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Improving Truck Fleet Maintenance Performance Using the PDCA Method

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***Abstract*—** *Trucking is one part of the supply chain for distributing goods by land. In the ecosystem of shipping goods by ship, trucks are the chain that connects to distributors and even directly to consumers. One shipping company saw that the need for trucks to carry containers to and from ships was very large and had become an inseparable part, so it developed PT MJT as a trucking business unit that supports container traffic to ships. PT MJT has at least 200 trailer trucks of various sizes spread across Surabaya, Jakarta, Palu and Makassar. In line with competition in the world of logistics, cost optimization must be carried out in all lines, including supporting business units, one of which is trucking. The results of the management review showed that PT MJT had not provided optimal performance so a thorough investigation was carried out to find out which potential could be improved. The research is focused on truck fleet maintenance. The results of the investigation found that the truck maintenance schedule had not been carried out according to the guidelines in the manual, so that serious breakdowns often occurred without planning, there were no routine maintenance standards such as greasing, checking tires, bolt ties, lights and even truck cleanliness. On the other hand, inventory management of spare parts needed for maintenance also tends to be minimal. As a result, the truck's performance in terms of reliability and availability is always below the set KPI standards. Given the existing conditions, several Standard Operating Procedures (SOP) must be developed. However, to see the results, researchers used the Plan-Do-Check-Action (PDCA) method to implement a plan to improve truck performance because this method applies a continuous, structured way of working and is relatively simple. An improvement pattern that is simple and easy to follow but right on target is an important consideration in choosing a method considering that the implementers of this performance improvement program are field workers who are not used to complex systems. If the program can be implemented, it is hoped that it will ultimately be able to fulfill the company's expectations as a reliable business unit that supports the logistics ecosystem.*

***Keywords*—** *Routine truck maintenance, Plan-Do-Check-Action (PDCA), SOP, realibility - availability.*

I. BACKGROUNDS

Engine maintenance is a critical component that supports truck performance, especially in terms of reliability and availability. Reliable means that the truck meets consumer demands in the distribution of goods in the desired conditions and time. Available means that when a customer needs a truck, the company can provide the requested fleet. PT MJT as a subsidiary providing a truck fleet that has at least 200 trucks of various sizes spread across Surabaya, Jakarta, Palu and Makassar, was found to be unable to meet demand from the parent company. The performance of this trucking company has reliability below 70% and many trucks cannot be used because they are damaged or in the process of being repaired for a long time, meaning availability is low so the parent company has to rent trucks from third parties.

To find out how to improve truck performance, research is carried out on the condition of all truck fleets currently owned, studying the current maintenance patterns and supporting systems.

Figure 1. Truck maintenance problem

This problem shows that there is no Standard Operational Procedure (SOP) and adequate management in carrying out maintenance. So it is important to first improve existing SOPs and how to implement them considering that truck units are spread across several cities. To achieve the desired results, this improvement process must be carried out continuously or continuously. The method must be easy to understand and execute by all teams in the field as direct implementers of maintenance. Researchers consider that PDCA is the most appropriate method to use in order to achieve the desired KPI goals. The PDCA (Plan, Do, Check, Act) method is an effective management approach to achieve continuous improvement in business. This approach is used to solve problems related to processes, customers, products, and employees. By using the PDCA cycle, companies can plan (Plan) the necessary steps, implement (Do) the plan, evaluate (Check) the results achieved, and take appropriate corrective action (Act) to improve performance and overcome problems encountered. identified.

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The benefits of using the PDCA method include increasing productivity, reducing waste, minimizing risk, continuously improving processes, encouraging competitive advantage and can be applied in various businesses. However, it also takes time to see the results.

This research aims to improve truck performance in terms of reliability and availability, which has so far been below expected standards. Moreover, with continued implementation, it is hoped that the improvements that occur can continue to be maintained and even increased so that companies become more competitive in responding to market challenges in the world of logistics.

Research Problem

1. How is routine truck maintenance carried out?
2. How is procurement and inventory supporting truck maintenance managed?
3. What are the work patterns and systems implemented at PT MJT?

