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ANALYSIS OF DELAYS IN DELIVERY OF EXPORTED GOODS USING THE SIX SIGMA METHOD IN FURNITURE COMPANIES

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ABSTRACT

The background of this research was the discovery during a field study that there were problems in the delivery process at Sentana Rattan Furniture, namely delays in delivery which could affect service quality. The purpose of this study is to identify the types of delivery delay problems that often occur, the factors that cause delivery delays, and improvement strategies to reduce delivery delays. The data analysis method used in this study is the six sigma method with the DMAIC (Define, Measure, Analyze, Improve, Control) stages. The results of this study note that the problem of late delivery that occurs is raw materials, factors causing delays in delivery are unavailability of raw materials in warehouses, employees who are less focused, employees do not enter simultaneously, lack of ship space, lack of maintenance of the trucking fleet, changes in weather uncertain. The improvement strategy to reduce delivery delays is to manage raw material inventory properly and increase coorperation with other raw material suppliers, the workforce must focus, make strict regulations, maintain communication with shipping companies, carry out periodic maintenance of the trucking fleet, and maintain communication with buyers. Control of delivery delays is caried out using the standard operational procedure (SOP).

Keywords: Delivery Delay, Six Sigma, DMAIC

INTRODUCTION

The advancement of science and technology has led to increased consumer expectations for their needs to be met quickly, including in the delivery process of goods. In this regard, the availability of transportation facilities is crucial to support the flow of goods and services from one location to another. The delivery process is one of the most critical steps in fulfilling customer demands. Without an effective delivery system, products cannot reach the consumer market, making them difficult to access. With technological advancements and the development of adequate infrastructure, product delivery has become increasingly faster and more efficient. The availability of various transportation modes, including land, sea, and air, has further accelerated the shipping process.

According to Lukas (2004:04), delivery is a logistical activity that involves managing goods related to the transportation and distribution of products from one organizational unit to another, which requires them by a predetermined system. However, in practice, the shipping process does not always run smoothly. Delays in product delivery to consumers are common, often leading to losses for both the company and the buyers. Various internal and external factors cause delivery delays. According to Ervianto (1998), delays occur when the execution time is not utilized according to the agreed-upon schedule. A delay in one area can disrupt other operations, making it impossible to complete tasks on time as scheduled.

Delivery delays have been observed at Sentana Rattan Furniture, a Sukoharjo Regency, Central Java company. This company specializes in manufacturing and exporting wooden and rattan furniture. Delays in product delivery at Sentana Rattan Furniture negatively impact the company's reputation and can cause financial losses for both the company and the buyers. Sentana Rattan Furniture fulfills orders based on buyer specifications outlined in purchase order documents. Typically, the production process at Sentana Rattan Furniture takes a maximum of two months from the issuance of a purchase order. However, the production timeline depends on several factors, including order volume, raw material availability, and the complexity of the requested product.

Poor inventory management is one of the leading causes of delivery delays at Sentana Rattan Furniture. Insufficient raw material stock increases the risk of stockouts, as raw materials cannot always be procured immediately or in the required quantities. This issue leads to production stoppages, delays in sales, and potential customer loss. Additionally, the time required to complete orders contributes to delivery delays at Sentana Rattan Furniture. Timely delivery is crucial, as it significantly impacts customer satisfaction. Meeting delivery deadlines according to the estimated schedule ensures excellent service. However, any delays in the delivery process can damage the company's reputation. Delivery time refers to when a customer places an order until the product arrives at the customer's location. The actual arrival time compared to the estimated delivery time is often the key factor customers use to assess the reliability of a delivery service (Sakti & Mahfudz, 2018).

In the study conducted by Haryono and Sari (2016), one of the factors influencing customer satisfaction levels is timely delivery. Their research aimed to identify the causes of

delivery delays. The data analysis technique employed was the fishbone or cause-and-effect diagram. Their findings indicated that the variables causing delivery delays were related to machines, methods, and financial resources. From these root issues, several factors leading to delivery delays were identified, including the company's failure to budget for travel allowances that fall under the scope of delivery, traffic congestion and rerouting, damage to operational resources, the presence of unnecessary operational resources, and the loss of specific product components.

In the study by Somadi (2020), it was stated that service quality is one of the primary considerations for consumers when selecting a company. One form of such service quality is on-time delivery. This research aimed to identify types of frequent delivery delays and the factors causing them, as well as propose corrective strategies to address these issues. The methodology employed was the Six Sigma approach, specifically following the DMAIC stages (Define, Measure, Analyze, Improve, Control). Based on the findings, the most common type of delay was the late submission of shipping documents. The factors contributing to these delays included postponed stuffing schedules, miscommunication regarding shipment details sent to the EMKL (freight forwarding company), delays in booking vessels, lack of communication, insufficient truck fleets, and a disorganized workspace.

