction activities. In addition to information flow, there is material flow from suppliers to the inventory, which includes delivery and storage of items from suppliers straight to the inventory. Because the product is manufactured to order, there is a flow of information from financial affairs and marketing to design. This information is connected to the design of the product that consumers want. After finished developing the design, go to the production area to see how the information flows.

4.2 Set the Scope

4.2.1 SWOT Analysis

SWOT Analysis is a tool used for strategic planning and strategic management in organizations. It can be used effectively to build organizational strategy and competitive strategy. “SWOT Analysis is a simple but powerful tool for sizing up an organization’s resource capabilities and deficiencies, its market opportunities, and the external threats to its future” (Thompson, Strickland, & Gamble, 2007). Its purpose is to conduct a situation analysis or conditions, so that it can formulate the company's strategy in its competition on the market. Here is a SWOT analysis of the company.

1. Internal Factor Analysis Strategy (IFAS)

   Evaluation of the company's internal factors is intended to determine the strengths and weaknesses of a company. The IFAS (Internal Factors Analysis Strategy) table was prepared to formulate these internal strategic factors within the framework of the company's strengths and weaknesses. Based on observations and interviews, the IFAS factors were formulated from CV. Sumber Baja Perkasa, there are 6 strengths and 4

weaknesses. IFAS factors in CV. Sumber Baja Perkasa are mentioned in Table 4.4 below:

Table 4.4 IFAS Factors

No.	Strength
1.	The manufacturing process is according to the procedure to continue maintaining the quality produced.
2.	The company also offers the manufacture of spare parts from tractors so that the main company only has to do the rest or assemble.
3.	The company has also implemented several standards such as ISO and JIS to reduce existing risks.
4.	There is physical evidence in the form of laboratory test results related to materials and production materials.
5.	The company has a good item control activity.
6.	This company is very detailed in maintaining the condition, quality and specifications of the goods sent by the manufacturer.
No.	**Weakness**
1.	Certain types of stock are limited in units
2.	Monitoring the sales process that is not optimal.
3.	Product marketing is not optimal.
4.	Some products have quite expensive selling prices.

2. External Factor Analysis Strategy (EFAS)

EFAS analyzes external conditions from all aspects, at least based on political, economic, social, cultural, and security factors from the company's external environmental conditions (state or local government). Based on observations and interviews, EFAS factors were formulated from CV. Sumber Baja Perkasa, there are 4

opportunities and 6 threats. EFAS factors in CV. Sumber Baja Perkasa are mentioned in table 4.5 below:

Table 4.5 EFAS Factors

No.	Opportunity
1.	High demand of metal treatment and also the supply of agricultural equipment and tools.
2.	A very wide market share seen from the number of customers
3.	The increasing need for food also increases the demand for products
4.	More consumers choose to remain loyal to the products offered by the company, because otherwise the consumers will bear more switching costs if you want to move to products from other competitors
No.	**Threats**
1.	There is a lot of competition.
2.	The incessant promotional activities of competitors.
3.	Competitive competitor product prices.
4.	There is a threat from newcomers
5.	Increasing prices for materials
6.	Pricing on this company is very dependent on the manufacturer influenced by

	the increase in dollar prices

4.2.2 Business Context Summary

A business context model is needed to express the current business problem and to propose the goodness and scope of a project. The Business Context Summary aims to identify and document the company, and its business, as well as an overview from a competitive point of view. This can be supported using the SWOT analysis that has been done above. The following is an explanation of the business context summary of several components in table 4.6.

Table 4.6. Business Context Summary

Component	Description
Business Description	CV Sumber Baja Perkasa is one of manufacturing company located in Sentono 35/14 Ngawonggo, Ceper, Klaten. Klaten is one of the popular cities that is known for cast iron and machinery since back then. CV Sumber Baja Perkasa is run on the manufacturing aspect for producing Farming, Tractor Parts and Spares business activities.
Challenge and Opportunities	Challenge: ● There is a lot of competition ● The incessant promotional activities of competitors. ● Competitive competitor product prices. ● There is a threat from newcomers ● Increasing prices for materials ● Pricing on this company is very dependent on the

Component	Description
	manufacturer, influenced by the increase in dollar prices Opportunity: ● High demand of metal treatment and also the supply of agricultural equipment and tools. ● A very wide market share seen from the number of customers ● The increasing need for food also increases the demand for products ● More consumers choose to remain loyal to the products offered by the company, because otherwise, the consumers will bear more switching costs if you want to move to products from other competitors
Value Proportion	● The company has also implemented several standards such as ISO and JIS to reduce existing risks. ● There is physical evidence in the form of laboratory test results related to materials and production materials.
Critical Issues	● The company has difficulties getting the raw materials because the raw material such as scrap steel is supplied or sold by a small company around the area. They only sell scrap steel when the price is higher. ● Because of the pandemic COVID-19, the order no is less than the expectation makes the revenue in 2020 fall to 1.2 billion instead of 2 billion as the company expected before.

Component	Description
	● Sometimes there is wrong processing that makes the product returned to the company to rework it again. ● Induction or copular machine break down: 1 week of repairing the machine. The breakdown of the induction or copular machine will affect all the business operations since the machine is the main thing in the production process.
Risks	This company could be threatened by several risks: ● Companies can have difficulties getting raw materials if raw materials are scarce. ● Apart from raw materials, companies may also face the risk of fluctuating rupiah exchange rates. ● Other, if there is the stock of finished but unused products due to the lack of market interests. ● In one situation, it could be that a company experiences an unstable economy and a strike or riot occurs due to employees dissatisfaction. ● Another risk is if the research and product development fails to produce new products. ● Companies can also face investment rigidity, namely the existence of government restrictions on investment in certain fields. ● Raw materials are hard to come by ● Induction or copular machine break down: 1 week of repairing

Component	Description
	the machine ● Incorrect process / defects -> wrong process
Financial Performance	Building area : >3000m2 ● 1 main factory ● 2 branch factory ● 1 outside warehouse Financial Income 2020: 1.500.000.000 Expected Income each year: 2.000.000.000 Total workers: 110 workers Lathes: 62 machines Drilling machine: 8 machines Scrap machines: 6 machines Shot Blasting: 6 machines Induction machine: 1 set Copular machines: 1 set Expected benefits: ● 10-25% from standalone shops ● 25-30% of PDAM region
External	Business Partner:

Component	Description
Profile	● PT Sinar Mas Andika ● PT Nylon ● PDAM Semarang Region ● PDAM Kulon Progo Region ● PDAM Pati Region ● SKBL Medan ● MCB Jakarta ● Cahaya Agung Surabaya ● Agung Diesel Jakarta ● Private Customer Delivery Channel: ● Wana Jaya ● Nusantara Express ● Dakota ● Jaya Express ● HM Marsiti

4.2.3 Document Current Supply Chain

1. Data Sourcing
    1) Customers and Markets

Customers and business partners from CV. Sumber Baja Perkasa comes from almost all regions in Indonesia. There are 4 product distribution areas, namely Sumatra, Java, Kalimantan, and eastern Indonesia. Eastern Indonesia consists of Sulawesi, Bali, East and West Nusa Tenggara and Papua.

2) Product

CV. Sumber Baja Perkasa is actually a company engaged in various fields, namely lodging / villas, plantations, livestock, and foundries. Here we will focus on foundry, where CV. Sumber Baja Perkasa produces around 1000 types of units which can be grouped into pipe fittings, pulleys, deck drains, agricultural spare parts and spare parts of tractors.

3) Suppliers and Channel Partners

CV. Sumber Baja Perkasa supplies its raw materials from various scrap metal collecting companies located in the area, but the largest supplier of raw materials is in Senden, Ngawonggo, namely CV. Dwi Jaya Logam. For other materials such as putty, coal, and sandpaper from the Wulan building shop which is also in the Ceper area. For Channel Partners, CV. Sumber Baja Perkasa already has certain markets that make marketing very easy. One of them is by submitting tenders from government projects and large companies in Indonesia and also door-to-door to companies.

4) Geography

CV. Sumber Baja Perkasa has 1 main company, 2 branch companies and 1 warehouse, all of which are located in one area, namely Sentono 35/14 Ngawonggo, Ceper, Klaten. This location is in the area of the Ceper metal foundry industry which has been famous since the New Order era. All production processes, from the deposit of raw materials to the storage of physical goods, are located in one area.

2. Prioritizing the Supply Chain

The goal of the Prioritizing the Supply Chain process is for the SCOR team to acknowledge that not all supply chains will provide worth or benefits to a company, such as some supply chain networks that generate very high revenue but several supply

chains networks that do not generate so much revenue that the priority sorting according to relevance is required.

Table 4.7 Supply Chain Priority

	Revenue	**Gross Margin%**	**#of SKUs**	**Unit Volume**	**Strategic Value**	**Rank**
Sumatra	2	3	2	2	2	3
Java	4	2	3	4	4	1
Kalimantan	1	1	1	1	1	4
Eastern Indonesia	3	4	4	3	3	2

According to table 4.7 above, Java is the largest market for CV. Sumber Baja Perkasa, is dominantly valued in three aspects such as revenue, unit volume, and strategic value. Eastern Indonesia comes in second, Sumatera comes in third, and Kalimantan comes in last. Based on the insight, there is a chance to maximize the potential market on Java by developing certain tactics to attract more client segments in Java. However, this is not simply owing to a large number of rivals in Java, particularly in the same region as the firm that has the same product and market because the company is located in the foundry area.

3. Supply Chain Definition Matrix

   Table 4.8 describes the supply chain definition matrix which is a summary of the figures from the supply chain in the CV. Sumber Baja Perkasa.

Table 4.8 Supply Chain Definition Matrix

Suppliers	**CV Sumber Baja Perkasa**	**Distributors**
● Supplier of used steel and grams/scrap steel	● Head Quarters	● **Customer: PDAM Semarang, Kulon Progo,**

from individuals a small company around the company SUBASA • The supplier for supporting materials such as inoculant, slap remover, silicon from CV Makmur Meta • The supplier of resin sand from CV Wulan that located in Ceper • The supplier of Coal is CV Dwijaya Logam also located in Ceper • Cardboard and sacks for packaging are from the used cardboard collectors from Semarang and Boyolali • Aluminum supplied by Hanora Teknik that located in Tegal • Iron AS supplied by Berkah Rizki Teknik	CV Sumber Baja Perkasa is a Klaten-based company that produces Farming, Tractor Parts and Spares parts business activities that supplies to the main company. • Factory The factory is in one location with the headquarters, Klaten. **Channel Partners** • Wana Jaya • Nusantara Express • Dakota • Jaya Express • HM Marsiti	**and Pati Region** The company's biggest market is in the PDAM region where the company supplies body shafts. • **Customer: Private Shop** The company deposits its production in the form of agricultural equipment spare parts, diesel spare parts, mixer truck spare parts, and pumps to several regions in Indonesia such as Sumatra, Java, Bali, Kalimantan, Sulawesi and Lombok. • **Customer: PT Sinar Mas Andika** Companies supplying piping tools such as pipe joints.

Supply chain matrix on CV. Sumber Baja Mulya is made based on sales data which are divided according to the product as follows:

Table 4.9 Sales data of CV. Sumber Baja Perkasa

Year	**Month**	**Finished Goods**					**Total**
		Pipe fittings	Pulley	Deck drains	Spare parts of agricultural tool	Spare parts of tractors	
2021	January	IDR 514,600,000	IDR 282,000,000	IDR 200,448,000	IDR 73,700,000	IDR 70,000,000	IDR 1,140,748,000
	February	IDR 229,400,000	IDR 202,500,000	IDR 138,591,000	IDR 55,000,000	IDR 65,000,000	IDR 690,491,000
	March	IDR 193,750,000	IDR 165,000,000	IDR 263,871,000	IDR 59,400,000	IDR 55,000,000	IDR 737,021,000
	April	IDR 268,150,000	IDR 84,000,000	IDR 427,518,000	IDR 50,600,000	IDR 69,000,000	IDR 899,268,000
	May	IDR 261,950,000	IDR 183,000,000	IDR 147,987,000	IDR 83,600,000	IDR 76,000,000	IDR 752,537,000
	June	IDR 327,050,000	IDR 262,500,000	IDR 338,256,000	IDR 110,000,000	IDR 80,000,000	IDR 1,117,806,000
	July	IDR 134,850,000	IDR 201,000,000	IDR 290,493,000	IDR 99,000,000	IDR 90,000,000	IDR 815,343,000
	August	IDR 114,700,000	IDR 339,000,000	IDR 249,777,000	IDR 66,000,000	IDR 78,000,000	IDR 847,477,000
	September	IDR 393,700,000	IDR 234,000,000	IDR 233,334,000	IDR 70,400,000	IDR 74,000,000	IDR 1,005,434,000
	October	IDR 396,800,000	IDR 268,500,000	IDR 223,155,000	IDR 61,600,000	IDR 58,000,000	IDR 1,008,055,000
Total revenue		IDR 2,834,950,000	IDR 2,221,500,000	IDR 2,513,430,000.00	IDR 729,300,000.00	IDR 715,000,000	IDR 9,014,180,000
Estimated Sales		1829	74050	3210	33150	35750	147989
Total Income		IDR 365,800,000	IDR 518,350,000	IDR 481,500,000	IDR 298,350,000.00	IDR 250,250,000	IDR 1,914,250,000

4.2.4 Geographical Mapping

Geographical Mapping from CV. Sumber Baja Perkasa describes the origin of raw material suppliers to CV. Sumber Baja Perkasa Supplier who has become a subscriber of CV. Sumber Baja Perkasa. It is a raw material supplier that includes for scrap metal, aluminum, AS iron, resin, putty, inoculant, slap remover, and silicon. The Geographical Mapping is as shown in Figure 4.2 below:

Figure 4.3 CV. Sumber Baja Perkasa's Geographical Mapping

CV. Sumber Baja Perkasa is located in Klaten Regency, as the the company's business center, where the production, warehouse, shop, administration, and marketing processes are integrated in a single location. Below is the detail of the supplier of CV. Sumber Baja Perkasa:

1. Supplier of used steel and grams/scrap steel are the individuals or small companies, which are situated around CV. Sumber Baja Perkasa.
2. Supplier for supporting materials such as inoculant, slap remover, and silicon is CV Makmur Meta.
3. Supplier of resin sand from CV Wulan that located in Ceper.
4. The supplier of Coal is CV Dwijaya Logam that also located in Ceper.
5. Cardboard and sacks for packaging is originated from the used cardboard collectors from Semarang and Boyolali.
6. Aluminum is supplied by Hanora Teknik located in Tegal.
7. Iron AS supplied by Berkah Rizki Teknik located in Klaten.

4.2.5 Define the Scope

In this study, based on the previous discussion, the scope of this study was formulated, namely the pulley product. Pulley is currently the most sold and is a production priority at the CV. Sumber Baja Perkasa in all market. Here the study will optimize the pulley because the pulley has big potential and impact the company's performance in the field of make-to-order.