Research Objectives

1. Create a Standard Operating Procedure (SOP) for truck maintenance and spare part inventory and maintenance support stores
2. Apply PDCA in implementing SOPs within a certain period of time
3. Evaluate the reliability and availability of trucks

Benefits of Research

The managerial benefit is that the results of this research can improve the way truck maintenance is managed, including inventory, thereby ultimately increasing the level of reliability and availability of trucks to support PT MJT's function as a supporting business unit for shipping companies to make them more competitive. Academically, this research is expected to further enrich research and references in the field of truck maintenance based on case-by-case facts which vary greatly in the field.

Problem Limitations

1. To focus on the problems in this research, problem boundaries were determined, namely routine maintenance related to overhaul schedules, routine maintenance schedules such as greasing, oil changes, bolt ties, lights and cleanliness
2. Research is limited to spare and store procurement and inventory patterns that support routine truck maintenance.

II. METHODOLOGY

The research used an exploratory descriptive research design to describe corrective steps in improving fleet maintenance performance through the application of the PDCA method. The research approach uses a qualitative approach to identify factors that cause problems and develop problem solving solutions in quality control activities. The types of data used in research solutions include (1) Primary data obtained from sources directly in the field inspection process (2) Secondary data obtained from company documents. Data collection techniques are carried out through (a) Observations carried out by making direct observations. (b) Discussions and interviews with relevant stakeholders in the company to gather information and thoughts in finding solutions to problem solving. (c) Documentation study to collect various information about the stages of the inspection or maintenance process activities (d) Literature study as a stage of data collection activities carried out by reading and studying knowledge from literature that has a direct relationship with the topic in the research.

III. LITERATURE REVIEW

Supply Chain Management

Today's business world is increasingly consumer-oriented, which means that companies must be able to meet consumer demands to produce products according to what consumers want. Today's modern business has the characteristics of increasingly short product life cycles, increasingly rapid introduction of new products, increasing consumer knowledge, very fast information and increasingly complex consumers. In order to survive, a company must have a good working network with other companies such as suppliers and distributors. The speed of delivering products to consumers is inseparable from smooth operations and distribution, which means it is also inseparable from suppliers and distributors. Seeing this, the role of supply chain management is needed to improve the company's internal and external performance. According to Sarwoko (2019), it is explained that effective supply chain management is making suppliers partners in the company's strategy.

With the aim of enhancing the long-term performance of each company and the supply chain as a whole, supply chain management is the methodical and strategic coordination of conventional business functions and tactics across business functions within a specific company and between businesses in the supply chain. (Mentzer et al, 2001). In this case, it means that supply chain management activities are not only oriented towards the internal affairs of a company but also external affairs involving relationships with partner companies. In addition, according to Sholeh (2020) supply chain management is said to be an integrated method, tool or approach with a spirit of collaboration to manage all stages of the supply chain.

Regarding Pujawan and Mahendrawathi (2017), there are six main activities included in the supply chain management classification when referring to a manufacturing company. First activities to design new products or product development such market research, designing new products and involving suppliers in new product design. Second acivities to obtain raw materials or procurement, purchasing or supply such selecting suppliers, evaluate supplier performance, purchase raw materials and components and monitor supply risk. Third production and inventory planning activities such as demand planning, demand forecasting, capacity planning and also production and inventory planning. Next production activities such as - Production execution and quality control. The fifth acticities are delivery or distribution such as distribution network planning, delivery scheduling, search for and maintain relationships with delivery service companies and monitor service levels at each distribution center. Finally, product or goods return management activities such as design product

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return channels, scheduling pickup, disposal process and determination of prices for refurbished products.

There are three main streams that must be managed in a supply chain. The first is the flow from upstream to downstream. For example, raw materials are sent from suppliers to factories to be produced into finished products. Once the product is finished it will be distributed to distributors, retailers and finally into the hands of consumers. An illustration of this process can be seen in Figure 2.1. The second is the flow of funds and financial transactions that flow from downstream to upstream. Money flowing from consumers to retailers, distributors, manufacturers and suppliers forms an important part of the supply chain, supporting raw material procurement, production, distribution and operational sustainability. The last one is the flow of information that can move from upstream to downstream or vice versa. Accurate and timely information is key to managing an efficient supply chain. This information can move from consumers to suppliers or vice versa, enabling better coordination and decision making.