Furthermore, Sulistyo and Nugroho (2022) examined package delivery delays at the J&T DC Sleman Barat facility in Yogyakarta, where 107,759 packages were scheduled for delivery. Out of those, 405 packages were delayed. A total of 371 packages were delayed because the customer's address was incomplete or incorrect. The remaining 34 packages were delayed due to customer complaints indicating discrepancies in the shipped items. These delayed packages required follow-up confirmations with customers and the sellers before re-shipment, ensuring the packages would reach their intended recipients. In this study, delivery delays were considered defects in service quality. The primary purpose of their research was to enhance the company's customer service to foster customer satisfaction. The study again employed the Six Sigma methodology, precisely the DMAIC concept (Define, Measure, Analyze, Improve, Control). The results indicated that the most common type of delay was misdirected shipments. The main contributing factors included a high volume of work, incorrect or incomplete shipping addresses provided by customers, lack of employee focus, untimely reporting of warehouse daily stock, absence of updated information provided to couriers about the availability of tools or packages for re-delivery, and the accumulation of documents in the workplace.

Service quality refers to the level of service provided to customer expectations and needs. In that sense, high-quality service occurs when it meets most of the customer's expectations. When generated, satisfaction motivates customers to make repeat purchases and fosters loyalty (Zikri & Harahap, 2022).

RESEARCH METHODS

This study adopts a descriptive quantitative research design. Data sources comprise both primary and secondary data. The primary data, serving as the main source for this

research, were gathered from shipping reports collected during field observations carried out by the researcher throughout an internship at Sentana Rattan Furniture. Meanwhile, the secondary data were obtained from various journal publications. Data collection methods included interviews and document studies; interviews were conducted to acquire more detailed insights on the research topic, particularly issues about shipping delays.

This study implements the Six Sigma methodology in data analysis following the DMAIC (Define, Measure, Analyze, Improve, Control) framework. The first phase, Define, focuses on identifying the key problems encountered at Sentana Rattan Furniture—specifically, shipping delays—and clarifying the factors contributing to these delays. During this Define phase, several analytical tools are employed. The SIPOC Diagram describes the production process from start to finish or from raw materials to finished goods.

Critical to Quality (CTQ) is employed to pinpoint the elements causing shipping delays and establish the most frequent problems. The Pareto Diagram was utilized to determine which factors exert the most significant influence among all identified causes of shipping delays. The Pareto diagram also helps specify the CTQ factors. In the subsequent steps, these CTQ factors are further analyzed using a control chart to define the necessary improvements for mitigating shipping delays.

During the Measure phase, the study quantifies delays in export shipments at Sentana Rattan Furniture by calculating DPOM and sigma capability and using control charts. The Analyze phase is then conducted to clarify the ongoing issues further and ascertain their root causes. Here, a fishbone diagram (or cause-and-effect diagram) is employed to systematically identify the primary drivers of shipping delays at Sentana Rattan Furniture.

The improvement phase involves formulating and implementing corrective measures to minimize shipping delays, guided by a 5W+1H analysis based on the root causes identified in the fishbone diagram. Finally, the Control phase concentrates on establishing strategies for continuous monitoring and ensuring that the improvements made in the previous phase are sustained. This stage includes creating a Standard Operating Procedure (SOP) for the company, thereby reducing the risk of recurrent shipping delays in the future.

RESULTS AND DISCUSSION

The data below is data on goods deliveries at Sentana Rattan Furniture from 2020 to 2022.

Table 1. Delivery Data at Sentana Rattan Furniture for 2020-2022

No	Product	Time	Number of Units	Information	Time Late	Problem
1	Furniture	7 Januari 2020	1050 pcs	Late	3 Days	Raw material
2	Furniture	1 Agustus 2020	6 pcs	On time	-	-

