

Wagons Maintenance Performance Analysis at Depot Gerbong Sidotopo, Surabaya

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ABSTRACT

The research objective is to improve the performance of the carriage Depot in terms of maintenance personnel, facilities and equipment to support the operational needs of the wagon facility. The Sidotopo Wagon Depot is one of the Depots that carries out periodic maintenance of wagon facilities in Operation Area 8 Surabaya. In carrying out the maintenance of facilities, there are several obstacles, namely the workload that is not in accordance with regular working hours, the minimum number of employees who have competency certification, several measuring instruments that have not been calibrated and several damaged work facilities and equipment. In this research, which will be a sample of maintenance personnel facilities at the Sidotopo Carriage Depot with a population of 28 people. This research uses the Importance Performance Analysis approach method, Cartesian diagram, validity and reliability test, analysis of characteristics and needs of maintenance personnel and analysis of availability of Depot maintenance facilities and equipment. Research results, found that the number of maintenance personnel needed is 30 maintenance personnel. Also, requires improvement efforts on the performance elements that are included in the main priority, namely; the condition of work equipment, calibration of work equipment and number of maintenance personnel.

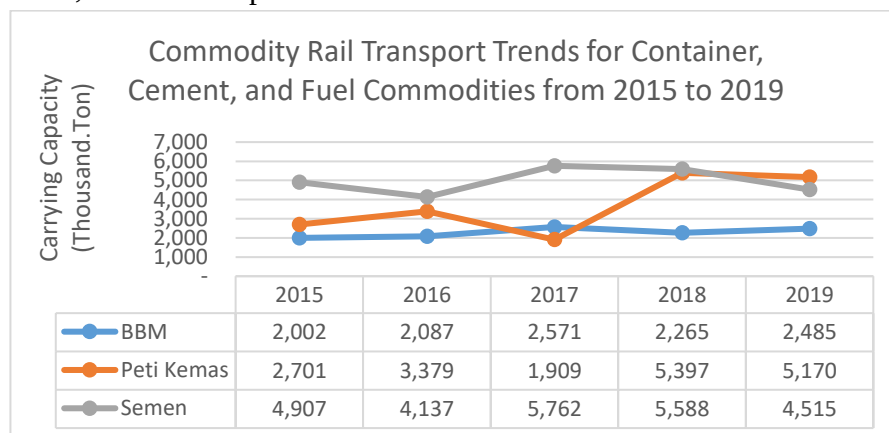
Keywords : depot performance; maintenance; workload analysis; importance performance analysis; wagons

A. Introduction

When compared to road transportation modes, the train is one of the forms of transportation that has unique characteristics and advantages. The special advantages of this railway are that it is a mass transportation system capable of transporting large numbers of people and goods, that it is energy efficient and environmentally friendly, that it does not necessitate a large amount of land for the construction of rail roads, and that it has a high safety factor with a signaling system. To improve the railway sector's role and great potential, the entire railway system, including facilities, infrastructure, and operational aspects of rail travel, must always be in a safe and reliable condition so that the railway can remain operational. In order to support the development of reliable and operable rail facilities and infrastructure, train inspections and

maintenance are critical for both facilities and infrastructure in order to reduce the rate of train accidents.

Area of operation 8 Surabaya is one of nine train operations areas on Java Island, with the East Java Province operating area. Operation area 8 is a large operation area with three large ports in East Java that serve as hubs/connectors for logistics flows in Eastern Indonesia, namely Tanjung Perak Port, Kalimas Port, and Teluk Lamong Port. The existence of this port promotes the creation of demand for goods transportation from and to Surabaya's operation area 8. The realization trend of freight transportation by rail transport for container, fuel, and cement commodities is as follows (Figure 1).