4.3 Configure the Supply Chain

4.3.1 Selection SCOR Performance Attribute

Based on interviews and observations at CV. Sumber Baja Perkasa, there is severe and often frequent problem experienced, the delay in delivery of product and mismatch in the number of goods. These problems lead to reduced customer satisfaction.

Based on observations and interviews, the difficulties that occurred at CV. Sumber Baja Perkasa warranted a follow-up to enhance performance. According to SCOR Racetrack version 12.0, the performance attribute that related to this problem is the Reliability attribute, which only contains 1 (one) level 1 metric, namely RL. 1.1 Perfect Order Fulfillment as shown in the table 4.10 below:

Table 4.10 Selected SCOR Level 1 Performance Metric

	Attribute	Level 1 Strategic Metrics
Customer	Reliability	RL. 1.1 Perfect Order Fulfillment
	Responsiveness	RS. 1.1 Order Fulfillment Cycle Time
	Agility	AG. 1.1 Upside Supply Chain Adaptability
		AG. 1.2 Downside Supply Chain Adaptability
		AG. 1.3 Overall Value at Risk (VAR)
Internal	Cost	CO. 1.1 Total Supply Chain Management Costs
		CO. 1.2 Cost of Goods Sold
	Asset Management Efficiency	AM. 1.1 Cash-to-Cash Cycle Time
		AM. 1.2 Return on Supply Chain Fixed Assets
		AM. 1.3 Return on Working Capital

Reliability was chosen because there were problems with customers who claimed that orders that were not fulfilled in accordance with the agreement, causing protests from customers and there were customers, who were not satisfied. Level 1 available in the reliability attribute is RL. 1.1 Perfect Order fulfillment. RL.1.1 Perfect Order Fulfilment has several 4 (four) metrics level 2 is perfect order fulfillment, % of orders delivered in full, delivery performance to customer commit date, documentation accuracy, and perfect condition. Actual data on level 2 metric performance along with internal targets for each delivery of pulley products can be seen in the following table:

Table 4.11 Reliability Performance Metrics Level 2

Level 1	Level 2	Actual	Target	Gaps
RL. 1.1 Perfect Order Fulfillment	% of orders delivered in full	70.27%	95%	24.73%
	Delivery performance to customer commit date	43.24%	90%	46.76%
	Documentation accuracy	100%	100%	-
	Perfect condition	100%	100%	-
	Total	313.51%	385%	71.49%

RL. 2.3 Delivery performance to customer commit date in the level 3 performance matrix has 2 matrices. Furthermore, processing and analysis of level 3 will be carried out on CV. Sumber Baja Perkasa. An explanation of the performance matrix and hierarchy can be seen in the Table 4.12.

Table 4.12Performance Metrics Level 3

Performance Metrics			Description
Level 1	Level 2	Level 3	
RL. 1.1 Perfect Order Fulfillment	RL. 2.1 % of Orders Delivered in Full	RL. 3.33 Delivery Item Accuracy	Percentage of orders in which all items ordered are the items actually provided, and no extra items are provided
		RL. 3.35 Delivery Quantity Accuracy	Percentage of orders in which all quantities received by the customer match the order quantities(within

Performance Metrics			Description
Level 1	**Level 2**	**Level 3**	
			mutually agreed tolerances)
	RL. 2.3 Delivery performance to customer commit date	RL. 3.32 Customer Commit Date Achievement Time of Customer Receiving	Percentage of orders which is received on time as defined by the customer
		RL. 3.34 Delivery Location Accuracy	Percentage of orders which is delivered to the correct location and customerentity.

Level 3 above is in accordance with the order and is a make-up process that occurs at CV. Sumber Baja Perkasa. Each performance matrix has its formulation. The performance matrix used in this study is determined by the calculation formula and the characteristics of the performance formula. Furthermore, the Table 4.13 explains the formula for each matrix with its characteristics, in which the larger the value, the better.

Table 4.13 Performance Metrics Formula

No.	Performance Metrics Level 2	Unit	Formula	Characteristics
1.	RL. 1.1 Perfect Order Fulfillment	%	[Total Perfect Orders] / [Total Number of Orders] x100%	The larger the value, the better.
2.	RL. 2.1 % of Orders	%	[Total number of orders delivered in full] / [Total number of orders delivered] x 100%	The larger the value, the better.

No.	Performance Metrics Level 2	Unit	Formula	Characteristics
	Delivered in Full			
3.	RL. 2.3 Delivery performance to customer commit date	%	[Total number of orders delivered on the original commitment date] / [Total number of orders delivered] x 100%	The larger the value, the better.
4.	RL. 3.33 Delivery Item Accuracy	%	[Total number of orders delivered that accordance with the items actually provided, no extra items] / [Total number of orders delivered] x 100%	The larger the value, the better.
5.	RL. 3.35 Delivery Quantity Accuracy	%	[Total number of orders delivered with quantities received by the customer match the order quantities] / [Total number of orders delivered] x 100%	The larger the value, the better.
6.	RL. 3.32 Customer Commit Date Achievement Time Customer Receiving	%	[Total number of orders delivered on time as defined by the customer] / [Total number of orders delivered] x 100%	The larger the value, the better.
7.	RL. 3.34 Delivery Location Accuracy	%	[Number of orders delivered to the correct location] / [Number of orders delivered] x 100%	The larger the value, the better.

After designing or mapping performance metrics, then the Configure the Supply Chain stage is carried out. This stage is the activity of calculating metric data and selecting metrics that are a priority for improvement and performing benchmarks on supply chain data analysis results.

4.3.2 Collection Detail Data

Before calculating the data, it is necessary to identify the data owner. The identification of the data owner is shown in Table 4.14 of the detailed data collection below which shows that the metric perfect order fulfillment data is owned by the production manager of CV. Sumber Baja Perkasa:

Table 4.14 Collection Detailed Data

Metric	Process	Owner	Due Date	Status
Perfect Order Fulfillment	RL. 1.1	Production Manager	01-11-2021	Valid

After identifying the data owner, the next step is to calculate the data collection metrics on performance metrics level 1 and 2. RL Level 1 metrics, namely RL. 1.1 Perfect Order Fulfillment to Level 2, namely RL. 2.3 Delivery performance to customer commit date at CV. Sumber Baja Perkasa is calculated based on the calculation of the SCOR dictionary version 12.0. The performance reliability metrics level 1 and 2 are seen in Table 4.15 below as follows:

Table 4.15 Performance Reliability Metrics Level 1 and 2

Reliability Perfect Order Fulfillment					
Metric Level 1	**Calculation**	**Total Perfect Orders**	**Total Number of Orders**	**Metric Level 2**	**Calculation**

RL. 1.1 Perfect Order Fulfillment	[Total Perfect Orders] / [Total Number of Orders] x100%	52	74	RL. 2.1 % of Orders Delivered in Full	[Total number of orders delivered in full] / [Total number of orders delivered] x 100%
		32	74	RL. 2.3 Delivery performance to customer commit date	[Total number of orders delivered on the original commitment date] / [Total number of orders delivered] x 100%

Next is the Perform Competitive Analysis which will explain the calculation for performance at level 3. The data is taken for 10 periods, namely from January to October 2021. There are 2 metrics on the reliability attribute used in this study. Calculations for each metric can be seen in the Table 4.16 below.

1. RL. 3.33 Delivery Item Accuracy

   Delivery item accuracy is used to measure how many orders delivered that accordance with the items actually provided and no extra items. To calculate the RL. 3.33 Delivery items accuracy, here is the formula:

$$\frac{\text{Total number of orders delivered that accordance with the items actually provided, no extra items}}{\text{Total number of orders delivered}} \times 100\%$$

   There is no problem with item accuracy. Everything is in accordance with the items ordered. There is no wrong item in the delivery.

2. RL. 3.35 Delivery Quantity Accuracy

   Delivery quantity accuracy is used to measure how many orders are delivered with quantities received by the customer matching the order quantities.

Period	Delivery									
	Date Receiving Time									
	SKBL Medan	MCB Jakarta	Cahaya Agung Surabaya	Sinar Mas Andika	Nylon	Agung Diesel Jakarta				
January	23/1/2021	22/1/2021	21/1/2021	8/1/2021		23/1/2021	10/1/2021		23/1/2021	
February	23/2/2021	22/2/2021	20/2/2021	10/2/2021	21/2/2021	26/2/2021	20/2/2021	7/2/2021	20/2/2021	28/2/2021
March	24/3/2021	23/3/2021	22/3/2021	7/3/2021	22/3/2021	25/3/2021		20/3/2021	21/3/2021	20/3/2021
April	22/4/2021	22/4/2021	20/4/2021	8/4/2021	22/4/2021	27/4/2021		22/4/2021		
May	25/5/2021	22/5/2021	21/5/2021	7/5/2021	20/5/2021					20/5/2021
June	23/6/2021	22/6/2021	20/6/2021	7/6/2021	23/6/2021	8/6/2021				
July	24/7/2021	23/7/2021	23/7/2021	9/7/2021	22/7/2021	7/7/2021	23/7/2021			
August	22/8/2021	22/8/2021	20/8/2021	8/8/2021	21/8/2021	7/8/2021	21/8/2021		7/8/2021	
September	22/9/2021	22/9/2021	19/9/2021	10/9/2021	21/9/2021	5/9/2021				25/9/2021
October	24/10/202	22/10/202	21/10/202	8/10/2021	24/10/202	5/10/2021		23/10/2021		

Figure 4.4 Delivery Quantity Accuracy

The delivery with the problem of delivery quantity is highlighted in green color. To calculate the RL. 3.35 Delivery quantity accuracy, below is the formula:

$$\frac{\text{Total number of orders delivered with quantities received by the customer match the order quantities}}{\text{Total number of orders delivered}} \times 100\%$$

The following is the delivery quantity accuracy from January to October 2021:

a. January 2021

The following is the delivery quantity accuracy in January 2021:

$$\frac{5}{7} \times 100\% = 71.4\%$$

So, the delivery quantity accuracy in January 2021 is 71.4%.

b. February 2021

The following is the delivery quantity accuracy in February 2021:

$$\frac{6}{10} \times 100\% = 60\%$$

So, the delivery quantity accuracy in February 2021 is 60%.

c. March 2021

The following is the delivery quantity accuracy in March 2021:

$$\frac{7}{9} \times 100\% = 77.7\%$$

So, the delivery quantity accuracy in March 2021 is 77.7%.

d. April 2021

The following is the delivery quantity accuracy in March 2021:

$$\frac{6}{7} \times 100\% = 85.7\%$$

So, the delivery quantity accuracy in April 2021 is 85.7%.

e. May 2021

The following is the delivery quantity accuracy in March 2021:

$$\frac{3}{6} \times 100\% = 50\%$$

So, the delivery quantity accuracy in May 2021 is 50%.

f. June 2021

The following is the delivery quantity accuracy in March 2021:

$$\frac{5}{6} \times 100\% = 83.3\%$$

So, the delivery quantity accuracy in June 2021 is 83.3%.

g. July 2021

The following is the delivery quantity accuracy in March 2021:

$$\frac{5}{7} \times 100\% = 71.4\%$$

So, the delivery quantity accuracy in July 2021 is 71.4%.

h. August 2021

The following is the delivery quantity accuracy in March 2021:

$$\frac{5}{8} \times 100\% = 62.5\%$$

So, the delivery quantity accuracy in August 2021 is 62.5%.

i. September 2021

The following is the delivery quantity accuracy in March 2021:

$$\frac{4}{6} \times 100\% = 66.6\%$$

So, the delivery quantity accuracy in September 2021 is 66.6%.

j. October 2021

The following is the delivery quantity accuracy in March 2021:

$$\frac{4}{7} \times 100\% = 57.1\%$$

So, the delivery quantity accuracy in October 2021 is 57.1%.

3. RL. 3.32 Customer Commit Date Achievement Time Customer Receiving

Customer commit date achievement time customer receiving is used to measure how many orders are delivered on time as defined by the customer.

Period	Delivery Date Receiving Time									
	SKBL Medan	MCB Jakarta	Cahaya Agung Surabaya	Sinar Mas Andika	Nylon	Agung Diesel Jakarta				
January	23/1/2021	22/1/2021	21/1/2021	8/1/2021		23/1/2021	10/1/2021		23/1/2021	
February	23/2/2021	22/2/2021	20/2/2021	10/2/2021	21/2/2021	26/2/2021	20/2/2021	7/2/2021	20/2/2021	28/2/2021
March	24/3/2021	23/3/2021	22/3/2021	7/3/2021	22/3/2021	25/3/2021		20/3/2021	21/3/2021	20/3/2021
April	22/4/2021	22/4/2021	20/4/2021	8/4/2021	22/4/2021	27/4/2021		22/4/2021		
May	25/5/2021	22/5/2021	21/5/2021	7/5/2021	20/5/2021					20/5/2021
June	23/6/2021	22/6/2021	20/6/2021	7/6/2021	23/6/2021	8/6/2021				
July	24/7/2021	23/7/2021	23/7/2021	9/7/2021	22/7/2021	7/7/2021	23/7/2021			
August	22/8/2021	22/8/2021	20/8/2021	8/8/2021	21/8/2021	7/8/2021	21/8/2021		7/8/2021	
September	22/9/2021	22/9/2021	19/9/2021	10/9/2021	21/9/2021	5/9/2021				25/9/2021
October	24/10/202	22/10/202	21/10/202	8/10/2021	24/10/202	5/10/2021		23/10/2021		

Figure 4.5 Customer Commit Date Achievement Time Customer Receiving

The delivery that has the problem of customer commit date is highlighted in light red color. To calculate the RL. 3.32 Customer commit date achievement time customer receiving, below is the formula:

$$\frac{\text{Total number of orders delivered on time as defined by the customer}}{\text{Total number of orders delivered}} \times 100\%$$

The following is the customer commit date achievement time customer receiving from January to October 2021:

a. January 2021

The following is the customer commit date of achievement time customer receiving in January 2021:

$$\frac{4}{7} \times 100\% = 57.1\%$$

So, the customer commit date achievement time customer receiving in January 2021 is 57.1%.

b. February 2021

The following is the customer commit date of achievement time customer receiving in February 2021:

$$\frac{5}{10} \times 100\% = 50\%$$

So, the customer commit date achievement time customer receiving in February 2021 is 50%.

c. March 2021

The following is the customer commit date of achievement time customer receiving in March 2021:

$$\frac{1}{9} \times 100\% = 11.1\%$$

So, the customer commit date achievement time customer receiving in March 2021 is 11.1%.

d. April 2021

The following is the customer commit date of achievement time customer receiving in April 2021:

$$\frac{3}{7} \times 100\% = 42.8\%$$

So, the customer commit date achievement time customer receiving in April 2021 is 42.8%.

e. May 2021

The following is the customer commit date of achievement time customer receiving in May 2021:

$$\frac{2}{6} \times 100\% = 33.3\%$$

So, the customer commit date achievement time customer receiving in May 2021 is 33.3%.

f. June 2021

The following is the customer commit date of achievement time customer receiving in June 2021:

$$\frac{4}{6} \times 100\% = 66.6\%$$

So, the customer commit date achievement time customer receiving in June 2021 is 66.6%.

g. July 2021

The following is the customer commit date of achievement time customer receiving in July 2021:

$$\frac{2}{7} \times 100\% = 28.5\%$$

So, the customer commit date achievement time customer receiving in July 2021 is 28.5%.

h. August 2021

The following is the customer commit date of achievement time customer receiving in August 2021:

$$\frac{4}{8} \times 100\% = 50\%$$

So, the customer commit date achievement time customer receiving in August 2021 is 50%.

i. September 2021

The following is the customer commit date of achievement time customer receiving in September 2021:

$$\frac{3}{6} \times 100\% = 50\%$$

So, the customer commit date achievement time customer receiving in September 2021 is 50%.

j. October 2021

The following is the customer commit date of achievement time customer receiving in October 2021:

$$\frac{5}{7} \times 100\% = 71.4\%$$

So, the customer commit date achievement time customer receiving in October 2021 is 71.4%.