No	Product	Time	Number of Units	Information	Time Late	Problem
3	Furniture	24 Desember 2020	191 pcs	On time	-	-
4	Furniture	19 Januari 2021	296 pcs	Late	3 Days	Raw material
5	Furniture	16 Maret 2021	14 pcs	On time	-	-
6	Furniture	7 Juni 2021	220 pcs	Late	5 Days	Armada
7	Furniture	27 Juli 2021	6 pcs	On time	-	-
8	Furniture	10 Agustus 2021	108 pcs	Late	2 Days	Raw material
9	Furniture	27 Agustus 2021	117 pcs	Late	3 Days	Fleet
10	Furniture	3 Januari 2022	250 pcs	On time	-	-
11	Furniture	3 Februari 2022	30 pcs	On time	-	-
12	Furniture	25 Februari 2022	160 pcs	Late	4 Days	Raw material
13	Furniture	1 Maret 2022	10 pcs	On time	-	-
14	Furniture	27 Maret 2022	54 pcs	Late	2 Days	Raw material
15	Furniture	20 Mei 2022	238 pcs	Late	3 Days	Fleet
16	Furniture	30 Juni 2022	60 pcs	Late	3 Days	Raw material
17	Furniture	24 Agustus 2022	150 pcs	Late	3 Days	Raw material
18	Furniture	1 September 2022	100 pcs	On time	-	-
19	Furniture	1 Oktober 2022	150 pcs	Late	4 Days	Raw material
20	Furniture	9 November 2022	83 pcs	On time	-	-
21	Furniture	7 Desember 2022	6 set	On time	-	-
22	Furniture	6 Desember 2022	285 pcs	Late	3 Days	Raw material

Source: Sentana Rattan Furniture, May 2022 (Processed)

Table 1 shows that there have been delays in the delivery of goods in the last 3 years. The researcher used the goods delivery data to elaborate on the discussion of the researcher's research, which focused on delays in the delivery of goods at Sentana Rattan Furniture.

The define stage is the initial stage to identify the problem of late delivery of goods at Sentana Rattan Furniture by determining critical to quality (CTQ) through the SIPOC (Supplier-Input-Process-Output-Customer) diagram. The following is a diagram of the goods delivery process at Sentana Rattan Furniture:

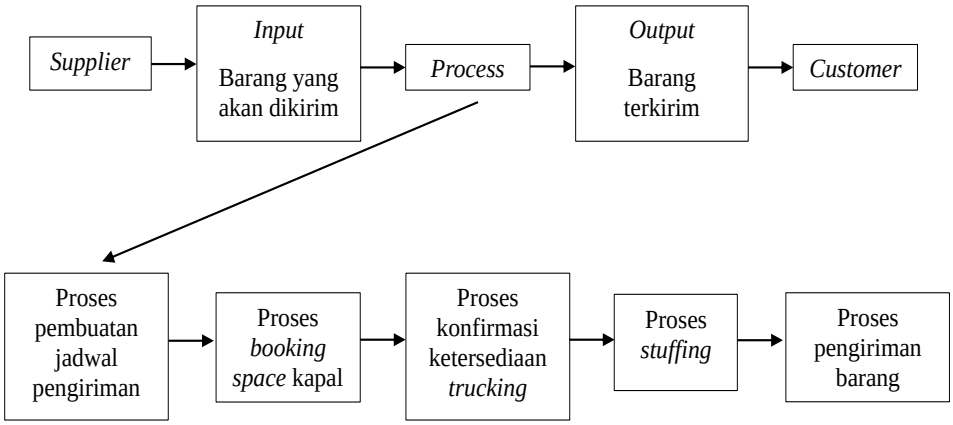

Figure 1. SIPOC Goods Delivery Diagram

Based on the SIPOC diagram above, it is hoped that the goods delivery process can run smoothly. However, in implementation, the process of sending goods experienced delays in delivery. The next stage is calculating critical quality (CTQ) for the late delivery of goods at Sentana Rattan Furniture.

Next, the critical to quality (CTQ) score is calculated. At the critical to-quality stage, the factors that cause delays in the delivery of goods are identified, and problems that often occur are determined using data on the delivery of goods at Sentana Rattan Furniture.

Table 2. Problems with Delivery of Goods at Sentana Rattan Furniture in 2020-2022

No	Year	Problem		Total
		Raw Material	Fleet	
1	2020	I		1
2	2021	I	III	4
3	2022	IIIII I	I	7
Total		8	4	12

Source: Sentana Rattan Furniture, May 2022 (Processed)

The critical to quality (CTQ) calculation is as follows:

Raw Material

$$\text{Persentase \%} = \frac{Jumlah\ jenis\ masalah\ keterlambatan}{Jumlah\ total\ keterlambatan}$$

$$= \frac{8}{12} \times 100$$

$$= 66{,}7\%$$

Fleet

$$\text{Persentase \%} = \frac{Jumlah\ jenis\ masalah\ keterlambatan}{Jumlah\ total\ keterlambatan}$$

$= \frac{4}{12} \times 100$
$= 33{,}3\%$

Table 3. Percentage of Goods Delivery Problems Based on CTQ

No	Problem	Total	Percentage (%)	Percentage Cumulative (%)
1	Raw Material	8	66,7 %	66,7 %
2	Fleet	4	33,3 %	100 %
	Total	12	100	

Source: Researcher Process, 2023

Determination of Critical To Quality (CTQ) to be able to identify critical to quality (CTQ) which was developed through specifications sourced from goods delivery data at Sentana Rattan Furniture.