Source: Directorate General of Railways, (2020)

Figure 1 Commodity Rail Transport Trends for Container, Cement, and Fuel from 2015 to 2019

According to the data on freight transportation realization presented above, the container by train has increased significantly over the last five years, from 2.701 million tons in 2015 to 5.170 million tons in 2019. Recognizing this opportunity, PT. Kereta Api Indonesia (Persero) has prepared Freight Transport

by Train services that serve transportation for goods in that area, such as Container Transport, Cement Transport, Fuel Transportation, and Delivery Goods Transport (Parcel), with as many as 36 Regular Trains and 14 Facultative Trains (executed when needed). The average number of cars in one train series

(stamformation) for fuel transport can be as high as 20 cars per series, but the stamformation for container transport can be as high as 30 cars per series. To accommodate the operational needs of the freight train, the carriages available at Sidotopo WAGON Depot is 597 units of

carriages, with the details 422 units of 42 Ton Flat Wagons (GD), 91 units of 30 Ton Tank Wagons (GK) and 70 units of 40 tons Tank Wagons (GK), 14 units of Open Wagons (GB). The Wagons are prepared to support the following railway operations (Table 1).

Table 1 Railway Operations

No	Train Name	Cross Service
1	Container	Kalimas-Tanjung Priok
2	Container	Kalimas-Klari
3	Container	Beteng-Kampung Bandan
4	Fuel	Benteng-Madiun
5	Fuel	Benteng-Malang

Source: Gapeka (2019)

To support it, Operation Area 8 Surabaya need to keep the wagon condition as a means of transportation to remain reliable. According to Assauri (2017), maintenance is an activity to maintain or maintain factory facilities or equipment and make necessary repairs or adjustments or replacements so that there is a satisfactory production operating condition in accordance with what is planned. While according to Corder & Hadi, (1992) maintenance is a combination of any actions or actions taken to maintain an item in, or repair it to an acceptable condition.

Maintenance that carried out by Sidotopo Wagon Depot is periodically maintenance of wagon such as daily maintenance, three monthly maintenance, six mothly maintenance, and annually maintenance. In that process, according to Law of the Republic of Indonesia of 2007 concerning Railways, Article 29, mandatory maintenance of facilities; (1) Meet the standard of maintenance of railway facilities and (2) Conducted by personnel who meet the requirements and

qualifications of expertise in the field of railway facilities (UU RI, 2007).

Carriage maintenance performance will achieve maximum result if the human resources (maintenance personnel) which meet the qualification requirements and availability of work facilities and equipment at the Depot available properly. According to Sofyandi, (2013) that Human Resources management is defined as a strategy in implementing management functions those are planning, organizing, leading and controlling, in every Human Resources operational activity or function starting from process of withdrawal, selection, and development, placement which includes promotion, demotion, and transfer, performance appraisal, compensation, industrial relation, and termination of employment which are shown to increase the productive contribution from organization of human resources towards achieving organizational goals more effectively and efficiently.

Work facilities and equipments are important factors in the dependability of

facilities that are not a resource for maintenance personnel. According to Daradjat, (2012), facilities are anything that can make efforts and work easier in order to achieve the goal. According to Moekijat, (2001), a facility is a physical facility that can process an input and produce the desired output. Maintenance equipment is available equipment in Depots and Service Halls to be used in carrying out maintenance of railway facilities, according to the provisions stipulated in the Regulation of the Minister of Transportation of 2019 concerning Standard Places and Equipment for Maintenance of Railway Facilities, while the definition of maintenance facilities (PM RI, 2019). Maintenance equipments the available at least as follow; (1) Path for maintenance, (2) Main building for maintenance, (3) Building for supporting equipment, (4) Office, and (5) Public facilities.

While the working equipments that must be at the Depot are work equipments that have a high level of accuracy in the carriage facility maintenance instruction manual. Even though the maintenance process activities were completed correctly, there are still issues with the facilities in the operation of the freight train. There were 37 time disruptions and 19 facility disruptions recorded between 2018 and 2019. Carriages are interrupted an average of three times per month, which has a negative impact on maintenance performance at the Sidotopo Wagon Depot. Wagon disturbances occur once per month on average, according to the facility disturbance control norms established by Depot management. It demonstrates that there is a mismatch between what is specified in the control

norm and the reality of the facility's operation.