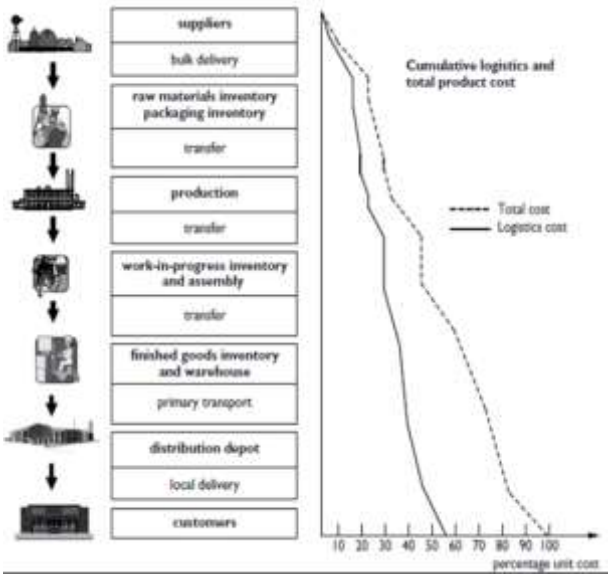

Figure 2. Physical flow of materials from suppliers to customers (Rushton et al, 2014)

Logistics

Increasingly complex economic growth, such as the productivity of goods produced by factories or companies, how they are distributed and stored as well as the overall management of product results, requires special and serious attention and requires good organization to achieve effective, efficient results and there are no imbalances in carrying out activities. -these activities (Chandra, 2013). As shown in Figure 2.2, the important parts of logistics consisting of order processing, inventory control, warehousing, transportation, material handling and storage, packaging and information have been fundamental elements of economic and industrial systems for many years. So that economic growth activities and the existence of processes in logistics cannot be separated and are of course very closely related to each other.

According to Yasseri et al (2012), logistics is the management of the flow of goods and services between the point of origin and the point of consumption to meet customer needs. Another definition related to logistics management is the part of supply chain management which consists of the activities of planning, implementing and controlling the efficient and effective flow and storage of goods, services and related information between the point of origin and the point of consumption to meet customer requirements (Garcia et al. , 2013). In another sense, Walker and Jones (2012) state that logistics is the process of positioning resources at the right time, in the right place, for the right cost and for the right quality.

Figure 3. Main Components of Logistics (Rushton et al, 2014)

TABLE 1. Potential Trade-Offs in Logistics

Trade-Off	Finance	Production	Distribution	Marketing
Production runs longer	Lower unit production costs	Lower unit production costs	More inventory and storage is required	Lower prices
Fewer deposits	Reduce warehouse costs	No impact	Less complicated logistics structure	Service reduction
Reduction of finished goods inventory	Reduce inventory costs	Higher unit production costs	No need to expand storage facilities	Lower product availability for customers
Reduce component raw material inventories	Reduce inventory costs	Inefficient production scheduling	Lower inventory requirements	There is no immediate impact
Reduced protective shipping packaging	Reduced shipping costs	No impact	Reduced choice of transport modes	Increased shipment of damaged goods
Reduce warehouse supervision	Reduced costs with fewer employees	No impact	Reduced efficiency by less supervision	Loss of sales results from under orders

Source: Bastuti et al. 2019

According to Prihantono (2012), logistics management functions are a series of processes consisting of planning and requirements determination functions, budgeting functions, procurement functions, storage and distribution functions, maintenance functions, write-off functions and control functions. Often these logistics management functions are interrelated and measurement and interpretation should be carried out and reciprocal relationships (trade-offs) should be carried out. The hope is that this approach will benefit the logistics system as a whole. This trade-off may incur additional costs in one function, but will provide greater cost savings in another function. Table 2.2 explains the potential trade-offs in the logistics process.

Transportation

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Transportation is a process of moving or moving people or goods from one place to another by using a certain system to meet human needs by moving and connecting with each other. Its function is to connect people with land use, bind activities and provide use of place and time for needed commodities (Ritonga et al, 2015). Transportation can mean the movement of products from one place to another which makes the product reach the hands of consumers. Transportation is the main key in the supply chain because products are rarely produced and consumed in the same place or location. Transportation is a significant cost component of most expenses. There are 2 keys to transportation that takes place in a supply chain, the shipper is the party who needs the product to move between two locations in the supply chain or the carrier is the party who moves or transports the product.