Table 4. Critical To Quality CTQ Characteristics

No	Problem	Types of Losses
1	Raw Material	There is a change in the goods delivery schedule and the goods are late for delivery Influences the trust of buyers
2	Fleet	There is a change in the goods delivery schedule and the goods are late for delivery

Source: Researcher Process, 2023

Based on table 4, it is known that losses arise due to delays in delivery of the goods. Next is the Pareto diagram based on critical to quality (CTQ). The Pareto diagram shows the most influential factor of the two existing factors. The following is a Pareto diagram of these two factors:

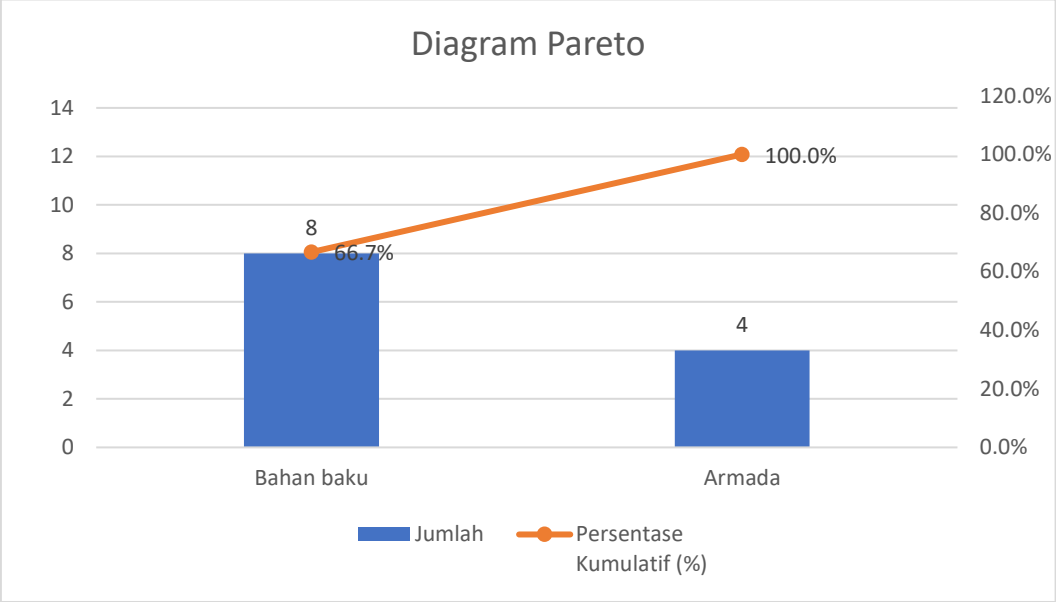

Figure 2. Pareto Diagram Results of Problem Factor Identification

Based on the Pareto diagram derived from the problem identification in Figure 2, it is evident that the factor most frequently contributing to delivery delays is the raw materials factor at 66.7%, compared to the fleet factor at 33.3%. The raw materials issue arises primarily due to the lack of available wood in the warehouse when furniture production is increasing. Consequently, the company must join a waiting list with other firms seeking the same wood supplies. Based on the comparison of these two factors, improvements are necessary to enhance the company's overall quality.

After calculating and identifying the most frequently occurring issues, this Measure phase focuses on quantifying the primary problem—shipping delays. As shown in Table 1, there are 22 total shipments, of which 12 experienced delays; these figures will be used to calculate the DPOM (Defect Per Million Opportunities). The following section details the calculation process.

Calculation of DPOM and Sigma Capability

DPO $= \frac{Jumlah\ total\ keterlambatan}{Jumlah\ pengiriman\ X\ Peluang}$

$= \frac{12}{22\ x\ 1}$

= 0,5454

DPMO = DPO x 1.000.000

= 0,5454 x 1.000.0000

= 545.400

Next, the sigma value is calculated using Ms. Excel, the formula is:

= NORMSINV(1-DPOM/1.000.000)+1,5

= NORMSINV(1-545.400/1.000.0000)+1,5

= 1,3859 = 1,39

Based on the above calculations, 1.5 is the shift value for the Six Sigma quality level. Furthermore, the calculated DPMO (Defects Per Million Opportunities) is 545,400, from 12 delays out of 22 shipments. With a DPMO of 545,400, the corresponding Sigma value is 1.39, and the probability of a delay-free shipping process is 45.46%. In other words, there is a 45.46% chance that shipments will be delivered on time and a 54.54% likelihood of delays. Given this delay rate, it is evident that improvements must be implemented to mitigate shipping delays.