According to Nurfaulinda, (2009) that the number of operational disturbances on locomotives in the South Sumatra Regional Division occurred due to limited maintenance personnel, spare parts availability, and work equipment availability. According to Sulistyarini, (2011), that has some problems in locomotive maintenance, such as a lack of maintenance equipments and spare parts for locomotives due to limited procurement of spare parts, technical personnel, and maintenance personnel at Balaiyasa Yogyakarta. To address the issues, one solution is to reduce the number of days that Yogyakarta service hall is open. The accelerated alternative is to add workers to some activities in order to reduce day-to-day service hall maintenance.

According to Harianto, (2014), that the completeness of maintenance facilities and maintenance personnel at the Jakarta wagon warehouse is still lacking, which is why it is necessary to add wagon maintenance facilities and improve the quality and quantity of human resources to improve the situation. According to Setyaningsih, (2018), she is researching ways to improve locomotive maintenance performance at the Medan Locomotive Depot. This study focuses on efforts to improve locomotive maintenance performance with the help of Human Resources (maintenance personnel) and maintenance facilities at the Medan Locomotive Depot. Based on the analysis, there is a delay in locomotive facility maintenance time caused by several factors such as employee workloads that are not in accordance with regular working hours, resulting in a shortage of

employees, employee competencies that do not meet the requirements, incomplete equipment at the Depot, and deck facilities that are not suitable.

Based on the literature review and previous research, the following problems can be formulated; (1) Is the workload of regular maintenance personnel at the Sidotopo Wagon Depot appropriate ?, (2) Is the condition of the facilities and equipment for maintenance work at Sidotopo Wagon Depot has confirmed to the laws and regulation ?, (3) How is the facilities maintenance at Sidotopo wagon Depot ?, (4) How is the support of human resources especially the maintenance at Sidotopo Wagon Depot? And (5) What

effort can be carried out to improve the working performance of wagon Depot to support operational needs of wagon facilities?

Referring to theoretical studies, relevant research and frameworks research above, it can be formulated the hypothesis of this research as following; (1) Availability of adequate and maintenance personnel have the required competencies will affect performance carriage maintenance at the Sidotopo Carriage Depot, (2) Availability of proper and reliable facilities and equipment will affect the performance of carriage maintenance at the Sidotopo Carriage Depot.