According to Ardianto (2014) there are several transportation costs such as: direct labor costs are costs directly incurred by the company based on the wages that must be paid to employees who work in the production process, indirect labor costs and vehicle operational costs, are the total costs incurred by a car driver which include several components, namely fuel consumption costs, lubricating oil consumption, tire consumption, maintenance and spare parts, depreciation and insurance and other costs

On another occasion, Pujawan and Mahendrawathi (2017) said that if you look at it from a carrier's point of view, things that need to be considered are the costs involved, such as the cost of the means of transportation itself (could be rental or purchase costs), fixed operational costs such as terminal or airport costs. the amount of which does not depend on the volume of goods sent and variable operational costs such as fuel costs, the amount of which depends on the volume of transportation or the distance traveled during delivery. Other costs such as overhead costs must also be considered. On the other hand, several aspects are not directly related to costs, such as speed, volume that can be transported and flexibility in making deliveries.

From the shipper's side, considerations can be based on various costs that arise in the supply chain, including costs other than those directly related to transportation. Apart from transportation costs that must be borne, companies also have to take into account inventory costs, loading-unloading costs and facility costs such as warehouses and others. Other consequences, such as the level of service level obtained and the uncertainty of delivery times, are important for shippers to consider.

According to Pujawan and Mahendrawathi (2017) each mode of transportation has its own advantages and disadvantages in terms of various considerations. Table 2.3 below provides a general evaluation of various transportation modes in terms of several supply chain criteria.

According to Maarif (2020), one of the modes of transportation needed for economic development is truck transportation services. This truck transportation service is part of a broad transportation service which is defined as one that consists of several physical infrastructure elements (networks, terminals, ports), transportation facilities and operational systems that support the smooth movement of physical objects (people and/or goods)) from a point of origin to a geographically separated destination point (Irwan, 2013). Apart from that, according to Anto (2018), this goods transportation service company makes a significant contribution to the development of small and large industries such as MSMEs (micro, small and medium enterprises), online buying and selling or e-commerce.

TABLE 2. General Evaluation of Various Transportation Modes

Mode Transport	Truck	Train	SHip	Airplane
Volume that can be sent	Medium	Very large	Very large	Large
Delivery time flexibility	High	Low	Low	Low
Delivery route flexibility	High	Very Low	Very Low	Very Low
Speed	Medium	Low	Medium	Very High
Shipping Costs	Medium	Low	Low	High
Inventory (in transit)	Low	High	Very High	Low

Source: Pujawan and Mahendrawathi, 2017

Maintenance

Care or upkeep is an activity that aims to ensure that a physical facility can continuously do what the user or users want. Another definition related to maintenance is a combination of various actions taken to maintain an item in or repair it to an acceptable condition (Kurniawan, 2013). Maintenance is very important so that the machine is always in good condition and ready to use. Maintenance is a function that monitors and maintains factory facilities, equipment and work facilities by designing, organizing, handling and checking work to ensure the function of the unit during uptime and minimize downtime caused by damage or improvement (Manzini, 2010).

The maintenance process generally aims to focus on preventive measures to reduce or even avoid damage to equipment by ensuring the level of reliability and readiness and minimizing maintenance costs (Imron, 2013). According to Sudrajat (2011), in general, treatment aims to guarantee the availability and reliability of facilities (machinery and equipment) economically and technically, so that their use can be carried out as optimally as possible. Beside that extend the useful life of facilities, ensure operational readiness of all facilities needed in an emergency and guarantee work safety and security in its use are objective of maintenance.

According to Sudrajat (2011), the form of care policy is as follows:

1. Preventive maintenance is a form of maintenance carried out before machine damage occurs.
2. Breakdown maintenance as a form of maintenance policy whereby machines or equipment are operated until they are damaged and then repaired or replaced.
3. Scheduled maintenance is a form of maintenance that aims to prevent damage and maintenance is carried out periodically within a certain time span.
4. Predictive maintenance as part of preventive maintenance, will remain in the form of a maintenance policy as a maintenance strategy where implementation is based on the condition of the machine itself. This maintenance is

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also known as condition based maintenance or also called machine condition monitoring, which means determining the condition of the machine by checking the machine regularly so that the reliability of the machine can be determined and work safety is guaranteed.