Following the Critical to Quality (CTQ) calculations, raw materials were identified as the primary factor contributing to shipping delays. The next step involves determining whether these delays fall within statistical control limits, employing a control chart (P chart). Table 4 presents the calculations for the P chart.

Percentage of Delays Each Year:

P tahun 2020 = $\frac{1}{3}$ = 0,3333

P tahun 2021 = $\frac{4}{6}$ = 0,6667

P tahun 2022 = $\frac{7}{13}$ = 0,5385

Average Delay Percentage or Center (CL) as the Center Line on the Control Chart:

CL = $\frac{12}{22}$ =0,5455

Upper Control Limit (UCL) and Lower Control Limit (LCL)

UCL = $CL + 3\frac{\sqrt{CL(1-CL)}}{Jumlah\ total\ pengiriman}$

= $0{,}5455 + 3\frac{\sqrt{0{,}5455(1-0{,}5455)}}{22}$

= 0,8639

LCL = $CL - 3\frac{\sqrt{CL(1-CL)}}{Jumlah\ total\ pengiriman}$

= $0{,}5455 - 3\frac{\sqrt{0{,}5455(1-0{,}5455)}}{22}$

= 0,2270

Based on the calculations above, the control limit calculation for the number of goods delivered and the number of delivery delays can be seen in the following table:

Table 5. Calculation of P Delay Control Limits

Years	Number of shipments	Number of Delays	P	CL	UCL	LCL
2020	3	1	0,3333	0,5455	0,8639	0,2270
2021	6	4	0,6667	0,5455	0,8639	0,2270
2022	13	7	0,5385	0,5455	0,8639	0,2270

Source: Researcher Process, 2023

The control chart diagram based on table 8 is as follows:

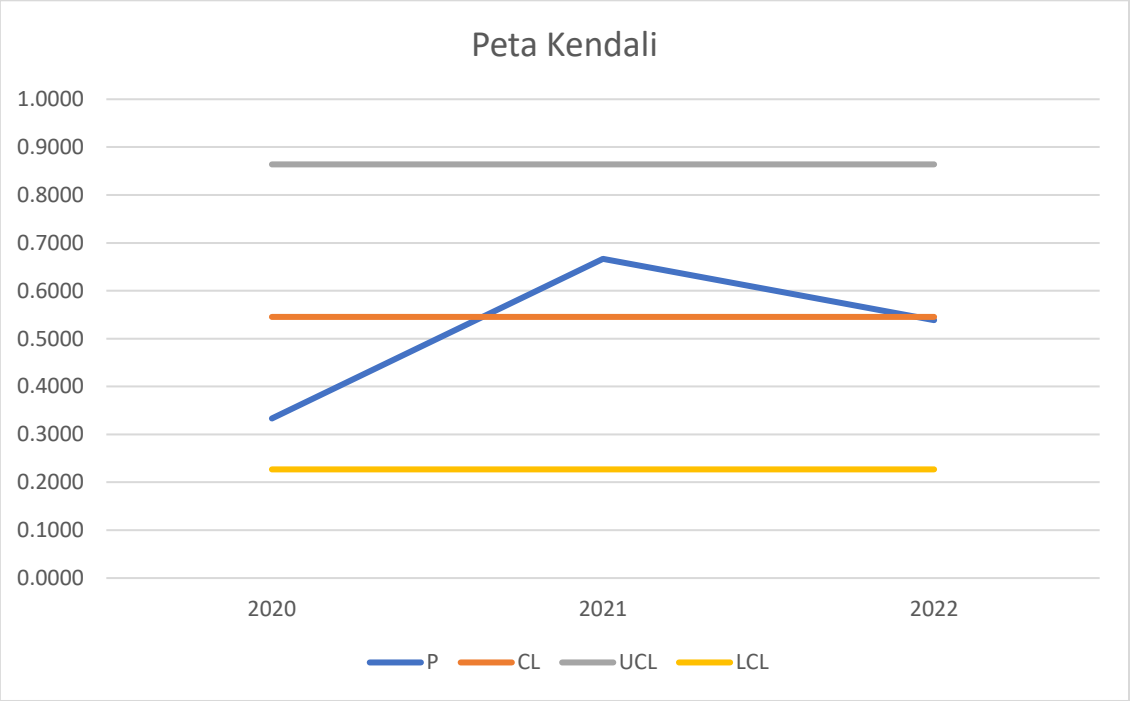

Figure 3. P Delay Control Map Diagram

Figure 3 above shows that there are data points extending upward, although they do not surpass the upper control limit. This indicates that, while there is a proportion of shipping delays, they remain manageable. Hence, a more detailed analysis of the root causes of these delays is required using a fishbone diagram, which will subsequently guide corrective actions.