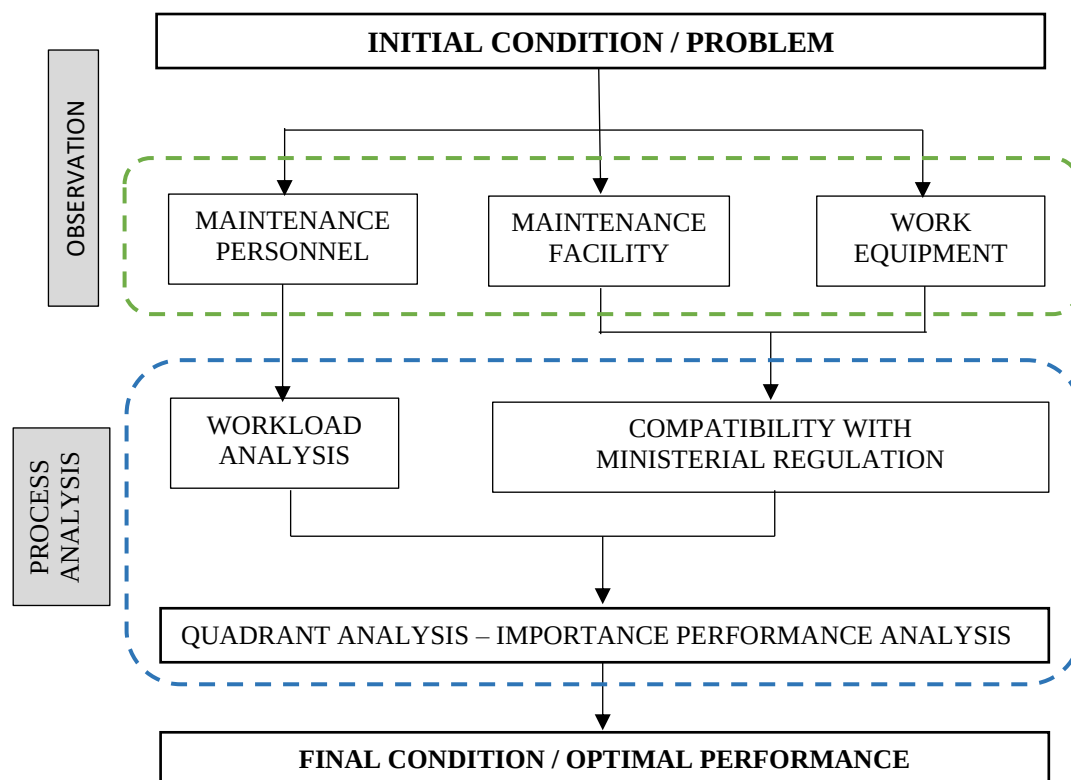


Figure 2 Research Framework

B. Methods

This research uses the Importance Performance Analysis approach method, Cartesian diagram, validity and reliability test, analysis of characteristics and needs of maintenance personnel and analysis of

availability of Depot maintenance facilities and equipment. This type of research is a mixed methods study with a concurrent embedded strategy model that is designed to use quantitative and qualitative methods in tandem. The

quantitative method was used as the primary method in this research. In this research, that will be the sample of facilities maintenance personnels at Sidotopo wagon Depot are 28 people. Remembering that the limit population, so all the population will be the samples, so that this research using saturated sample taken by census technique. As for the number of informants taken as many as six informants, those are; (1) Regulator (Directorate General of Railways), as many as two informant and (2) Operator, as many as four informants. From the data that has been collected by the writer, carried out analysis and problem solving using the Importance-Performance Analysis (IPA) Methods, which is equipped with an analysis of the characteristics and needs of maintenance personnel and analysis of the availability of facilities and equipment for maintenance Depot. As primary data, this study uses a Likert scale to measure a person's attitudes, opinions, and perceptions about social phenomena. The questionnaire used is a closed questionnaire which has provided answers to strongly agree, agree, neutral, disagree, and strongly disagree.

C. Results and Discussion

To describe the research variables used is descriptive analysis which is equipped with Importance Performance Analysis. Descriptive research design is used to determine the condition of the level of fulfillment of existing resources at the Sidotopo Main Depot and to explain the level of carriage maintenance performance, to what extent the suitability of the level of importance or expectations of maintenance elements with the performance that has been carried out.

Primary data collection includes inventory data of work facilities at the Dipo and through direct observation in the field, and the condition of the Sidotopo Carriage Depot. Research results are determined through; 1. Determination of data processing tools and techniques, and 2. Data processing; such as, (a). Importance Performance Analysis (IPA) (Quantitative), (b) Analysis of human resource needs (Qualitative), and (c). Analysis of the needs for carriage maintenance facilities (Qualitative), such as, (1) Workplace Facilities, and (2) Work Equipment (Tools).

Some of the variables in this research such as; 1. Maintenance Facility (Variable X_1), with variable dimensions, namely; (1) Availability of maintenance facilities, and (2) Physical condition of maintenance facilities, 2. Availability of Work Equipment (Variable X_2), with variable dimensions, namely; (3) Completeness of work equipment, (4) Work equipment condition, (5) Work equipment calibration, 3. Human Resources (Variable X_3) with variable dimensions, namely; (6) Adequate number of employees, (7) Optimal working time, (8) Appropriate training and competence, and (9) Employee understanding of SOPs, Check Sheet Maintenance, and 4. Maintenance Performance (Variable Y) with variable dimensions, namely; (10) Facility Reliability (number of disturbances/complaints on Depot facilities), and (11) Punctuality in the process of Depot maintenance. The four variables and eleven dimensions of this study were tested through validity tests and reliability tests (Table 2 and 3), also Level of Conformance of Each Element (Tabel 4).