4. RL. 3.34 Delivery Location Accuracy

Delivery location accuracy is used to measure how many orders which is delivered to the correct location and customer entity. Here is the data for the delivery location accuracy:

Period	Delivery									
	Date Receiving Time									
	SKBL Medan	MCB Jakarta	Cahaya Agung Surabaya	Sinar Mas Andika	Nylon	Agung Diesel Jakarta				
January	23/1/2021	22/1/2021	21/1/2021	8/1/2021		23/1/2021	10/1/2021		23/1/2021	
February	23/2/2021	22/2/2021	20/2/2021	10/2/2021	21/2/2021	26/2/2021	20/2/2021	7/2/2021	20/2/2021	28/2/2021
March	24/3/2021	23/3/2021	22/3/2021	7/3/2021	22/3/2021	25/3/2021		20/3/2021	21/3/2021	20/3/2021
April	22/4/2021	22/4/2021	20/4/2021	8/4/2021	22/4/2021	27/4/2021		22/4/2021		
May	25/5/2021	22/5/2021	21/5/2021	7/5/2021	20/5/2021					20/5/2021
June	23/6/2021	22/6/2021	20/6/2021	7/6/2021	23/6/2021	8/6/2021				
July	24/7/2021	23/7/2021	23/7/2021	9/7/2021	22/7/2021	7/7/2021	23/7/2021			
August	22/8/2021	22/8/2021	20/8/2021	8/8/2021	21/8/2021	7/8/2021	21/8/2021		7/8/2021	
September	22/9/2021	22/9/2021	19/9/2021	10/9/2021	21/9/2021	5/9/2021				25/9/2021
October	24/10/202	22/10/202	21/10/202	8/10/2021	24/10/202	5/10/2021		23/10/2021		

Figure 4.6 Delivery location accuracy

The delivery with the problem of delivery location is highlighted in green color. To calculate the RL. 3.34 Delivery location accuracy, the formula is delivered, as follows:

$$\frac{\text{Total number of orders delivered to the correct location and customerentity}}{\text{Total number of orders delivered}} \times 100\%$$

The following is the customer commit date achievement time customer receiving from January to October 2021:

a. January 2021

The following is delivery location accuracy in January 2021:

$$\frac{7}{7} \times 100\% = 100\%$$

So, delivery location accuracy in January 2021 is 100%.

b. February 2021

The following is the delivery location accuracy in February 2021:

$$\frac{7}{10} \times 100\% = 70\%$$

So, delivery location accuracy in February 2021 is 70%.

c. March 2021

The following is the delivery location accuracy in March 2021:

$$\frac{9}{9} \times 100\% = 100\%$$

So, delivery location accuracy in March 2021 is 100%.

d. April 2021

The following is the delivery location accuracy in April 2021:

$$\frac{6}{7} \times 100\% = 85.7\%$$

So, delivery location accuracy in April 2021 is 85.7%.

e. May 2021

The following is the delivery location accuracy in May 2021:

$$\frac{5}{6} \times 100\% = 83.3\%$$

So, delivery location accuracy in May 2021 is 83.3%.

f. June 2021

The following is the delivery location accuracy in June 2021:

$$\frac{6}{6} \times 100\% = 100\%$$

So, delivery location accuracy in June 2021 is 100%.

g. July 2021

The following is the delivery location accuracy in July 2021:

$$\frac{7}{7} \times 100\% = 100\%$$

So, delivery location accuracy in July 2021 is 100%.

h. August 2021

The following is the delivery location accuracy in August 2021:

$$\frac{8}{8} \times 100\% = 100\%$$

So, delivery location accuracy in August 2021 is 100%.

i. September 2021

The following is the delivery location accuracy in September 2021:

$$\frac{6}{6} \times 100\% = 100\%$$

So, delivery location accuracy in September 2021 is 100%.

j. October 2021

The following is the delivery location accuracy in October 2021:

$$\frac{6}{7} \times 100\% = 85.7\%$$

So, delivery location accuracy in October 2021 is 85.7%.

Calculations for each metric can be seen in the Table 4.16 below.

Table 4.16 RL. 2.1 and RL. 2.3's Hierarchy Calculation

Metrics		Month										Average
		January 2021	February 2021	March 2021	April 2021	May 2021	June 2021	July 2021	August 2021	September 2021	October 2021	
RL. 3.33	Delivery Item Accuracy	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
RL. 3.35	Delivery Quantity Accuracy	71.4%	60%	77.7%	85.7%	50%	83.3%	71.4%	62.5%	66.6%	57.1%	68.5%
RL. 3.32	Customer Commit Date Achievement Time Customer Receiving	57.1%	50%	11.1%	42.8%	33.3%	66.6%	28.5%	50%	50%	71.4%	46.1%
RL. 3.34	Delivery Location Accuracy	100%	70%	100%	85.7%	83.33%	100%	100%	71.4%	100%	85.7%	92.4%
											Total	307%

Based on Table 4.16 on calculation for RL 3.32 Customer commitment date achievement time customer receiving is 46.1% means that there is only 46.1% of the total order that fulfills the customer receiving time. Furthermore, for RL. 3. 34 the delivery location accuracy is 91.2%. This means that there is a problem in shipping goods to a predetermined location, which also interferes with the delivery of goods to the customer. However, nowadays technology has advanced.

4.3.3 Benchmarking

Performance evaluation is performed by applying gap analysis to the SCOR model. The discrepancy between the percentage of corporate performance accomplishment and the percentage of supply chain performance metrics yields a gap analysis. The percentage of performance attainment is calculated by comparing the actual percentage to the company's aim. Table 4.17 below compares the targets that the company wants to achieve with actual data.

Table 4.17 Benchmarking of RL. 2.3 Hierarchy

	Metrics	**Target**	**Actual Data**	**Gap**
RL. 3.35	Delivery Quantity Accuracy	95%	68.5%	26.5%
RL. 3.32	Customer Commit Date Achievement Time Customer Receiving	90%	46.1%	43.9%
RL. 3.34	Delivery Location Accuracy	97%	92.4%	7.6%

The author discovered the RL 3.32 Customer commitment date achievement time customer receiving's gap in Table 4.15 above is 43.9 percent. CV. Sumber Baja Perkasa management aimed for a 90 percent customer commitment date achievement time customer receiving. Then there's the RL. 3. 34 The delivery location accuracy gap is 5.8 percent. As a result, an improvement program is required to remedy the CV. Sumber Baja Perkasa issue.

4.3.4 Supply Chain Thread Diagram

Business Thread Diagram is a development of business scope diagrams and every stage of business processes, starting from plan, source, make, deliver, return, and enable. Figure 3 shows the following activities from the second level:

a. P2 (Plan to Source), P3 (Plan to Make), P4 (Plan to Deliver), and P5 (Plan to Return)

b. S2 (Source Make-to-Order)
c. M2 (Make-to-Order)
d. D2 (Deliver Make-to-Order)
e. SR1 (Source Return) and DR1 (Product Return)

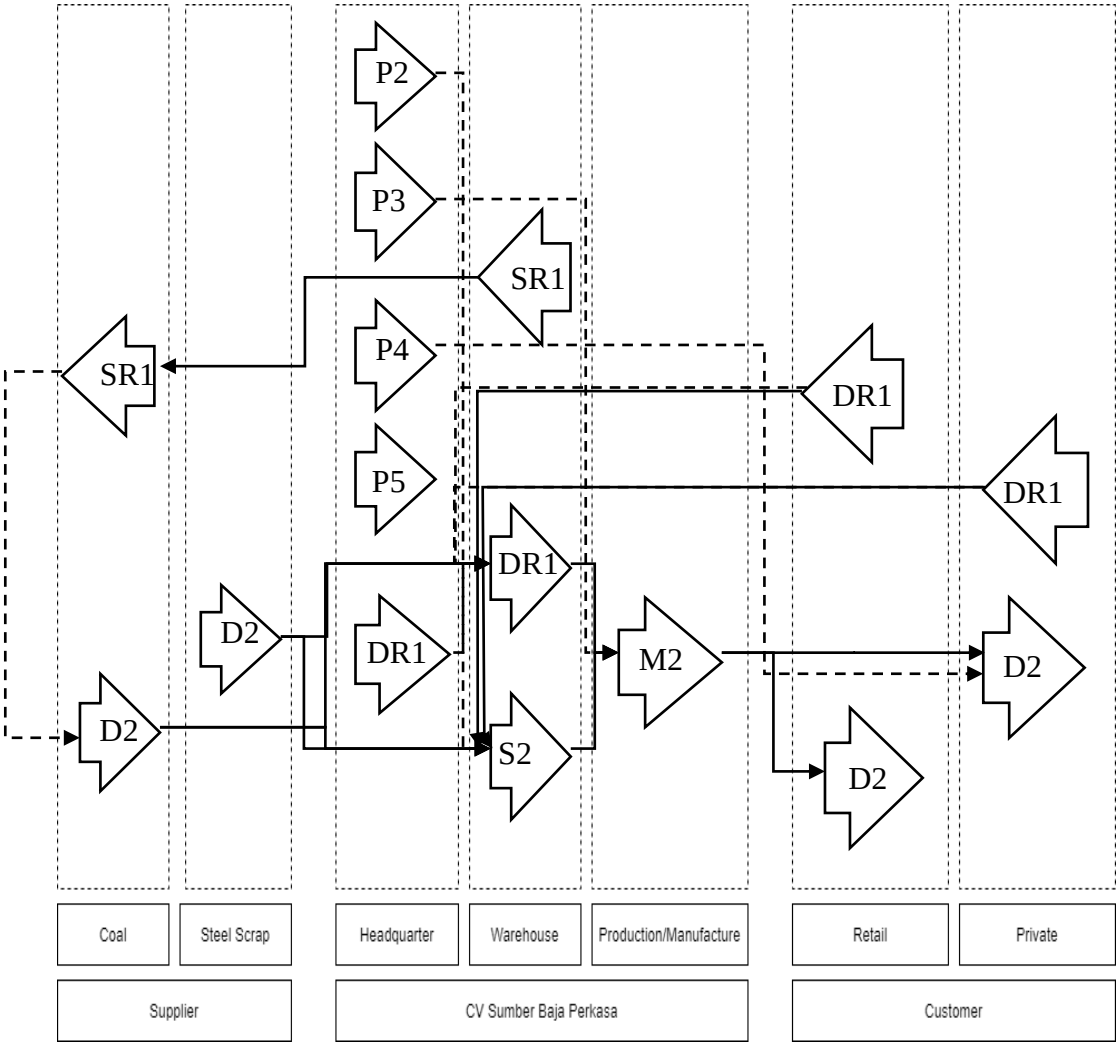

Figure 4.7. Thread Diagram

Based on the mapping of each process in the CV. Sumber Baja Perkasa can be simplified into one section called a thread diagram. The diagram describes the entire business process starting from suppliers who send raw materials to CV. Sumber Baja Perkasa. The black line indicates the flow of raw materials, the raw materials that have been sent are temporarily stored in the warehouse before entering the production process. After the production process is carried out, the finished product is stored back in the finished product warehouse for later delivery to consumers. The dotted line indicates the flow of information from which the process plan can be taken from the customer's request.

Based on consumer demand it will be calculated how much raw material will be ordered later in the process.

4.3.5 Fishbone Diagram

Fishbone diagrams are conducted to analyze the causes of gaps in several performance metrics. This diagram can be useful for figuring out what's causing an issue (San, Tjitro, & Santoso, 2003). Fishbone diagram obtained based on interviews with the owner of the CV. Sumber Baja Perkasa and observation. Fishbone in this case identifies the cause of the delay in the arrival of goods orders to customers based on the RL factor. 3.32, 3.34, and 3.35.

1. Fishbone diagram of delivery quantity accuracy

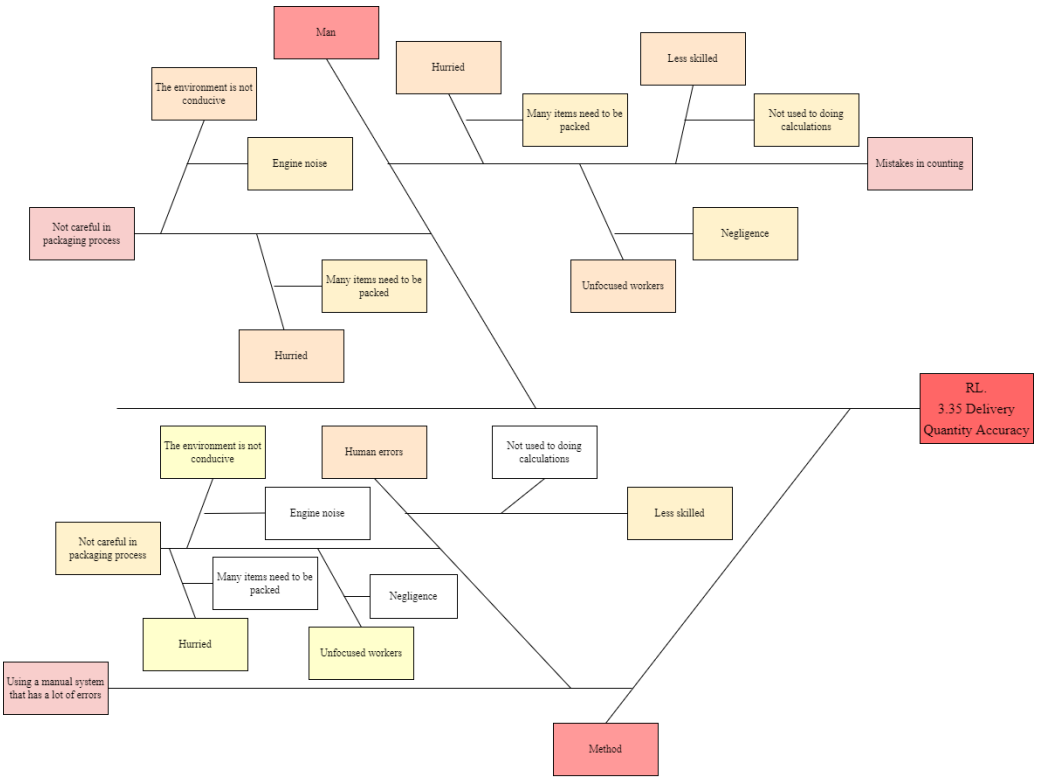

Figure 4.8 Fishbone Diagram of Delivery Quantity Accuracy

Based on the fishbone diagram, the cause of the inaccurate amount of goods sent is identified. The following are the causes in terms of RL. 3.35 Delivery quantity accuracy metrics that experience gaps, namely:

a. Man

In the man factor itself, there are 2 main causes, namely due to counting errors and lack of accuracy in the packaging process (Murnawan & Mustofa, 2014). These counting errors are caused by workers who are in a hurry because many items that need to be packaged, less-skilled because they are not used to it, and workers are not focused because of their negligence (Putri, Wibawa, & Laksamana, 2017). Meanwhile, inaccuracy in the packaging process is caused by an unfavorable environment, namely the sound of the machine and the rush because there are too many items that need to be packaged.

b. Method

In the method itself, in the process of calculating the number of goods in packaging, we still use manual or human methods. This occurrence happens due to human error caused by a lack of skill. The workers are less familiar with the process and less careful due to unconducive environment, they are in a hurry because there is a lot to be packaged, and losing focus because of negligence. When items are checked before delivery, there is always the possibility of human mistakes (Putri, Wibawa, & Laksamana, 2017).