The Analyze phase seeks to clarify the underlying issues and to pinpoint their root causes. Here, a fishbone diagram is a primary tool for identifying the factors contributing to shipping delays at Sentana Rattan Furniture. The following section provides an analysis using the fishbone diagram.

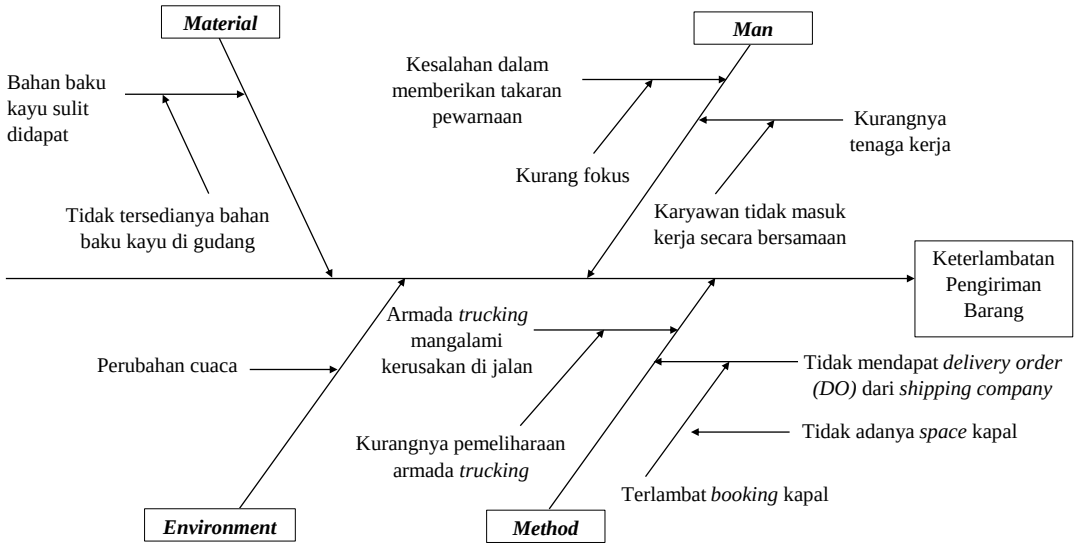

Figure 4. Fishbone diagram analysis

From the analysis conducted in the Analyze phase, the first factor contributing to shipping delays is related to materials. Sentana Rattan Furniture collaborates with various suppliers located in different regions. The raw materials used by Sentana Rattan Furniture include teak roots and branches from Ngawi and Bojonegoro, mahogany from Serenan (Klaten) and Tlogosari (Boyolali), as well as rattan, banana stems, pandan leaves, and water hyacinth from Surabaya and Jepara. Sentana Rattan Furniture does not maintain a well-managed raw materials inventory. When a customer places an order, the needed materials are often unavailable in the warehouse, forcing the company to request additional raw materials from suppliers via WhatsApp or telephone.

Ordering raw materials from these suppliers is not always seamless; the process can take around three weeks to one month before the materials are ready and delivered to Sentana Rattan Furniture. Moreover, when furniture production surges, raw materials become more difficult to obtain, requiring the company to queue alongside other businesses. Consequently, waiting times may exceed expected durations because the selected suppliers also serve orders from multiple companies. These delays cause the production timeline at Sentana Rattan Furniture to fall behind the initially scheduled deadline, ultimately impacting on-time shipment.

The second factor pertains to human resources (man). Ideally, every company aspires to recruit employees with high-quality performance and a sense of responsibility. In reality, however, not all personnel at Sentana Rattan Furniture demonstrate this level of accountability. It is common for employees to be absent on the same day without proper notification, primarily due to inadequate supervision or consequences for such behavior. Consequently, the remaining employees must double up on tasks to meet production targets, leading to slower production cycles. Additionally, unfocused employees can disrupt the production process. For instance, errors in measuring or mixing colors for furniture products could mean a second color coat that does not match the first, thus requiring time-consuming revisions.