Validity Test: Employee Perception on Maintenance Importance

Table 2 Validation Test on Maintenance Importance

Dimension	Nos.	Attribute	Significance Test	R critical	Note
Maintenance Facility (X ₁)	1	Availability of maintenance facilities (maintenance lane, canopy, lighting, waste disposal area, prayer room)	0,499	0,374	Valid
	2	Physical condition of maintenance facilities	0,946	0,374	Valid
Availability of Work Equipment (X ₂)	3	Completeness of work equipment	0,774	0,374	Valid
	4	Work equipment condition	0,946	0,374	Valid
	5	Work equipment calibration	0,946	0,374	Valid
Human Resources (X ₃)	6	Adequate number of employees	0,619	0,374	Valid
	7	Optimal working time	0,671	0,374	Valid
	8	Appropriate training and competence	0,946	0,374	Valid
	9	Employee understanding of SOPs, Check Sheet Maintenance	0,946	0,374	Valid
Maintenance Performance (Y)	10	Facility Reliability (number of disturbances/complaints on Depot facilities)	0,499	0,374	Valid
	11	Punctuality in the process of Depot maintenance	0,439	0,374	Valid

Validity Test: Employee Perception on Maintenance Performance

Table 3 Validation Test on Maintenance Performance

Dimensions	Nos.	Attribute	Significance Test	R critical	Conclusion
Maintenance Facility	1	Availability of maintenance facilities (maintenance lane, canopy, lighting, waste disposal area, prayer room)	0,539	0,374	Valid
	2	Physical condition of maintenance facilities	0,966	0,374	Valid
Availability of Work Equipment	3	Completeness of work equipment	0,966	0,374	Valid
	4	Work equipment condition	0,966	0,374	Valid
	5	Work equipment calibration	0,966	0,374	Valid
Human Resources	6	Adequate number of employees	0,966	0,374	Valid
	7	Optimal working time	0,7	0,374	Valid
	8	Appropriate training and competence	0,966	0,374	Valid

	9	Employee understanding of SOPs, Check Sheet Maintenance	0,966	0,374	Valid
Maintenance Performace	10	Facility Reliability (number of disturbances/complaints on Depot facilities)	0,605	0,374	Valid
	11	Punctuality in the process of Depot maintenance	0,7	0,374	Valid

Significant test of correlation coefficient is carried on by using critical r at a significant level of 5% or 0.05. From the calculation table, it is about the employee perception questionnaire regarding the importance of maintenance (expectations) of the Sidotopo wagon Depot, where the correlation coefficient value is compared to the critical r value with a total of 28 respondents. The results of the calculations carried out where the significant value of the correlation of all

attributes > 0.3 , it can be concluded that each attribute is valid.

Reliability Test

The results of the reliability test show that the reliability coefficient is between 0.915 to 0.955, so it can be concluded that the data is reliable. Requirements with a reliability coefficient > 0.6 then the existing attributes are said to be reliable and can be used for research data retrieval.

Level of Conformance of Each Element

Table 4 Level of Conformance

Number of Question	Maintenance Quality	Implementation Score (X)	Importance Score (Y)	Level of Conformance (%)
1	Availability of maintenance facilities (maintenance lane, canopy, lighting, waste disposal area, prayer room)	97	131	74,05
2	Physical condition of maintenance facilities	100	128	78,13
3	Completeness of work equipment	73	99	73,74
4	Work equipment condition	80	127	62,99
5	Work equipment calibration	76	128	59,38
6	Adequate number of employees	72	127	56,69
7	Optimal working time	105	96	109,38
8	Appropriate training and competence	96	128	75,00

9	Employee understanding of SOPs, Check Sheet Maintenance	107	97	110,31
10	Facility Reliability (number of disturbances/complaints on Depot facilities)	107	129	82,95
11	Punctuality in the process of Depot maintenance	75	98	76,53
Average		78,10		

From the calculation results as shown in Table 4, it can be concluded that the respondent's assessment of the need for quality of maintenance performance can be categorized in the medium category with an average level of conformity of 78.10%.