2. Fishbone diagram of customer commit date achievement time cusomer receiving

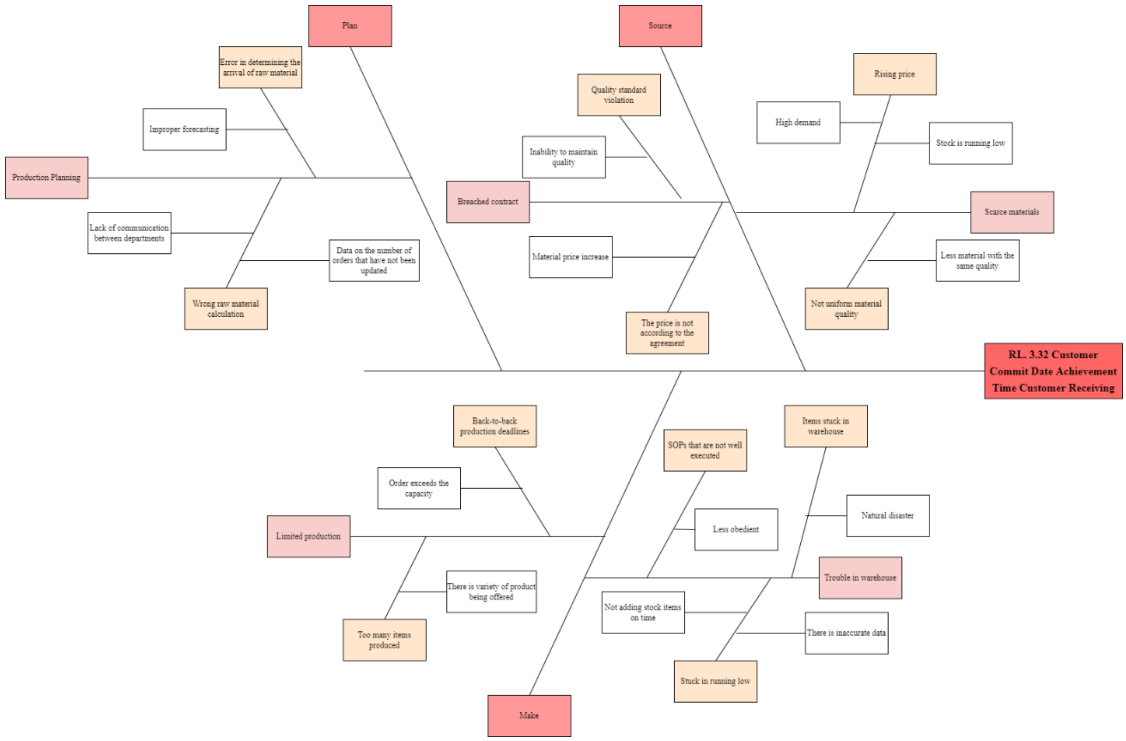

Figure 4.9 Fishbone Diagram of Customer Commit Date Achievement Time Cusomer Receiving

Based on the fishbone diagram, it is identified the cause of the violation of customer commit date achievement time customer receiving. The following are the causes in terms of RL. 3.32 Customer commit date achievement time customer receiving metrics that experiences gaps, namely:

a. Plan

   In the plan process itself, there was an error in the production planning caused by an error in determining the arrival of materials and an error in calculating the amount of raw material purchased. Errors in determining raw material activities due to errors or improper forecasting (Hidayat & Astrellita, 2012). Meanwhile, there was an error in calculating the amount of raw material ordered because the inputted data was not updated and there was a lack of communication between departments (Purba & Wanda, 2014).

b. Source

   In the source process, there are several causes, namely a breach of contract by suppliers of materials and scarce materials. A violation of material quality standards can cause violation of this contract because the supplier cannot maintain quality and the next factor is the price that is outside the contract agreement due to the increase in materials (Utari, 2015). This will hinder the company from obtaining materials. As for the scarcity of this material because the material has increased in price that suppliers are unable to supply it. This price increase is due to low stock and high demand. The next factor due to material scarcity is the non-uniform quality of the material.

c. Make

   In the make process itself, there are 2 main factors, namely limited production capacity and problems in the warehouse. Limited production capacity is caused by the existence of back-to-back production deadlines due to the number of orders that have exceeded capacity and the next contributing factor is a large number of types of items that must be produced because there are various kinds of items offered to the market (Hidayat & Astrellita, 2012). As for the problems that exist in the warehouse due to the low stock of finished goods because the supply of finished goods is not on time to the warehouse and there is inaccuracy of data. The next contributing factor to the warehouse, the problem is the SOP

that is not implemented properly because the workers are not obeyed. The last factor is the item stuck in the warehouse due to a natural disaster (Nikmah, 2015).

3. Fishbone diagram of delivery location accuracy

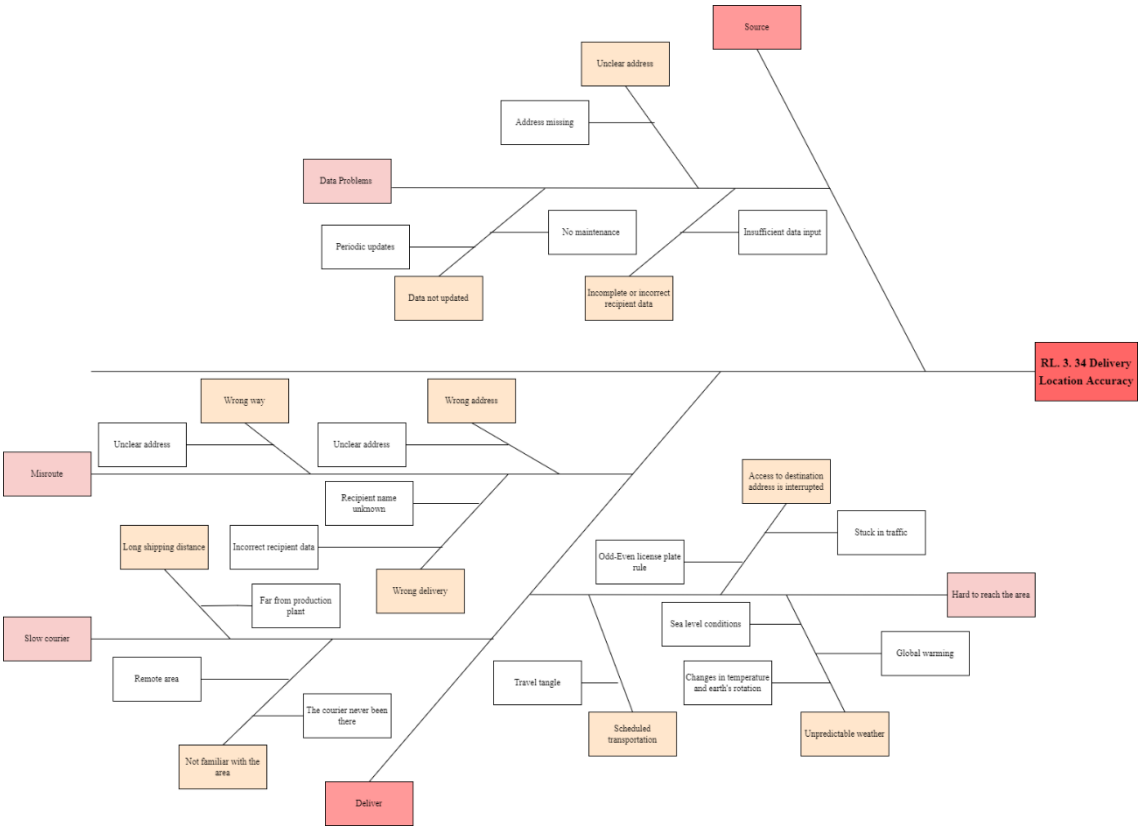

Figure 4.10 Fishbone Diagram of Delivery Location Accuracy

Based on the fishbone diagram, it is known the cause of the delivery location inaccuracy. The following are the causes in terms of RL. 3.34 Delivery location accuracy metrics that experience gaps, namely:

a. Source

In this source process, there are errors or problems in the data due to data that is not updated, lack of recipient data, and unclear addresses. This un-updated data is due to the absence of database maintenance and periodic updates (Somadi, 2020) (Purba & Wanda, 2014). For recipient data, it is incomplete due to insufficient input data for addresses that are not clear because there are missing addresses such as lacking street names, numbers or village names.

b. Deliver

In the delivery process, there are 3 main factors, namely difficulty reaching the delivery area, slow expeditions/couriers, and wrong routes (Permadi & Rahimi, 2015). It is difficult to reach the delivery area due to erratic weather due to global warming and temperature changes, scheduled transportation due to travel tangles, and disrupted access to delivery addresses due to congestion and the odd-even plate regulation (Purba & Wanda, 2014). Then for slow expeditions or couriers because they are unfamiliar with the area and long shipping distance. Unfamiliarity with the area because of the remote area and couriers who never reach the area. As for the long shipping distance because the shipping address is far from the production plant. While this route error can be caused by the wrong way, wrong address, and wrong delivery. Wrong-way, and wrong address are triggered by unclear address or missing part. Wrong delivery is mostly caused by incorrect recipient data and unclear recipient names.

Based on the fishbone diagram, the cause of the gap has been identified, resulting in imperfections in order fulfillment. In summary, the causes of the gap are presented in the following Table 4.18:

Table 4.18 Causes of the Gaps

Metrics		**Causes of Gaps**	
RL. 3.35	Delivery quantity accuracy	#1	Human error
RL. 3.32	Customer commit date achievement time customer receiving	#2	Limited production capacity
		#3	A miscalculation in raw material
		#4	Scarce on raw material
RL. 3.34	Delivery location accuracy	#5	Data problems

The table above shows that there are 5 (five) causes of gaps in RL. 1.1 Perfect Order Fulfillment. Then for a more detailed improvement described in the next phase, namely, optimizing the project.

4.4 Optimize Projects

This stage consists of examining the data that has been calculated and benchmarks that have been performed. This study tries to identify the performance priorities that can be improved and the advantages that we will get from completing the project. The following are the steps from the Optimizing Project:

4.4.1 Project Portfolio

Prior to creating the Project Portfolio, this step will be used to identify projects that will be upgraded. Following the receipt of the results, a portfolio project is formed to identify and categorize the metrics that will be improved. Based on the method and the similarity of the problem, groups are formed. The cause of the gap from RL. 1.1 Perfect order fulfillment that has been identified in the CV. Sumber Baja Perkasa is presented in the project portfolio table as shown in table 4.19 as follows:

Table 4.19 Original Issues

Metrics		Causes of Gaps	
RL. 3.35	Delivery quantity accuracy	#1	Human error
RL. 3.32	Customer commit date achievement time customer receiving	#2	Limited production capacity
		#3	A miscalculation in raw material
		#4	Scarce on raw material
RL. 3.34	Delivery location accuracy	#5	Data problems

4.4.2 Grouping Issues

This stage is a grouping of metrics based on the process and the similarity of the problem. The cause of the gap in CV. Sumber Baja Perkasa is grouped into production and inventory groups and among process plans, source, make, deliver, return, and enable. The metric grouping table (grouping issues) can be seen in Table 4.20 below:

Table 4.20 Grouping Issues

Group	Plan	Source	Make	Deliver	Return
Production	#2 #3		#1		
Inventory	#4				
Administration		#5			

4.4.3 Project List

The project list is a suggested improvement based on the source of the gap. There are six suggestions for improvement based on the causes of the gaps that develop in this situation. Table 26 shows the list of projects in the CV. Sumber Baja Perkasa that will be improved:

Table 4.21 Project List

Metrics Level 1	Metrics Level 2	Metrics Level 3	Project	
RL. 1.1 Perfect Order Fulfillment	RL. 2.1 % of Orders Delivered in Full	RL. 3.35 Delivery quantity accuracy	#1	Automation
	RL. 2.3 Delivery performance to customer commit date	RL. 3.32 Customer commit date achievement time customer receiving	#2	Production planning
			#3	Material calculation standard
			#4	Material Availability Recording
		RL. 3.34 Delivery location accuracy	#5	Update and maintain data regularly

Based on the table above, it has been decided that the 5 (five) projects are ready to move forward with implementation. The SCOR Racetrack's last step, Ready for Implementation, is preparation for implementation.

CHAPTER 5
RESULT AND DISCUSSION

5.1 Ready for Implementation

Ready for Implementation is the final step of the SCOR Racetrack before the project that was compiled in the previous stage is implemented. Here are the steps for the Ready for Implementation stage:

5.1.1 Implementation Project Charter

The Implementation Project Charter is an activity that involves creating a document that contains all of the material contained for a future improvement project.

Table 5.1 Implementation Project Charter

Metric	Case	Plan Improvement		Benefits
RL. 2.3 Delivery performance to customer commit date	There is limited production capacity and on the other hand the company has orders that are over the capability.	#1	Production planning	Increasing the productivity of the production so it can afford all the orders that have been agreed to be fulfilled by the company.
	There is some occurrence where the PPIC department miscalculates the raw material.	#2	Material calculation standard	To identify the list of the raw materials and how many raw materials required to produce the items.