5. Corrective maintenance is a form of maintenance carried out after damage to equipment occurs so that the equipment cannot function properly.

The maintenance activity itself must be accompanied directly by providing spare parts and tools or equipment appropriately and always available when the maintenance process is running. So inventory management and maintenance plans are very important to ensure every activity can run optimally.

PDCA method

The PDCA cycle (Plan, Do, Check, Act) is generally used to carry out testing and implement changes to improve product quality. According to Nasution (2015), the explanation of the stages in the PDCA cycle is as follows:

1. Develop a plan (Plan)
   Planning specifications, establishing good and correct specifications or quality standards, giving workers or employees an understanding of the importance of product quality, quality control is carried out continuously and continuously.
2. Implement the plan (Do)
   The plans that have been prepared are implemented in stages, starting from a small scale and distributing tasks evenly according to the capacity and abilities of each individual. While implementing the plan, control must be exercised, that is, ensuring that all plans are implemented properly so that they are according to plan and on target.
3. Check or examine the results achieved (Check)
   Checking or researching refers to determining whether the implementation is on track or in accordance with what was planned, comparing the quality of production results with predetermined standards, based on research obtained from failure data and then identifying the cause of the failure.
4. Carry out adjustment actions if necessary (Act)
   Adjustments are made if deemed necessary, based on the results of the analysis above. Adjustments relate to standardizing new procedures to avoid the recurrence of the same problem or setting new targets for subsequent improvements.

PDCA is very suitable for use in small scale continuous improvement activities to reduce the occurrence of product failures, eliminate waste in the workplace and increase productivity. The following benefits of PDCA include:

1. To facilitate the mapping of authority and responsibility of an organizational unit.
2. As a work pattern in improving a process or system in an organization.
3. To resolve and control a problem in an organized and systematic pattern.
4. For continuous improvement activities in order to improve quality
5. Eliminate waste in the workplace and increase productivity.

IV. CONCLUSION

The increase in the price of fuel oil, spare parts, mechanic salaries and the purchase price of truck fleets has a big influence on the operational costs of truck fleets. The issue of being able to operate a truck fleet to increase utilization while still ensuring efficient operating costs including maintenance costs that can achieve a safe and economical operating life is a special challenge for trucking companies.

Effective and efficient truck fleet maintenance has been carried out starting from fleet selection, implementing preventive, corrective and even predictive maintenance systems to selecting spare parts, which have begun to be carried out by many road transport operators to ensure the readiness and reliability of the truck fleet.

The application of strategies to technical maintenance patterns both from system and technology aspects, spare parts, equipment and mechanics has been widely implemented. In order to ensure consistency and discipline in its implementation, it is considered that the PDCA concept is still needed in truck fleet maintenance. This concept is ultimately able to create a company culture that values truck fleet maintenance as an important asset for trucking companies.

This PDCA concept, which is carried out repeatedly, is able to find small damage early so that maintenance and even repairs can be carried out first, thus avoiding major damage which results in high breakdown times as well as increased maintenance costs and loss of potential income because the unit is not operating.

V. RECOMMENDATION

Several aspects that need to be the main concern of trucking companies in ensuring effective and efficient truck fleet maintenance through the PDCA concept are as follows:

PDCA implementation will be greatly influenced by the role of the human resources involved. The quality of the organization and workshop team members, both managers, supervisors and mechanics, is very determining. Increasing capabilities through periodic training will determine the success of the truck maintenance program.

The creative ideas that emerge in the PDCA program will be largely determined by the methods applied. Methods that involve more mechanics (bottom up) will be very productive in creating efficiency and effectiveness in fleet maintenance.

The availability and reliability of tools, machines and machinery that support workshop operational activities is also a factor that needs to be the company's focus in ensuring that the quality of maintenance will be more perfect.

Selection of materials used such as oil, tires, batteries through a transparent procurement system involving not only the workshop division but also procurement and finance will create opportunities for maintenance cost efficiency without sacrificing the quality of maintenance work.

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