Cartesian Importance Diagram - Performance Analysis (IPA)

The position of each element of quality of maintenance and the coordinates of the lines that make up the

quadrant are known by finding the average value of the X (axis) performance level and the average Y importance level (ordinate), which is then used as the coordinate point of each service element while the line coordinates quadrant forming is the average of the average values of X and Y (x , y) based on the obtained values (3.21;4.18), while the coordinates (X,Y) of each service element are based on the equation (Table 5).

Table 5 Coordinate Points of Cartesian Diagram

Number of Question	Items of Maintenance Quality	X	Y
1	Availability of maintenance facilities (maintenance lane, canopy, lighting, waste disposal area, prayer room)	3,46	4,68
2	Physical condition of maintenance facilities	3,57	4,57
3	Completeness of work equipment	2,61	3,54
4	Work equipment condition	2,86	4,54
5	Work equipment calibration	2,71	4,57
6	Adequate number of employees	2,57	4,54
7	Optimal working time	3,75	3,43

8	Appropriate training and competence	3,43	4,57
9	Employee understanding of SOPs, Check Sheet Maintenance	3,82	3,46
10	Facility Reliability (number of disturbances/complaints on Depot facilities)	3,82	4,61
11	Punctuality in the process of Depot maintenance	2,68	3,50
	Total	35,29	46,00
	Average	3,21	4,18

Based on the data in Table 5, the Cartesian Importance Performance Analysis diagram is then generated (Figure 3).

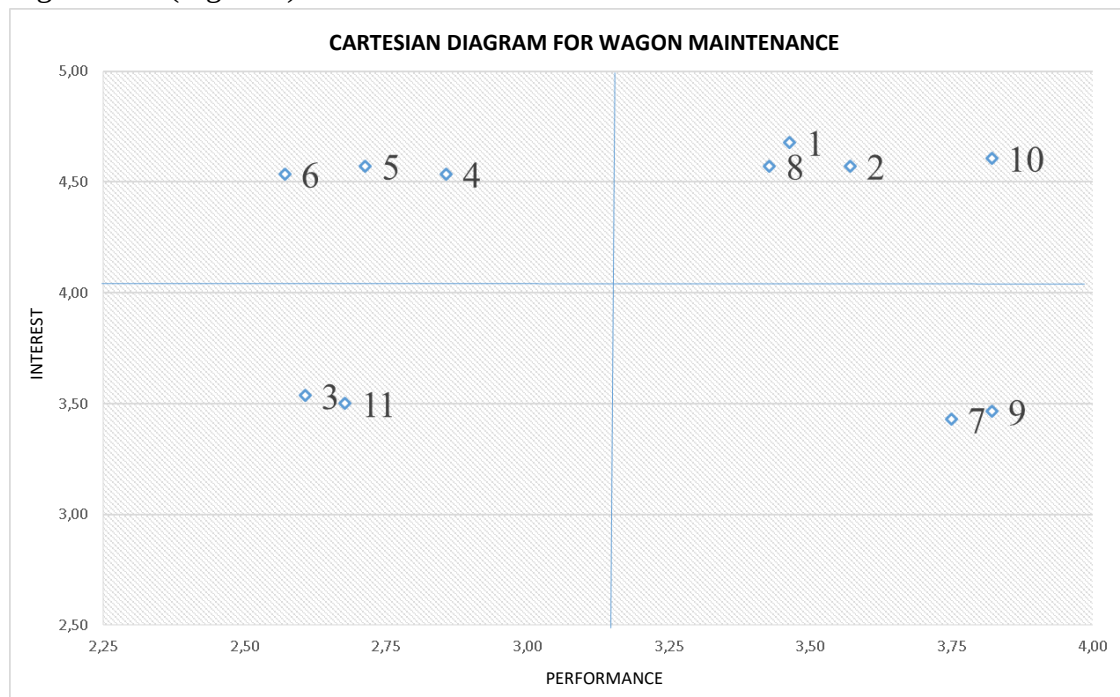


Figure 3 Cartesian Diagram of Wagon Maintenance

Based on the results of the analysis for wagon maintenance above, it can be concluded as follows (Table 6).