	The scarcity of raw materials that happens in a company, which can hurdle the production schedule.	#3	Material Availability Recording	To track the amount of material in the inventory and the availability of the raw material.
	Lack of maintenance and updating data in the database on a regular basis.	#4	Update and maintain data regularly	To minimize the risk of delivery error in location.

5.1.2 Readiness Check

Readiness Check is a pre-implementation process organized into five categories: Vision, Incentives, Resources, Skills, and Action Plans.

Table 5.2 Readiness Check

Project	Vision	Incentives	Resources	Skill	Action Plan	Result
#1	√	√	√	√	√	Change
#2	√	√	√	√	√	Change
#3	√	√	√	√	√	Change
#4	√	√	√	√	√	Change

Based on Table 5.2, it is explained the 4 (four) projects that have been proposed beforehand can be applied. Then the last stage is the priority matrix.

5.1.3 Prioritization Matrix

A prioritization matrix is a tool that usually used in business process analysis. The prioritization matrix helps in which project to focus on and get done (Peterson, 2019). Prioritization Matrix is the final level of Ready for Implementation. Based on the findings of the preceding analysis, changes will be prioritized in the judgment of the CV. Sumber Baja Perkasa owner depending on effort and risk.

Table 5.3 Prioritization Matrix

CV. Sumber Baja Perkasa		Effort				
		Low ⟷ High				
		1	2	3	4	5
Risk	1					
	2		#3 #1	#2	#4	
	3					
	4					
	5					

Table 5.3 shows four project suggestions, each with its own assessment of work and risk. The prioritized project in the project kick-off is Project 1, which develops a production planning. Developing a production plan will need a significant amount of time and work, as well as a moderate level of risk. The other project has been deferred for the time being in order to optimize efforts on the prioritized project, which is to develop a production plan for CV. Sumber Baja Perkasa.

5.2 Project Kick-Off

To carry out the production functions properly, so it can overcome the late in product delivery. There is a series of activities needed to carry out the production function properly and form a production system. For this reason, planning is carried out to monitor actual production results against production plans and make adjustments. With planning, production activities to be carried out will be more focused and the company can achieve the goal well and overcome the delay in delivery. Therefore, to carry out this project, a work break-down should be implemented:

Table 5.4 Work Breakdown Activity

No.	Work Breakdown	Activity	Product	Deadline
1.	Planning			
	Project Planning	Preparing all interests related to the program for pulley production planning	Previous data on pulley sales	≤10 weeks before the first production planning project implemented
		Preparing the requirement for pulley production planning	Proposal/ draft	≤10 weeks before the first production planning project implemented
	Meeting	Designing activities to be carried out starting from the time of the activity up to the cost to be used	Project charter	≤9 weeks before the first production planning project implemented
		Determining the person who will be in charge of the production planning	The structure of PPIC Department	≤9 weeks before the first production planning project implemented

No.	Work Breakdown	Activity	Product	Deadline
	Administration	Designing SOP for production planning	SOP	≤8 weeks before the first production planning project implemented
2.	Requirement for the Production Planning			
	Making draft	Making draft for calculation in production planning	Excel	≤7 weeks before the first production planning project implemented
	Training Programs Material	Preparing the and making instructional materials for production planning	Guide book	≤6 weeks before the first production planning project implemented
3.	Production Planning			
	Forecasting	Forecasting the demand in the next period	Forecasting	≤5 weeks before the first production planning project implemented
	Making Production Schedule	Making a master production schedule to schedule the production	Master Production Schedule (MPS)	≤5 weeks before the first production planning project implemented
	Calculating material	Making Material Requirement Planning (MRP) to calculate how many materials that need to be available for production	Material Requirement Planning (MRP)	≤4 weeks before the first production planning project implemented
	Calculating production capacity	Calculating Capacity Requirement Planning (CRP)	Capacity Requirement Planning (CRP)	≤4 weeks before the first production planning project implemented

No.	Work Breakdown	Activity	Product	Deadline
	Aggregate planning	Making aggregate planning to minimize the cost	Aggregate Plan	≤3 weeks before the first production planning project implemented
4.	Production			
	Monitoring	Monitoring the production	Report	Day of production
	Improving	Improving if there is any problem out of the production planning	Improvement	Day of production
5.	Pra-Event			
	Evaluation	Evaluating the production planning	Report	≤2 weeks after the production is carried out
		Giving solution and initiation for next production planning	Report	≤2 weeks after the production is carried out

Production Planning is used to adapt demand that comes from forecasting with all abilities in the company's shopfloor. In other words, the company cannot simply follow the result of forecasting that has been obtained. Due to the uncertainty of forecasting results, the type of manufacturing company, and the costs incurred when changing the production level.

In doing production planning, of course, there will be some risks or obstacles that arise. So, it needs a risk mitigation strategy that will focus on the causes of risk. As is known, the cause of risk is the root cause of the emergence of a risk. Identification process Preventive actions are carried out through a review of previous studies regarding production planning. The following is the identification of risks and their preventive actions (Nikmah, 2015) (Utari, 2015):

Table 5.5 Risk and Mitigation Strategy Identification

No.	Risk	Mitigation Strategy
1.	Significant increase in demand	Demand forecasting and inventory planning are carried out together or collaboratively
2,	Significant increase in demand	ERP system empowerment
3.	Late arrival of materials	Implementation of a strategic agreement with 3rd company
4.	Late arrival of materials	Better coordination with suppliers
5.	Late arrival of materials	The company has sufficient raw materials
6.	Late arrival of materials	Have a replacement supplier
7.	Inaccuracy of production planning	Refresher training for PIC
8.	Finished goods shortage	Fulfillment of stock carried out by cross-fulfillment with other companies
9.	Finished goods shortage	The company must always have a stock of producing goods in the warehouse
10.	Limited facilities and resources to support product planning activities	Achieving a balance between limited resources includes the time, cost and quality required
11.	HR is not consistent	Increasing employee motivation through cash bonuses or vacations, staff training, career advancement, prizes for outstanding employees
12.	Market demand fluctuation	Periodic and detailed estimates of the entire project
13.	Inaccuracy of production planning	Production planning system automation
14.	Broken machine	Carry out regular maintenance of equipment and machinery

5.2.1 Forecasting

Forecasting helps to reduce the company's vulnerability or volatility while making short-term operating decisions and long-term development plans. Forecasting is implemented to forecast the pulley make-to-stock since this strategy implemented by the company. The following is the result of forecasting the Pulley demand data for 2021 from January to October. This forecast calculation uses the Simple Average (SA) method, 3-Moving Average (3MA), Weighted Moving Average (WMA), and Simple Exponential Smoothing (SES).

Period in year 2021	Actual Data	Forecast by SA	E SA	|E SA|	Forecast by 3-MA	E 3-MA	|E 3-MA|	Forecast by 3WMA	E 3WMA	|E 3WMA|	Forecast by SES	E SES	|E SES|
1	9400		9400	9400		9400	9400		9400	9400	9400	0	0
2	6750	9400	-2650	2650		6750	6750		6750	6750	9400	-2650	2650
3	5500	8075	-2575	2575		5500	5500		5500	5500	8075	-2575	2575
4	2800	7216.667	-4416.67	4416.67	7216.667	-4416.67	4416.67	6655	-3855	3855	6787.5	-3987.5	3987.5
5	6100	6112.5	-12.5	12.5	5016.667	1083.33	1083.33	4400	1700	1700	4793.75	1306.25	1306.25
6	8750	6110	2640	2640	4800	3950	3950	4990	3760	3760	5446.875	3303.13	3303.13
7	6700	6550	150	150	5883.333	816.667	816.667	6765	-65	65	7098.438	-398.438	398.438
8	11300	6571.429	4728.57	4728.57	7183.333	4116.67	4116.67	7195	4105	4105	6899.219	4400.78	4400.78
9	7800	7162.5	637.5	637.5	8916.667	-1116.67	1116.67	9410	-1610	1610	9099.609	-1299.61	1299.61
10	8950	7233.333	1716.67	1716.67	8600	350	350	8630	320	320	8449.805	500.195	500.195
11	9500	7405	2095	2095	9350	150	150	9075	425	425	8699.902	800.098	800.098
12	9825	7595.455	2229.55	2229.55	8750	1075	1075	8995	830	830	9099.951	725.049	725.049
13	10150	7781.25	2368.75	2368.75	9425	725	725	9552.5	597.5	597.5	9462.476	687.524	687.524
14	10475	7963.462	2511.54	2511.54	0	10475	10475	9922.5	552.5	552.5	9806.238	668.762	668.762
15	10800	8142.857	2657.14	2657.14	0	10800	10800	10247.5	552.5	552.5	10140.62	659.381	659.381
MAD				**2719.26**			**4048.33**			**2668.17**			**1597.45**

Figure 5.1 Forecasting Supply Data Calculation

Here is the graphic for demand forecasting data with several other forecasting methods such as the Simple Average (SA) method, 3-Moving Average (3MA), Weighted Moving Average (WMA), and Simple Exponential Smoothing (SES) that can be shown in the Figure 5.2.

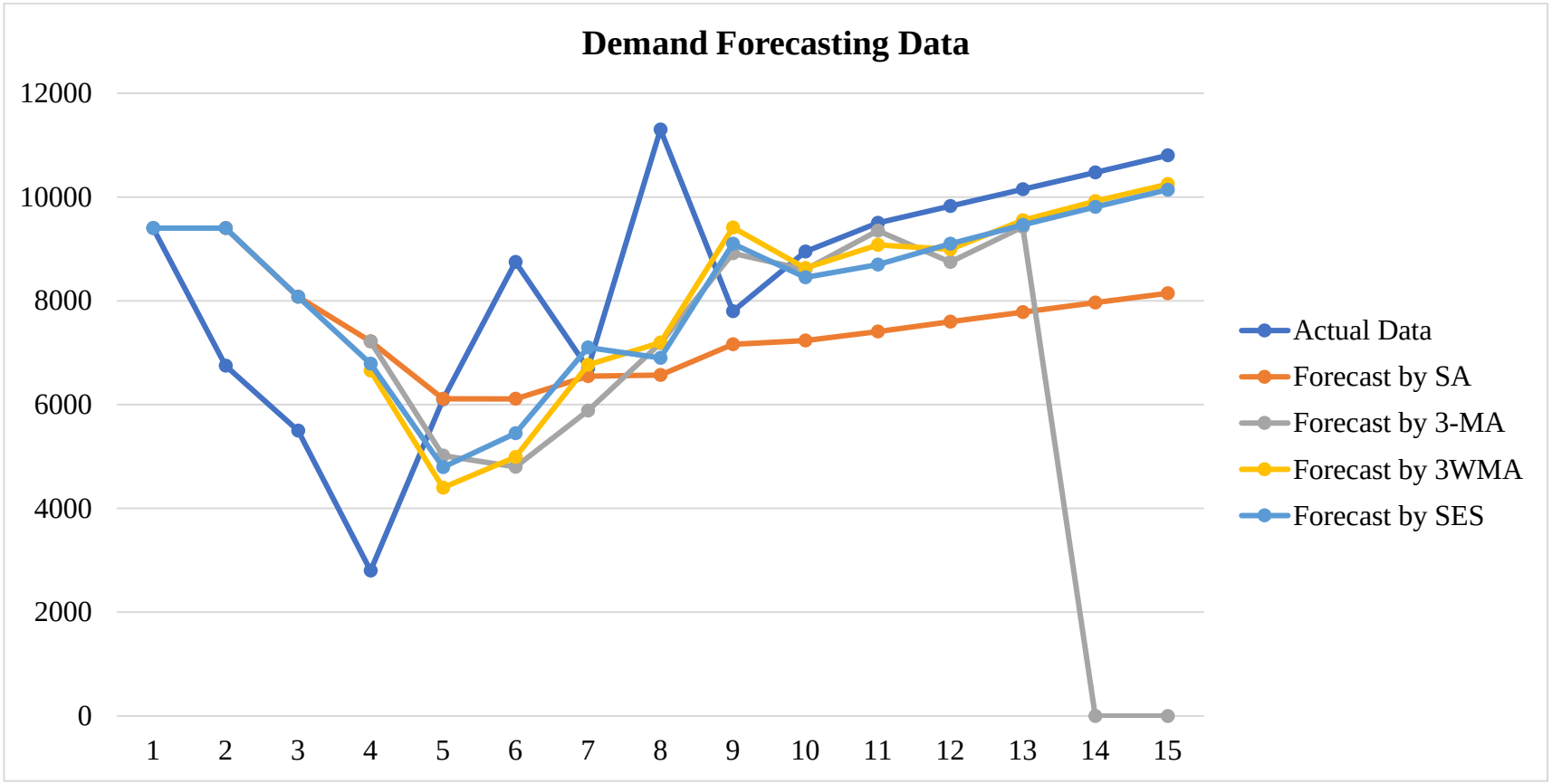

Figure 5.2 Demand Forecasting Data

In the previous case it was found that in the charts, the MA, 3WMA and SES methods are close to the historical demand charts. To choose the best methods, see the smallest MAD than the others. So that the smallest MAD is obtained is SES. Therefore, it can be concluded that the best forecasting in this case study is to use the SES method.

Then, calculate the tracking signal to see whether the SES forecasting is between LCL and UCL.