The third factor concerns methods. For instance, when there is a lack of available cargo space on a vessel, Sentana Rattan Furniture may be unable to make timely bookings. This results in the company's failure to receive a delivery order (DO) from the shipping company, preventing them from retrieving containers at the depot. Under these circumstances, shipping cannot be completed according to the predetermined schedule. The heightened frequency of export shipments further exacerbates the problem, often requiring rescheduling based on vessel availability.

Additionally, inadequate maintenance of trucking fleets used for stuffing (loading goods into containers) can lead to vehicle breakdowns en route to the company's premises. The trucking firm must send mechanics to the site for repairs if a truck breaks down. If the damage is significant and requires extensive repair time, a replacement truck must be dispatched to the company for stuffing. These extra steps introduce delays and disrupt the overall shipping schedule.

Lastly, environmental factors also play a significant role. Sentana Rattan Furniture's production process heavily depends on sunlight to dry furniture products. Unpredictable weather or a lack of sufficient sunlight prolongs the drying stage. Under favorable conditions, the drying process takes roughly two to three days; in adverse conditions, it can take twice as long—or even longer—to ensure the products are dehydrated and ready for the next production stage. Inevitably, this extended drying period delays shipment.

After employing the fishbone diagram to identify these root causes, the next step is the Improve phase, wherein the 5W+1H analysis (Who, What, When, Where, Why, and How) is utilized to propose targeted solutions. The following section details recommended improvements based on the fishbone diagram's findings.Tabel 9.

Table 6. Analysis of Improvement Proposals

Factor	Description	Explanation
The unavailability of raw materials in warehouses means that raw materials are difficult to obtain	What	Unavailability of raw materials
	When	When there is a product order
	Where	Warehouse
	Why	So that the production process can be carried out quickly and completed on time
	Who	Production workforce
	How	Manage raw material inventory management well and increase cooperation with other raw material suppliers.
Employees who lack focus result in errors in giving coloring doses	What	Employees who lack focus
	When	During the finishing process
	Where	Place of production or company location
	Why	So that the color given to the product matches the buyer's request and the product is not revised
	Who	Production workforce
	How	The workforce must focus and re-confirm the color dosage that will be given to the product

Factor	Description	Explanation
Employees who are absent from work at the same time result in a labor shortage that hampers the production process	What	Employees do not come to work at the same time
	When	When there is a delivery target
	Where	Place of production or company location
	Why	To prevent employees from having to double up on tasks, ensuring that the shipping process can be carried out on time.
	Who	Production workforce
	How	Make regulations aimed at employees so that employees can be disciplined at work
The lack of ship space results in delays in booking ships so that you don't get a DO from the shipping company	What	There is no ship space
	When	When booking a ship
	Where	Administration room
	Why	In order to get space on the ship so that it is not too late to book the ship and the goods arrive at the destination country on time
	Who	Administration and delivery staff
	How	Maintain good and active communication with the shipping company
Lack of maintenance on the trucking fleet has resulted in the trucking fleet experiencing damage on the road	What	Lack of maintenance on the trucking fleet
	When	When heading to the company location for stuffing
	Where	on the road
	Why	So that there are no delays in stuffing
	Who	Trucking fleet driver
	How	Carry out regular maintenance of the trucking fleet
Weather changes cause the production process to be hampered, causing delivery delays	What	Unpredictable weather
	When	During the product drying process
	Where	Place of production or company location
	Why	So that the color on the product can dry quickly
	Who	Natural weather
	How	Maintain good communication with buyers and provide explanations regarding weather changes to ensure time tolerance

Source: Researcher Process, 2023

The final stage is the control stage, which is carried out to minimize the problem of late delivery of goods by creating a company Standard Operational Procedure (SOP) addressed to all employees at Sentana Rattan Furniture. The following is the Standard Operational Procedure (SOP) that can be applied to Sentana Rattan Furniture:

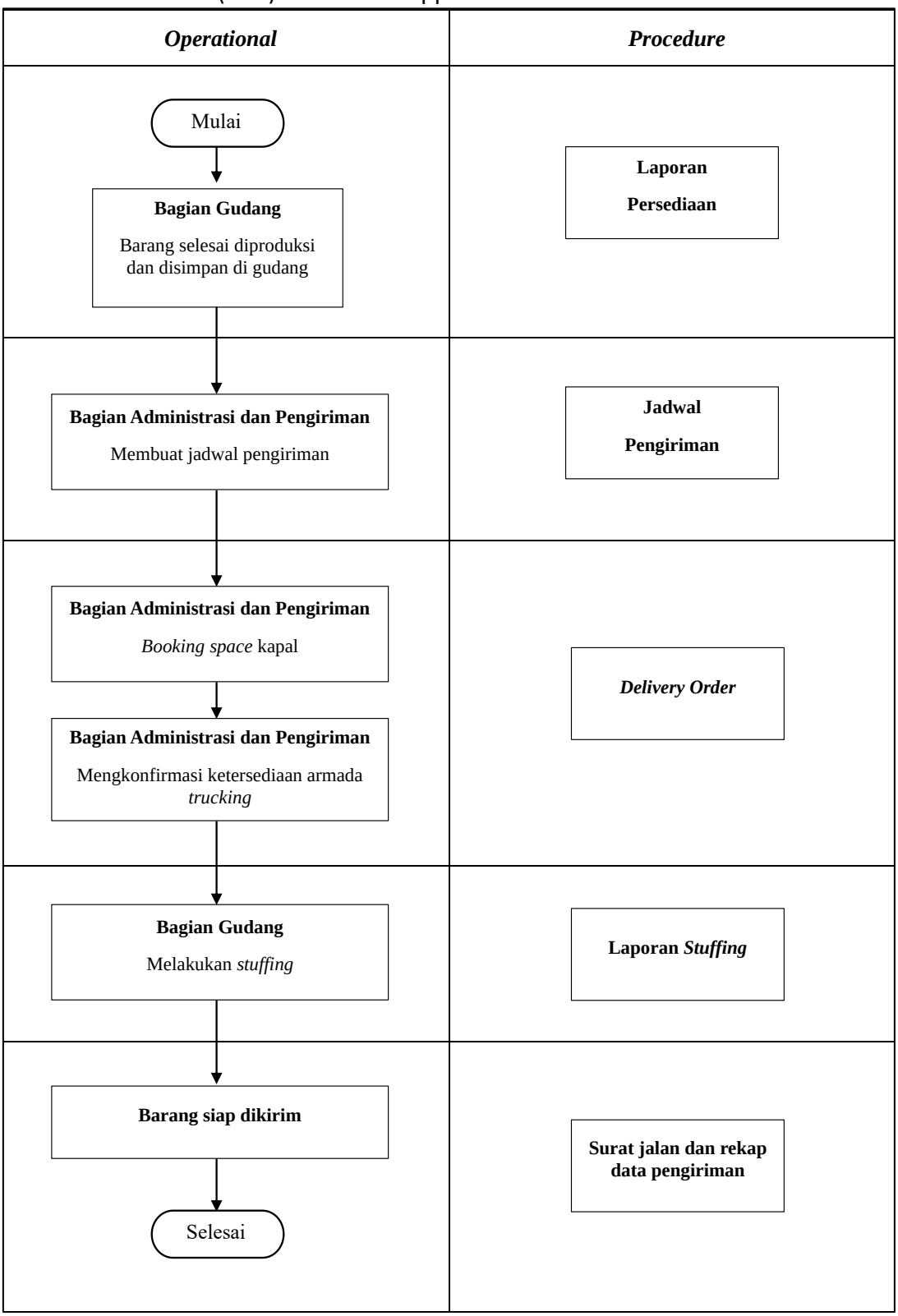

Figure 5. Standard Operational Procedure (SOP) for Sentana Rattan Furniture

Based on Figure 5. above, it can be seen that the goods delivery process is that the warehouse department prepares and ensures that the goods to be sent are by the purchase order document from the buyer. In contrast, the administration and shipping department re-ensures the delivery schedule by the purchase order document. It makes a reservation for ship space with the shipping company one week before delivery.

CONCLUSION

The primary factors causing shipping delays at Sentana Rattan Furniture include the unavailability of wood raw materials in the warehouse—making it difficult to procure sufficient supplies—insufficient worker focus that leads to mistakes in color measurements for products, and employees being absent simultaneously, which results in a labor shortage. Additionally, a lack of available cargo space on vessels causes delays in booking, preventing the company from obtaining delivery orders from the shipping provider. Inadequate trucking fleet maintenance can result in vehicle breakdowns during transit, and unpredictable weather patterns further hinder the production process.

Based on the above conclusions, the researcher proposes several suggestions for the company to consider in improving the quality of its shipping services. The company should establish and conduct regular performance evaluations for all employees so that their work progress can be closely monitored and any issues can be promptly addressed. Moreover, the company is encouraged to implement quality control improvements to minimize shipping delays and enhance overall service effectiveness.

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