Table 6 Results of Daily Maintenance Analysis

Number of Question	Items of Maintenance Quality	Quadrant	Conclusion
1	Availability of maintenance facilities (maintenance lane, canopy, lighting, waste disposal area, prayer room)	C	Maintain
2	Physical condition of maintenance facilities	C	Maintain
3	Completeness of work equipment	B	Low Priority
4	Work equipment condition	A	Main Priority

Human Resource

Sidotopo Wagon Depot is led by a Senior Supervisor-level Wagon Depot Head who has main duties and responsibilities of carrying out wagon maintenance/maintenance and repair, daily utilization and quality control inspection of the carriages, preparation of the carriages, setting up the train service department and the administration of the Wagon Depot. The number of employees serving at the Sidotopo Wagon Depot is very limited, as many as 28 employees

including the Head of the Sidotopo Depot. All employees of the Sidotopo Wagon Depot are male.

Working hours per day for each employee is six hours in a day and there are six days work a week, but in practice there are often additional working hours that has to be done. In average, employees have 26 days work a month, according to the data from administration supervisor of Sidotopo Wagon Depot, the basis of the calculation at the Sidotopo Carriage Depot is (Table 7).

Table 7 Employee Workload Calculation Table

Nos.	Descriptions	Number of Fleet (Q)	Maintenance Frequency (F)	Standard JO	BKP = Q X F X JO
GK					
1	P3	161	3	16	7728
2	P12	161	1	52	8372
GB					
1	P3	14	3	16	672
2	P12	14	1	52	728
GD					
1	P3	422	3	16	20256
2	P12	422	1	52	21944
TOTAL					59700

For information, calculation person's hour (JO) Per day. Working load Per Month; BKP: 12, or 59.700 : 12 is 4.975 Person's hour. JO Per Day; BKP Per Month: Total of working day per month. Thus, JO Per Day 4975 : 26 is 191,3 Person's hour. Calculation person's hour (JO) Per day Per person. JO Per Person is JO Per Day: Lots of maintenance staff; 191,3 : 18 persons is 10,6 $\approx$ 11 JO / Day.

From the analysis above, found that the calculation of the workload of people per employee per day is 11 hours per day, while the regular working hours in a day is 6 hours, so it needed to add employees so that the workloads for each employee is in accordance with the working hours. Based on the Director's Regulation about workload calculation and maintenance employee needed is : Maintenance Employee is $(59.700 / 1947,75) \times 1,04$, Thus, maintenance Employee is 29,5 $\approx$ 30 employees. Based on the calculation above, it is found that need of the employee should be 30 employees while

the number of maintenance employee that exist are 18 employees. So, for maintenance employees there are still less than 12 maintenance personnels.

Maintenance Work Facilities and Equipment

In determining the minimum need for equipment at the Depot, the following criteria must be met; Prioritizing the conditions that absolutely require. Equipment must be prioritized in conditions that absolutely require it, to carry out maintenance on the main components that greatly determine the operational performance of a system. Equipment must take into account the workload of the Depot, such as the number of carriages that must be maintained. Considering the scope of equipment / Machinery. It is necessary to learn about the usefulness and capabilities of an equipment in supporting the system and maintenance activities, including the use of special equipment and general equipment. The technology of the

equipment must be in accordance with the process and maintenance system as well as the technology of the wagon to be maintained. It is necessary to update maintenance equipment for example modernization of wheel diameter measurement equipment, so that speeding up the measurement process. Equipment must be reliable and have high accuracy in accordance with international standards and be certified by the authorized agency.