Period	Actual Data	Forecast by SES	E SES	CUM E SES	|E SES|	CUM |E SES|	MAD	TS	LCL	UCL
1	9400	9400	0	0	0	0	0	0	-12.1658	13.0566
2	6750	9400	-2650	-2650	2650	2650	1325	-0.5	-12.1658	13.0566
3	5500	8075	-2575	-5225	2575	5225	1741.667	-0.33333	-12.1658	13.0566
4	2800	6787.5	-3987.5	-9212.5	3987.5	9212.5	2303.125	-0.25	-12.1658	13.0566
5	6100	4793.75	1306.25	-7906.25	1306.25	10518.75	2103.75	-0.26609	-12.1658	13.0566
6	8750	5446.875	3303.125	-4603.13	3303.125	13821.88	2303.646	-0.50045	-12.1658	13.0566
7	6700	7098.438	-398.438	-5001.56	398.4375	14220.31	2031.473	-0.40617	-12.1658	13.0566
8	11300	6899.219	4400.781	-600.781	4400.781	18621.09	2327.637	-3.87435	-12.1658	13.0566
9	7800	9099.609	-1299.61	-1900.39	1299.609	19920.7	2213.411	-1.16471	-12.1658	13.0566
10	8950	8449.805	500.1953	-1400.2	500.1953	20420.9	2042.09	-1.45843	-12.1658	13.0566
11	9500	8699.902	800.0977	-600.098	800.0977	21221	1929.181	-3.21478	-12.1658	13.0566
12	9825	9099.951	725.0488	124.9512	725.0488	21946.04	1828.837	12.63641	-12.1658	13.0566
13	10150	9462.476	687.5244	812.4756	687.5244	22633.57	1741.044	2.142888	-12.1658	13.0566
14	10475	9806.238	668.7622	1481.238	668.7622	23302.33	1664.452	1.12369	-12.1658	13.0566
15	10800	10140.62	659.3811	2140.619	659.3811	23961.71	1597.448	0.746255	-12.1658	13.0566

Figure 5.3 Tracking Signal of SES Forecasting

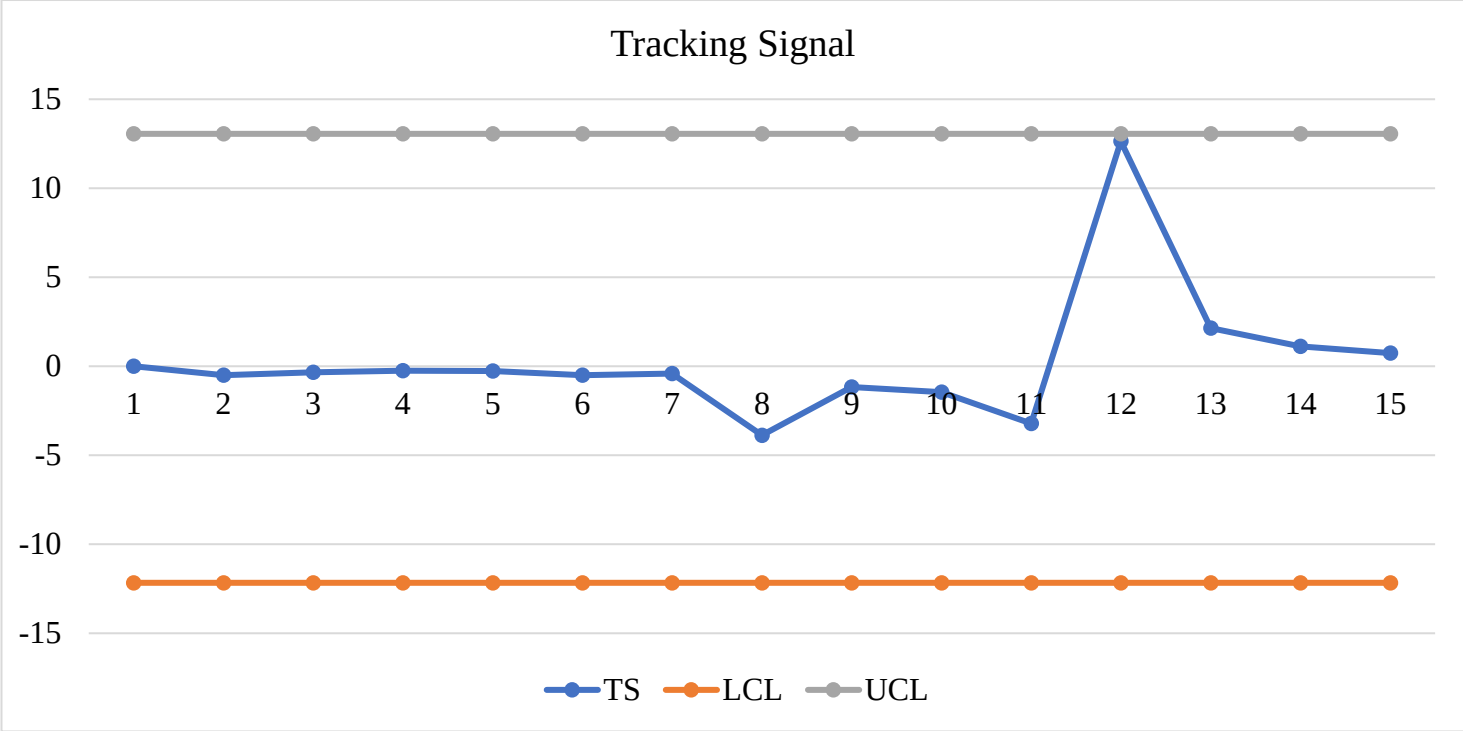

Figure 5.4 Tracking Signal Graph

5.2.2 Master Production Schedule

Based on the lowest error on forecasts and by recalculating the most optimum production capacity with aggregate planning, the quantity of demand as the Master Schedule Production may be generated, as shown in the table below:

Table 5.6 Master Production Schedule

Year	Month	Master Production Schedule (Unit)
2021	January	9400
	February	9400
	March	8075
	April	6787.5
	May	4793.75
	June	5446.875
	July	7098.4375
	August	6899.21875
	September	9099.609375
	October	8449.804688

5.2.3 Material Requirement Planning (MRP)

Material Requirement Planning (MRP) is a mechanism for controlling raw material inventories in a business. In order to prevent any benefits and drawbacks in raw material inventory, a firm that implements policies in raw material planning must have an adequate calculation (Rimawan, Saroso, & Rohmah, 2018). For the material requirement planning, the company has determined that there is a safety stock of 1000 units to anticipate the production shortage if the suppliers are late in supplying with the lead time of 1 month. One period here is similar to one month. Below table demonstrates the material requirement planning that can be implemented by the CV. Sumber Baja Perkasa.

Table 5.7 Material Requirement Planning

Period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Gross Requirement	0	9400	9400	8075	6787.5	4793.75	5446.88	7098.44	6899.22	9099.61	8449.8
Schedule Receipt		9400	0	0	0	0	0	0	0	0	0
Project on hand	5700	5700	1000	1000	1000	1000	1000	1000	1000	1000	1000
Net Requirement			4700	8075	6787.5	4793.75	5446.88	7098.44	6899.22	9099.61	8449.81
Planned order receipt			4700	8075	6787.5	4793.75	5446.88	7098.44	6899.22	9099.61	8449.81
Planned order release		4700	8075	6787.5	4793.75	5446.88	7098.44	6899.22	9099.61	8449.81	

5.2.4 Capacity Requirement Planning (CRP)

CRP is a method of calculating the detailed capacity needed to verify the Material Requirement Planning (Marikena & Rahmania, 2019). Determining work center capacity can be conducted by identifying and defining work centers, calculating work center capacity, as a set of one or more machines and operators that can be considered as a unit for capacity planning and scheduling purposes with use the capacity calculated version. Capacity is calculated based on the available working time multiplied by the utility and efficiency of the machine. The Available work time version is the time scheduled for production, which is less than the maximum available time. For the production flow, namely part A, is as shown in the following figure:

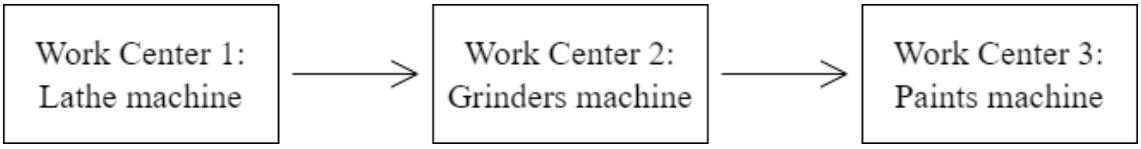

Figure 5.5 Production Flow

The following is a detail of the set-up time and run time of the three work centers.

Table 5.8 Detail of Three Work Center

Part	Operation	Work Center	Setup/Lot	Run time/piece
A	1	1	15	1
	2	2	10	1
	3	3	5	1

In the CRP calculation below it is assumed that the utility and efficiency are 100%. Here is the calculation for Capacity Requirement Planning:

1. Set-Up Time Computation for Planned Order Released

The formula that needed to be implemented to calculate the set-up time for planned order release (POR):

$$Capacity\ required\ for\ planned\ order\ release = set\ up\ \text{time/lot} \times Planned\ order\ release$$

Here is the calculation recapitulation of the set-up time for planned order release (POR):

Table 5.9 Set Up Time Computation for Planned Order Released

Work Center	**Part**	**Period**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
WC 1	A	70500	121125	101812.5	71906.25	81703.2	106476.6	103488.3	136494	126747.2	0
WC 2		47000	80750	67875	47937.5	54468.8	70984.4	68992.2	90996.1	84498.1	0
WC 3		23500	40375	33937.5	23968.75	27234.4	35492.2	34496.1	45498.1	42249.05	0

2. Run Time Calculation for Planned Order Release

The formula that needed to be implemented to calculate the run time for planned order release (POR):

$$Capacity\ required\ for\ planned\ order\ release = run\ time/piece \times Planned\ order\ release$$

Here is the calculation recapitulation of the run time for planned order release (POR):

Table 5.10 Run Time Calculation for Planned Order Release

Work Center	Part	Period									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
WC 1	A	4700	8075	6787.5	4793.75	5446.88	7098.44	6899.22	9099.61	8449.81	0
WC 2		4700	8075	6787.5	4793.75	5446.88	7098.44	6899.22	9099.61	8449.81	0
WC 3		4700	8075	6787.5	4793.75	5446.88	7098.44	6899.22	9099.61	8449.81	0

3. Capacity Requirement for Planned Order Release

   The formula required to calculate the capacity requirement for planned order release (POR):

$$Capacity\ required\ for\ planned\ order\ release = set\ up\ time\ for\ POR + run\ time\ for\ POR$$

   Here is the calculation recapitulation of the capacity requirement for planned order release (POR):

Table 5.11 Capacity Requirement for Planned Order Released

Work Center	Period									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
WC 1	75200	129200	108600	76700	87150.08	113575	110387.5	145593.8	135197	0
WC 2	51700	88825	74662.5	52731.25	59915.68	78082.84	75891.42	100095.7	92947.9	0
WC 3	28200	48450	40725	28762.5	32681.28	42590.64	41395.32	54597.66	50698.9	0

4. Capacity required by Released Order

   The formula that needed to be implemented to calculate the capacity required by the released order:

$$Capacity\ required\ by\ released\ order = Planned\ order\ release \times run\ time \times amount\ of\ deadline\ per\ period$$

Here is the calculation recapitulation of the capacity required by the released order:

Table 5.12 Capacity Required by Released Order

Part	WC	Week	Set Up Time	Total Run Time in a period									
				1	2	3	4	5	6	7	8	9	10
A	1	1,3	15	141000	242250	203625	143812.5	163406.4	212953	206976.6	272988.3	253494.3	0
	2	2,4	10	94000	161500	135750	95875	108937.6	141969	137984.4	181992.2	168996.2	0
	3	2.4	5	47000	80750	67875	47937.5	54468.8	70984.4	68992.2	90996.1	84498.1	0

5. Released Order Capacity Required Summary

The released order capacity required is obtained from the capacity required by the released order. Since it consists only 1 part, it should be moved to the template table to release the order capacity required summary.

Table 5.13 Released Order Capacity Required Summary

Work Center	Period									
	1	2	3	4	5	6	7	8	9	10
WC 1	141000	242250	203625	143812.5	163406.4	212953.2	206976.6	272988.3	253494	0
WC 2	94000	161500	135750	95875	108937.6	141968.8	137984.4	181992.2	168996	0
WC 3	47000	80750	67875	47937.5	54468.8	70984.4	68992.2	90996.1	84498.1	0

6. Capacity Requirement Plan for Standard Widget

   The formula that needs to be implemented is:

$$Capacity\ requirement\ plan\ = capacity\ requirment + releaserd\ order\ capacity$$

   Here is the calculation recapitulation:

Table 5.14 Capacity Requirement Plan for Standard Widget

Work Center	**Period**										**Average**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
WC 1	216200	371450	312225	220512.5	250556.5	326528.2	317364.1	418582.1	388691	0	282211
WC 2	145700	250325	210412.5	148606.3	168853.3	220051.6	213875.8	282087.9	261944	0	190185.7
WC 3	75200	129200	108600	76700	87150.08	113575	110387.5	145593.8	135197	0	98160.34

7. Capacity Available

   The following is the capacity available of the three work centers:

$$Capacity\ Available = number\ of\ machines\ \times working\ time\ \times work\ days$$

   Here is the calculation for the capacity available for each work center:

   a. Work Center 1

      The number of lathe machines is 10 units, so the capacity available:

$$Capacity\ Available = 20 \times (10 \times 60)\ \times 24$$

$$Capacity\ Available = 115{,}200\ minutes$$

      So, the capacity available for lathe machines is 115,200 minutes.

b. Work Center 2

The number of grinders machines is 10 units, so the capacity available:

$$Capacity\ Available = 20 \times (10 \times 60)\ \times 24$$

$$Capacity\ Available = 115{,}200\ minutes$$

So, the capacity available for grinders machines is 115,200 minutes.

c. Work Center 3

The number of paints machines is 10 units, so the capacity available:

$$Capacity\ Available = 10 \times (10 \times 60)\ \times 24$$

$$Capacity\ Available = 115{,}200\ minutes$$

So, the capacity available for paints machines is 115,200 minutes.

The following is the recapitulation of the available capacity:

Table 5.15 Capacity Available

WC	**Period**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	288000	288000	288000	288000	288000	288000	288000	288000	288000	288000

WC	Period									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
2	288000	288000	288000	288000	288000	288000	288000	288000	288000	288000
3	144000	144000	144000	144000	144000	144000	144000	144000	144000	144000

The following is a comparison of the capacity requirement plan with the capacity available at the company:

1. Work Center 1

   Figure 5.4 shows the comparison of the capacity requirement plan with the capacity available of WC1 which is lathe machines.

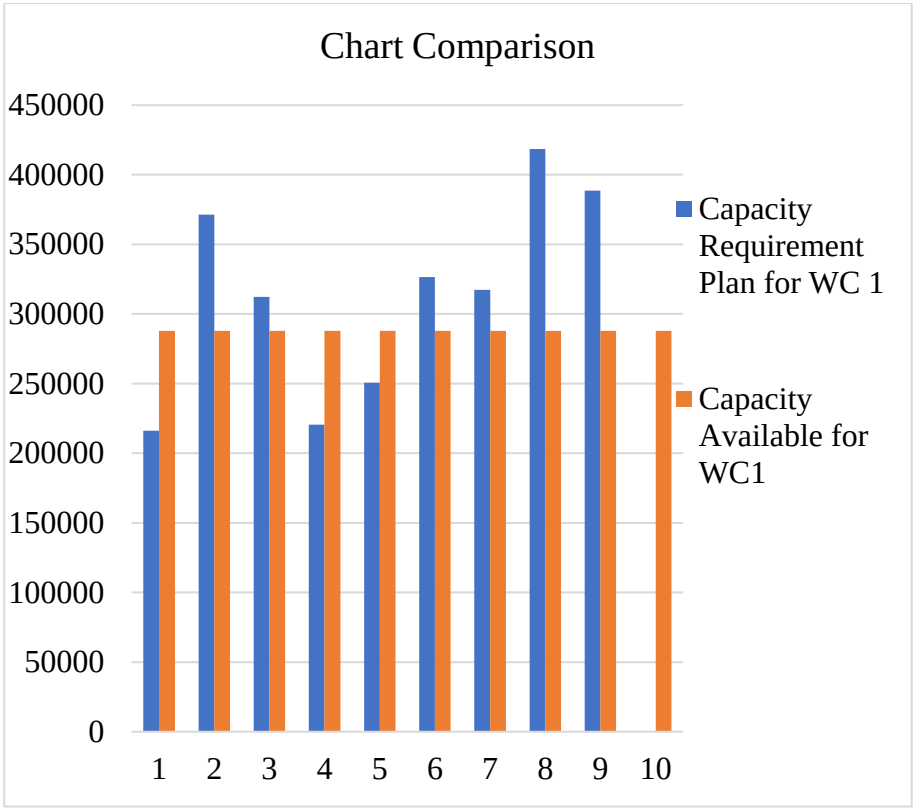

Figure 5.6 Chart Comparison of CPR and Capacity Available for WC1

It can be concluded that in WC1, the capacity required exceeds the capacity available such as in periods 2, 3, 6,7, 8, and 9. So, it is needed to subcontract like on the aggregate planning that has already been recommended to minimize the production cost. Another recommendation is to add machines in WC1.