From the results of the inventory of work equipment owned by Sidotopo Carriage Depot, there are still equipment that has not been calibrated, including wheel diameter measuring instruments., E Knuckle Nose Worn Limit Gauge, Type E Coupler, F Knuckle Nose Limit Gauge, Type F Coupler (coupler wear gauge tools). Calibrating is the process of checking and measuring the accuracy of a measuring instrument by comparing it with standards. Calibration is required to ensure that the measurement results are accurate and consistent with other instruments.

Efforts to Improve Care Performance Based on Analysis of the Level of Interest and Performance

Based on the analysis obtained using the IPA method, the following results are obtained.

Quadrant A (Main Priority)

In this quadrant explains that the current level of performance is low while the level of importance or expectations for the implementation of care is high. So the factors in this quadrant are considered very important and affect the quality of care, but the implementation is not appropriate, so the results are disappointing or unsatisfactory. Based on

the results of the analysis of the respondent's assessment, it was found that the condition of work equipment, calibration of work equipment and adequate number of employees need attention and improvement.

Quadrant B (Low Priority)

In this quadrant explains that the current level of performance is in accordance with the level of importance or expectations for the implementation of care but is low. So the factors in this quadrant are considered normal in the treatment carried out. Based on the results of the analysis of the respondent's assessment, it was found that the completeness of work equipment and timeliness in the wagon maintenance process were included in Low Priority to be improved.

Quadrant C (Keep Achievement)

This quadrant explains that the current level of performance is in accordance with the level of importance or expectations for the implementation of care. So the factors in this quadrant have been successfully realized/fulfilled and for that they must be maintained. Considered very important and very satisfying. Based on the results of the analysis of the respondent's assessment, it was found that the availability of maintenance facilities, condition of treatment facilities, appropriate training and competence, and reliability of facilities can be maintained.

Quadrant D (Excessive)

This quadrant explains that the current level of performance is high while the level of importance or expectations for the implementation of maintenance is low. So the factors in this quadrant are considered

to be less influential/less important, but their implementation is excessive. Considered less important but very satisfying. Based on the results of the analysis of respondents' assessments, it was found that the optimal working time and employee understanding of SOP, Check Sheets were included in Quadrant D.

D. Conclusion

Based on the analysis and explanation of the research result is carried out to maintenance performance Sidotopo Carriage Depot, it can be concluded that Depot's maintenance performance is generally good but there are some findings that can be followed up as follows:

The workload of Human Resources per day for each employees are 11 hours per day. Ideally 6 hours per person per day. Maintenance personnel needed at Sidotopo Carriage Depot based on the study was 30 personnels, while the number of maintenance employee that exist are 18 employees. It is recorded that only 8 employees have certification for maintenance of non-motorized railway facilities and 2 employees who have certification for inspection of non-motorized railway facilities.

Facilities and Equipments of Maintenance Work Facilities. Sidotopo Wagon Depot declared still in accordance with the provisions stipulated in the Minister of Transportation Number PM. 18 of 2019 concerning Standards for Places and Equipment for Maintenance of Railway Facilities (PM RI, 2019). Working Equipments. There are still equipment that has not been calibrated, including wheel diameter measuring instruments, E Knuckle Nose Worn Limit

Gauge, Type E Coupler, F Knuckle Nose Limit Gauge, Type F Coupler (coupler wear gauge tools).

The results of the analysis of the level of importance on the Maintenance Performance of the Sidotopo Wagon Depot on the elements of the quality of care, obtained several things as follows; (1) Condition of work equipment, calibration of work equipment and number of employees are in Quadrant A which is the main priority in an effort to improve carriage maintenance, (2) Completeness of work equipment and timeliness of the wagon maintenance process is in Quadrant B where is a low priority, (3) Availability of treatment facilities, Physical condition of treatment facilities, appropriate training and compensation for maintenance personnel and reliability of facilities for facility disturbances are in Quadrant C, where these conditions need to be maintained. Optimal Working Time and employee understanding of SOP and Maintenance Check Sheets are in Quadrant D, where it is excessive, that is the performance of these elements is good but has a low importance value.

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