2. Work Center 2

   Figure 5.5 shows the comparison of the capacity requirement plan with the capacity available of WC2 which is grinders machines.

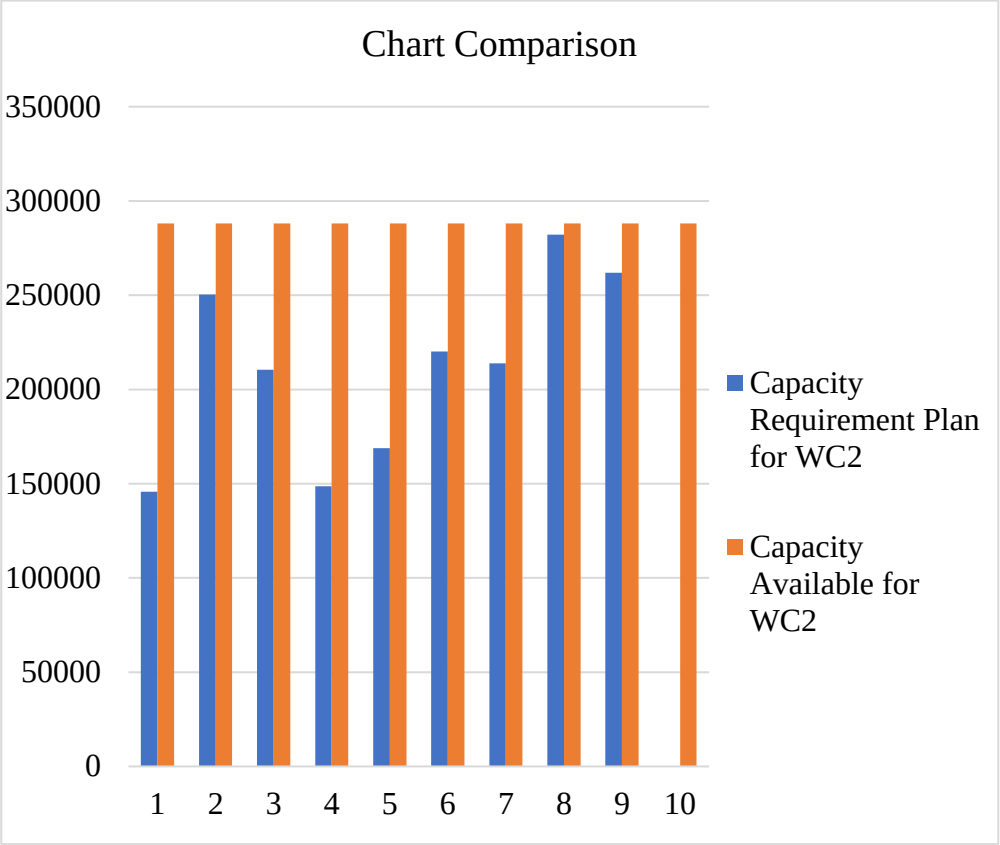

Figure 5.7 Chart Comparison of CPR and Capacity Available for WC2

It can be concluded that in WC2, the capacity required is not exceeding the capacity available. So, it is still good to use and further action is to lay back the employee like on the aggregate planning that has already been recommended to minimize the production cost.

3. Work Center 3

Figure 5.6 shows the comparison of the capacity requirement plan with the capacity available of WC3, which is paint machines.

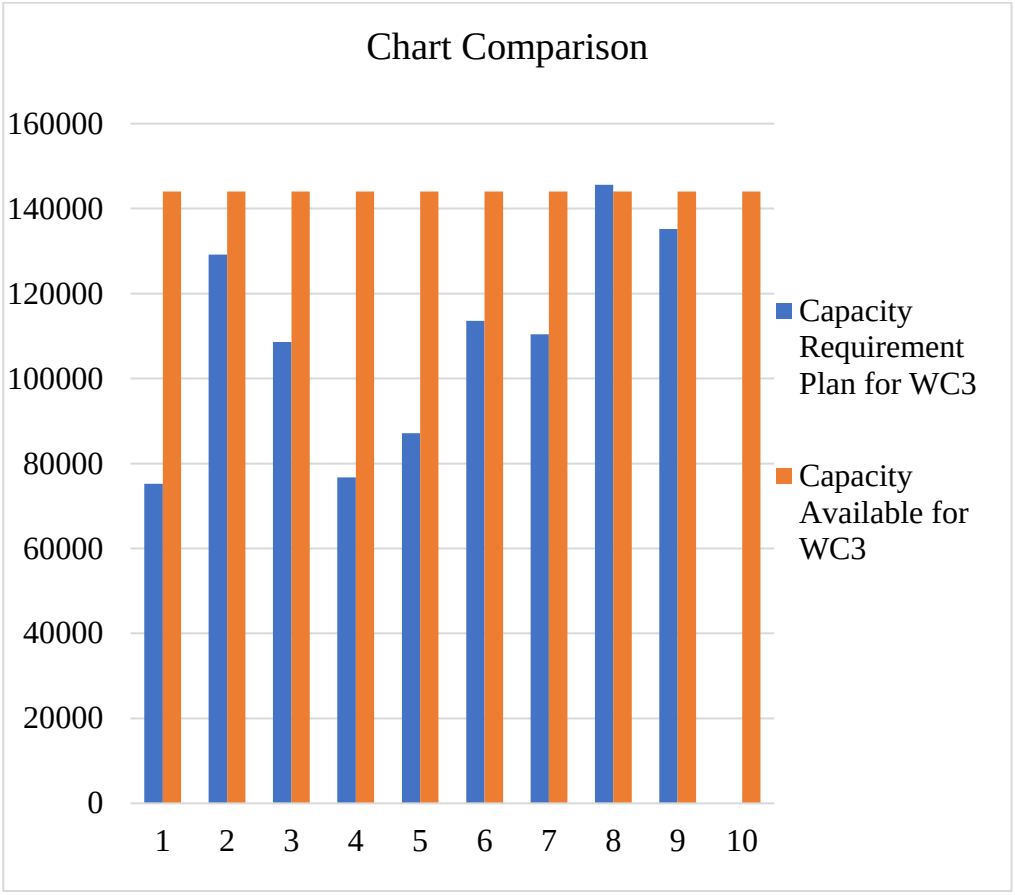

Figure 5.8 Chart Comparison of CPR and Capacity Available for WC3

It can be concluded that in WC3, the capacity required exceeds the capacity available in period 8. So, it is needed to subcontract/overwork/add machine in WC3 on period 8 as the solution.

5.2.5 Aggregate Planning

Aggregate Planning is the process of calculating the entire level of output / production capacity to satisfy the level of demand derived from forecasting and orders, with the goal of reducing total production costs (Sukendar & Kristomi, 2008). Here, it will use the heuristic (trial-and-error) and optimization method. Here is the data needed for aggregate planning obtained from interviewing the owner and the manager of CV. Sumber Baja Perkasa:

Table 5.16 Aggregate Planning Data

Data	Information
Initial inventory	2300 units
Inventory carrying cost	IDR -
Subcontracting cost per unit	IDR 20,000/unit
Average pay rate	IDR 16,700 per hour (IDR 133,000 per day)
Overtime pay rate	IDR 30,000 per hour after regular working hours
Labor-house to produce a unit	0.5 hour per unit
Cost of increasing monthly production rate (hiring and training)	IDR 30,000 per unit
Cost of decreasing monthly production rate (layoffs)	IDR 40,000 per hour

And for the expected demand is retrieved from the forecasting that has already been in the previous sub-chapter.

1. Plan A

   Plan A is to produce at the same rate every month of average demand.

Table 5.17 Calculation of Average Requirement

Period	Expected Demand	Production Days	Demand per Day (computed)	Average Requirement
1	9400	24	391.666667	314.3758138
2	9400	24	391.666667	314.3758138
3	8075	24	336.458333	314.3758138
4	6787.5	24	282.8125	314.3758138
5	4793.75	24	199.739583	314.3758138
6	5446.875	24	226.953125	314.3758138

Period	Expected Demand	Production Days	Demand per Day (computed)	Average Requirement
7	7098.4375	24	295.768229	314.3758138
8	6899.21875	24	287.467448	314.3758138
9	9099.609375	24	379.150391	314.3758138
10	8449.804688	24	352.075195	314.3758138

Here is the calculation of the average unit produced requirement per day:

$$Average\ Requirement = \frac{Total\ Expected\ Demand\ in\ 10\ periods}{Total\ Working\ Days\ in\ 10\ periods}$$

$$Average\ Requirement = \frac{75{,}450.19531\ units}{240\ days}$$

$$Average\ Requirement = 314.3758138\ units/day$$

So, the company needs to produce 314.3758138 units per day to fulfill the average requirement. If it is rounded up then it will be 314 units per day. Here is some formula that will be used in the calculation of the table:

a. Production at 314 units per day

   The following is the formula to calculate the production unit at 314 units per day.

$$Production\ at\ 314\ units\ per\ day_N = average\ requirement \times Production\ days_N$$

   N is the period.

b. Monthly inventory change

   The following is the formula to calculate the monthly inventory change.

$$Monthly\ inventory\ change_N = Production\ at\ 314\ per\ day_N - Demand\ forecast_N$$

   N is the period.

   If the monthly inventory change has a negative value, it means that the production cannot fulfill the demand forecast.

c. Initial inventory

   The following is the formula to calculate the initial inventory.

$$Initial\ inventory_N = Ending\ inventory_{N-1}$$

   It is known that the initial inventory$_1$ is 2,300 units.

d. Ending inventory

The following is the formula to calculate the ending inventory.

$$Ending\ inventory_N = Monthly\ inventory\ change_N + Initial\ inventory_N$$

N is the period.

And here is the recapitulation.

Table 5.18 Recapitulation of Plan A's Implementation

Period	Production at 314 Units per Day	Demand Forecast	Monthly Inventory Change	Initial Inventory	Ending Inventory	Product Shortage
1	7545.019531	9400	-1854.980469	2300	445.0195	-
2	7545.019531	9400	-1854.980469	445.0195313	0	1409.961
3	7545.019531	8075	-529.9804688	0	0	529.9805
4	7545.019531	6787.5	757.5195313	0	757.5195	-
5	7545.019531	4793.75	2751.269531	757.5195313	3508.789	-
6	7545.019531	5446.875	2098.144531	3508.789063	5606.934	-
7	7545.019531	7098.4375	446.5820313	5606.933594	6053.516	-
8	7545.019531	6899.21875	645.8007813	6053.515625	6699.316	-
9	7545.019531	9099.60938	-1554.589844	6699.316406	5144.727	-
10	7545.019531	8449.80469	-904.7851563	5144.726563	4239.941	-
				Total	32455.76	1939.941

Total units of inventory carried over from one month to the next month = 32,455.76 units. Workforce required to produce 314.37581 units per day and here is the calculation.

$$Required\ workforce = \frac{average\ requirement}{working\ hours} \times labour\ hours\ to\ produce\ a\ unit$$

$$Required\ workforce = \frac{314.37581\ units\ per\ day}{8\ hours\ per\ worker\ per\ day} \times 0.5\ hours\ per\ unit$$

$$Required\ workforce = 19.6448836\ workers$$

$$Required\ workforce = \sim 20\ workers$$

So, the required workforce to produce the pulley at rate 314 units per day is 20 workers. Here is the cost calculation if the Plan A is used for production:

$$Regular - time\ labor\ cost = required\ workforce\ \times\ pay\ rate\ in\ a\ day\ \times production\ days$$

$$Regular\ time\ labor\ cost = 20\ workers\ \times Rp.133.000\ per\ worker\ per\ day \times 240\ days$$

$$Regular\ time\ labor\ cost = Rp.638{,}400{,}000.00$$

Since there is no inventory carrying cost and other cost such as overtime, hiring, layoffs, and subcontracting then the cost for plan A is Rp. 638,400,000.00

2. Plan B

   Plan B is to produce at the same rate which is 7000 units per month and subcontract when demand is higher than production. The formula that will be used if plan B is implemented:

   a. Demand per day

      The following is the formula to calculate the demand per day:

$$Demand\ per\ day_N = \frac{Expected\ demand_N}{Production\ days_N}$$

      N in here is the period.

So, in table is the recapitulation if the plan B is implemented:

Table 5.19 Recapitulation of Plan B's Implementation

Period	Expected Demand	Production Per Month	Production Days	Demand Per Day (computed)
1	9400	7000	24	291.6666667
2	9400	7000	24	291.6666667
3	8075	7000	24	291.6666667
4	6787.5	7000	24	291.6666667
5	4793.75	7000	24	291.6666667
6	5446.875	7000	24	291.6666667
7	7098.4375	7000	24	291.6666667
8	6899.21875	7000	24	291.6666667
9	9099.609375	7000	24	291.6666667

Period	Expected Demand	Production Per Month	Production Days	Demand Per Day (computed)
10	8449.804688	7000	24	291.6666667
Total Expected Demand	75450.19531	**Total Production Days**	240	

Here is the calculation for the minimum requirement which come from the minimum amount of number from the demand per day, 292 units per day. After knowing the demand per day, it is necessary to calculate how much production is carried out by the company without relying on outsourcing, the number of workers needed, and the units obtained from outsourcing.

b. In-house production units

The following is the calculation for in-house production units:

$$In-house\ production = minimum\ requirement \times total\ production\ days$$

$$In-house\ production = 292\ units\ per\ day \times 240\ days$$

$$In-house\ production = 70{,}000\ units$$

The amount of product that the company can produce is only 70,000 units out of the 75,450.19531 units expected demand.

c. Worker per day

The following is the calculation for worker per day to fulfill the minimum production number per day:

$$Worker\ per\ day = \frac{minimum\ requirement \times labours\ hours\ to\ produce\ a\ unit}{working\ hours}$$

$$Worker\ per\ day = \frac{292\ units \times 0.5\ hour\ per\ unit}{8\ hours\ per\ worker}$$

$$Worker\ per\ day = 18.25\ workers$$

$$Worker\ per\ day = \sim 18\ workers$$

After the calculation, it can be obtained that the worker needed per day to fulfill the minimum production unit requirement is 18 workers.

d. Sub-contract units

The following is the calculation for the number of sub-contract units:

$$Sub-contract\ units = Total\ expected\ demand - in\ house\ production\ units$$

$$Sub-contract\ units = 75{,}450\ units - 70{,}000\ units$$

$$Sub - contract\ units\ = 5{,}450\ units$$

Then the number of subcontracted units that need to be transferred to another party or company is 5,450 units.

Here is the cost calculation if the Plan B is used for production:

a. Regular time labor cost

The following is the calculation for regular time labor cost:

$$Regular - time\ labor\ cost = required\ workforce\ \times\ pay\ rate\ in\ a\ day\ \times production\ days$$

$$Regular - time\ labor\ cost = 18\ workers/day\ \times\ Rp.133{,}000/worker/day\ \times 240\ days$$

$$Regular - time\ labor\ cost = Rp.574{,}560{,}000$$

For regular time labor costs incurred by the company, namely Rp. 574,560,000.

b. Sub-contracting cost

The following is the calculation for sub-contracting cost:

$$Sub - contract\ units\ cost = sub - contract\ units\ \times sub - contracting\ cost\ per\ unit$$

$$Sub - contract\ units\ cost = 5{,}450\ units\ \times Rp.20{,}000\ per\ unit$$

$$Sub - contract\ units\ cost = Rp.109{,}000{,}000$$

The costs incurred to cover production shortages with sub-contract units are Rp. 109,000,000.

3. Plan C

   Plan C is to produce the same number of requests or demands by changing the number of workers (hiring and firing). The production rate as of December 2020 is 5700 units per month. The following is the formula that will be used for implementing plan C:

   a. Demand per day

      The following is the formula to calculate the demand per day:

$$Demand\ per\ day_N = \frac{Expected\ demand_N}{Production\ days_N}$$

      N in here is the period.

   b. Basic production demand cost

      The following is the formula to calculate the basic production demand:

$$Basic\ production\ demand\ cost_N = expected\ demand_N \times labor - hours\ to\ produce\ unit \times average\ pay\ rate\ per\ hour$$

      N in here is the period.

   c. The extra cost of increasing production (hiring)

      The following is the formula to calculate the extra cost of increasing production (hiring):

$$Extra\ cost\ of\ increasing\ poduction_N = |Demand\ per\ day_{N-1} - Demand\ per\ day_N| \times cost\ increasing\ production\ rate\ per\ unit\ ,$$

      If the demand per day_{N-1} < demand per day_N.

      N in here is the period.

   d. The extra cost of decreasing production (layoff)

      The following is the formula to calculate the extra cost of decreasing production (layoff):

$$Extra\ cost\ of\ decreasing\ poduction_N = |Demand\ per\ day_{N-1} - Demand\ per\ day_N| \times cost\ increasing\ production\ rate\ per\ unit\ ,$$

if the demand per day_{N-1} > demand per day_N.

N in here is the period.

e. Total cost

The following is the formula to calculate the total cost:

$$Total\ cost_N = Basic\ production\ demand\ cost_N + Extra\ cost\ of\ increasing\ production_N + Extra\ cost\ of\ decreasing\ production_N$$

N in here is the period.

Here is the recapitulation if plan C is implemented.

Table 5.20 Recapitulation of Plan C's Implementation

Month	Expected Demand	Production Days	Demand Per Day (computed)	Basic Production Demand Cost	Extra cost of Increasing Production (hiring)	Extra cost of Decreasing Production (Layoff)	Total Cost
December	5700	24	237.5	IDR 47,595,000.00	IDR -	IDR -	IDR 47,595,000.00
January	9400	24	391.6666667	IDR 78,490,000.00	IDR 4,625,000.00	IDR -	IDR 83,115,000.00
February	9400	24	391.6666667	IDR 78,490,000.00	IDR -	IDR -	IDR 78,490,000.00
March	8075	24	336.4583333	IDR 67,426,250.00	IDR -	IDR 2,208,333.33	IDR 69,634,583.33
April	6787.5	24	282.8125	IDR 56,675,625.00	IDR -	IDR 2,145,833.33	IDR 58,821,458.33
May	4793.75	24	199.7395833	IDR 40,027,812.50	IDR -	IDR 3,322,916.67	IDR 43,350,729.17

Month	Expected Demand	Production Days	Demand Per Day (computed)	Basic Production Demand Cost	Extra cost of Increasing Production (hiring)	Extra cost of Decreasing Production (Layoff)	Total Cost
June	5446.875	24	226.953125	IDR 45,481,406.25	IDR 816,406.25	IDR -	IDR 46,297,812.50
July	7098.4375	24	295.7682292	IDR 59,271,953.13	IDR 2,064,453.13	IDR -	IDR 61,336,406.25
August	6899.21875	24	287.4674479	IDR 57,608,476.56	IDR -	IDR 332,031.25	IDR 57,940,507.81
September	9099.609375	24	379.1503906	IDR 75,981,738.28	IDR 2,750,488.28	IDR 3,667,317.71	IDR 82,399,544.27
October	8449.804688	24	352.0751953	IDR 70,555,869.14	IDR -	IDR 1,083,007.81	IDR 71,638,876.96
Total	**75450.19531**	**240**		**IDR 630,009,130.86**	**IDR 10,256,347.66**	**IDR 12,759,440.10**	**IDR 653,024,918.62**

The total cost of using plan C is Rp. 653,024,918.62.

After calculating the cost from the Plan A, B, and C approved by the owner and manager of CV. Sumber Baja Perkasa, below is the recapitulation:

Table 5.21 The Total Cost Recapitulation of Proposed Plan

Cost	Plan A	Plan B	Plan C
Inventory Carrying	-	-	-
Regular Labor	IDR 638,400,000	IDR 574,560,000	IDR 630,009,130.86
Overtime Labor	-	-	-
Hiring	-	-	IDR 10,256,347.66
Layoffs	-	-	IDR 12,759,440.10
Subcontracting	-	IDR 109,000,000	-
Total Cost	IDR 638,400,000	IDR 683,560,000	IDR 653,024,918.6

When viewed from the costs incurred, Plan A was chosen but it should be notified that in Plan A there was a production shortage in periods 2 and 3, which means the company could not meet the existing demand. So, the only remaining plans are B and C, which can be implemented by the company to meet customer demands. From the total cost, it is verified that the cost of Plan C is smaller than Plan B. So, the best plan for CV. Sumber Baja Perkasa is Plan C.

CHAPTER 6
CONCLUSION AND SUGGESTION

6.1 Conclusion

Based on the result of the research that has been conducted in CV. Sumber Baja Perkasa metal casting company, it can be concluded:

1. The researcher found a problem with delays in product delivery and a mismatched number of orders. It can be concluded from the SCOR metrics that there is a problem in reliability. The supply chain performance calculation using level 3 of reliability attribute on SCOR found that there was 68.5% delivery quantity accuracy, 46.1% customer commit date achievement time customer receiving, and 92.4% delivery location accuracy. The root cause of the above three aspects leads to gaps that may cause are human error, limited production capacity, miscalculation, scarce on raw material, and data problems. The issue that needs to be prioritized is the production capacity.
2. In order to overcome the production capacity, production planning needs to be done by implementing several regular activities and mitigation strategies. Several regular activities that need to be implemented such as forecasting, aggregate planning, master production schedule, material requirement planning, and capacity requirement planning.

6.2 Suggestion

Based on the analysis and discussion, the following suggestions can be provided:

1. For CV. Sumber Baja Perkasa

   The result of the research should be able to measure performance on a regular basis and also identify problems in the supply chain to the root. Hence, the correct solution can be accommodated. This solution certainly helps companies to compete in an increasingly competitive market.
2. For further research

Suggestions are given to further explore the conditions that occur at the research site according to the SCOR 12.0 Racetrack method to identify in detail the problems that occur as well as more specific information. Therefore, the proposed solution is appropriate and can contributed to solve the existing problems.

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ATTACHMENT

Pengiriman Pulley 2021

	Pengiriman																			
	Perjanjian Tanggal Penerimaan Barang										Tanggal Terima Barang									
	SKBL Medan	MCB Jakarta	Cahaya Agung Surabaya	Sinar Mas Andika	Nylon	Agung Diesel Jakarta					SKBL Medan	MCB Jakarta	Cahaya Agung Surabaya	Sinar Mas Andika	Nylon	Agung Diesel Jakarta				
Januari	16/1/2021	22/1/2021	16/1/2021	8/1/2021		22/1/2021	10/1/2021		23/1/2021		23/1/2021	22/1/2021	21/1/2021	8/1/2021		23/1/2021	10/1/2021		23/1/2021	
Februari	19/2/2021	22/2/2021	16/2/2021	10/2/2021	13/2/2021	26/2/2021	17/2/2021	7/2/2021	15/2/2021	28/2/2021	23/2/2021	22/2/2021	20/2/2021	10/2/2021	21/2/2021	26/2/2021	20/2/2021	7/2/2021	20/2/2021	28/2/2021
Maret	17/3/2021	22/3/2021	17/3/2021	5/3/2021	15/3/2021	25/3/2021		14/3/2021	17/3/2021	15/3/2021	24/3/2021	23/3/2021	22/3/2021	7/3/2021	22/3/2021	25/3/2021		20/3/2021	21/3/2021	20/3/2021
April	17/4/2021	22/4/2021	16/4/2021	8/4/2021	15/4/2021	27/4/2021		22/4/2021			22/4/2021	22/4/2021	20/4/2021	8/4/2021	22/4/2021	27/4/2021		22/4/2021		
Mei	16/5/2021	22/5/2021	16/5/2021	5/5/2021	19/5/2021					20/5/2021	25/5/2021	22/5/2021	21/5/2021	7/5/2021	20/5/2021					20/5/2021
Juni	18/6/2021	22/6/2021	18/6/2021	7/6/2021	23/6/2021	8/6/2021					23/6/2021	22/6/2021	20/6/2021	7/6/2021	23/6/2021	8/6/2021				
Juli	19/7/2021	22/7/2021	16/7/2021	9/7/2021	20/7/2021	5/7/2021	23/7/2021				24/7/2021	23/7/2021	23/7/2021	9/7/2021	22/7/2021	7/7/2021	23/7/2021			
Agustus	22/8/2021	22/8/2021	19/8/2021	8/8/2021	17/8/2021	5/8/2021	15/8/2021		7/8/2021		22/8/2021	22/8/2021	20/8/2021	8/8/2021	21/8/2021	7/8/2021	21/8/2021		7/8/2021	
September	19/9/2021	22/9/2021	17/9/2021	10/9/2021	21/9/2021	3/9/2021				25/9/2021	22/9/2021	22/9/2021	19/9/2021	10/9/2021	21/9/2021	5/9/2021				25/9/2021
Oktober	17/10/2021	22/10/2021	16/10/2021	8/10/2021	24/10/202	5/10/2021		23/10/2021			24/10/2021	22/10/2021	21/10/202	8/10/2021	24/10/202	5/10/2021		23/10/2021		
November																				
Desember																				

order perusahaan lain disekitar perusahaan
tidak ada order
telat kedatangan barang
masalah di ekspedisi
masalah telat dan ekspedisi
kelebihan/kekurangan jumlah barang

Pengiriman Pulley 2021

	Pengiriman																			
	Perjanjian Tanggal Penerimaan Barang										Tanggal Terima Barang									
	SKBL Medan	MCB Jakarta	Cahaya Agung Surabaya	Sinar Mas Andika	Nylon	Agung Diesel Jakarta					SKBL Medan	MCB Jakarta	Cahaya Agung Surabaya	Sinar Mas Andika	Nylon	Agung Diesel Jakarta				
Januari	16/1/2021	22/1/2021	16/1/2021	8/1/2021		22/1/2021	10/1/2021		23/1/2021		23/1/2021	22/1/2021	21/1/2021	8/1/2021		23/1/2021	10/1/2021		23/1/2021	
Februari	19/2/2021	22/2/2021	16/2/2021	10/2/2021	13/2/2021	26/2/2021	17/2/2021	7/2/2021	15/2/2021	28/2/2021	23/2/2021	22/2/2021	20/2/2021	10/2/2021	21/2/2021	26/2/2021	20/2/2021	7/2/2021	20/2/2021	28/2/2021
Maret	17/3/2021	22/3/2021	17/3/2021	5/3/2021	15/3/2021	25/3/2021		14/3/2021	17/3/2021	15/3/2021	24/3/2021	23/3/2021	22/3/2021	7/3/2021	22/3/2021	25/3/2021		20/3/2021	21/3/2021	20/3/2021
April	17/4/2021	22/4/2021	16/4/2021	8/4/2021	15/4/2021	27/4/2021		22/4/2021			22/4/2021	22/4/2021	20/4/2021	8/4/2021	22/4/2021	27/4/2021		22/4/2021		
Mei	16/5/2021	22/5/2021	16/5/2021	5/5/2021	19/5/2021					20/5/2021	25/5/2021	22/5/2021	21/5/2021	7/5/2021	20/5/2021					20/5/2021
Juni	18/6/2021	22/6/2021	18/6/2021	7/6/2021	23/6/2021	8/6/2021					23/6/2021	22/6/2021	20/6/2021	7/6/2021	23/6/2021	8/6/2021				
Juli	19/7/2021	22/7/2021	16/7/2021	9/7/2021	20/7/2021	5/7/2021	23/7/2021				24/7/2021	23/7/2021	23/7/2021	9/7/2021	22/7/2021	7/7/2021	23/7/2021			
Agustus	22/8/2021	22/8/2021	19/8/2021	8/8/2021	17/8/2021	5/8/2021	15/8/2021		7/8/2021		22/8/2021	22/8/2021	20/8/2021	8/8/2021	21/8/2021	7/8/2021	21/8/2021		7/8/2021	
September	19/9/2021	22/9/2021	17/9/2021	10/9/2021	21/9/2021	3/9/2021				25/9/2021	22/9/2021	22/9/2021	19/9/2021	10/9/2021	21/9/2021	5/9/2021				25/9/2021
Oktober	17/10/202	22/10/202	16/10/202	8/10/2021	24/10/202	5/10/2021		23/10/2021			24/10/202	22/10/202	21/10/202	8/10/2021	24/10/202	5/10/2021		23/10/2021		
November																				
Desember																				

order perusahaan lain disekitar perusahaan
tidak ada order
telat kedatangan barang
masalah di ekspedisi
masalah telat dan ekspedisi
kelebihan/kekurangan jumlah barang