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Correlation Between Parts Readiness and On Time In Full (OTIF) Performance

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Abstract

PT XYZ is a distributor company that moves in the heavy equipment sector. One of KPIs that is used to evaluate the company's operations is On Time In Full (OTIF). On the other side, PT XYZ is monitoring the readiness of spare parts in all branches on a daily basis. The objective of this research is to find out if there is a correlation between spare parts readiness and OTIF performance, to identify to what extent the readiness of parts can affect OTIF performance, and to provide a solid understanding basis for companies to make strategic decisions related to improve company processes and achieve optimal OTIF performances. The method that will be performed in this article is Pearson correlation, by using historical data from the 5 branches (Jakarta, Medan, Banjarmasin, Ujung Pandang, and Sorong). From the research, it is known that the correlation values in the 5 branches are, by order, 50%, 49%, 55%, 56%, 58% in which all of them are categorized as "moderate positive", which means between parts readiness and OTIF performance in the company is correlated, but it can also be affected by other factors such as lead time agreement, strategic inventory management, solid cooperation between company branches, and a good relationship between company and the principal.

Keywords: OTIF, *spare parts readiness, correlation,* KPI, *supply chain*

1. Introduction

PT XYZ is a distributor company that engages in heavy equipment sector. Several equipment for sale is trucks, bus, crane, excavator, and other types of equipment. With the evolving customer's preference and needs, company faces against big challenges to improve customer experience (CX). One of the ways to improve CX is utilizing key performance indicators (KPIs). By making supply chain KPIs with the solid focus on customers, company could gain comprehensive understanding about its customers, design a good strategy, and build a customer-centered culture. These days, customers are looking for improvements in sectors such as on time and in full (OTIF) delivery, shorter lead time, and personalized products and packages.

OTIF or DIFOT is a form of key performance indicators in the world of supply chain where it can be formatted as number or percentage, which in this research case is formed as percentage. OTIF can be compared with targets set either internally for company performance or externally for the bench-marking evaluation (Soroka, Ramjaun, & Coverdale, 2021). OTIF, other than to be used for products review and evaluation, can also be used as information for customers or suppliers for the clarity of both sides (Ahmad & Dhafr, 2002). A study in European companies stated world-class targets for OTIF excess 99% (Restivo, 2004). Ahmad and Benson (2000) mentioned that there should be a stringent system and process to keep track of orders and delivery information from a product or a company or the logistic provider, especially if there is an out-sourcing.

OTIF is divided as two elements, there are On Time and In Full. On Time in OTIF represents how far a company can fulfill orders in the scheduled time. On Time calculation usually divides the actual quantities of products that has been delivered before the agreed deadline with the overall ordered quantities. Suppose there is a distribution company who needs to deliver 1000 spare parts by Sunday of the month's first week. The company delivered 850 spare parts on Saturday, but the rest will be delivered on Monday of the month's second week, which means it has passed the agreed deadline. From that it can be concluded that the OT score for the whole order is 85%, since there are only 850 spare parts that are delivered on time out of 1000 spare parts, while 150 spare parts are delivered not on time.

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In Full in OTIF measures delivered or produced orders quantities to rate its compliance against the desired quantities. To calculate In Full delivery, divide total of delivered products with the overall ordered products in the specified time interval. Using the previous case, the distribution company will have 90% for IF score if it can deliver 900 out of 1000 spare parts.

Parts readiness refers to the readiness and the availability of stocked spare parts in the company branches. Exceptionally, it includes the ability to have the right number of spare parts that are ready to be used when it's needed, therefore it can support the company's operational activities without being hampered by the unavailability of spare parts. Spare parts are a common inventory stock that is needed for maintenance (Qiwei, Boylan, Huijing, & Labib, 2018). Spare parts readiness is crucial in any sector of industry that relies on equipment and machines to execute its daily operations. Companies that have good spare parts readiness can minimize the risk of production or services downtime caused by equipment damages, because the organization is able to change the spare parts quickly. By making sure the spare parts in stock are ready, the company can improve the operational efficiency, minimize downtimes, and support the whole operational performance.

The objective of this research is to find out if there is a correlative relationship between spare parts readiness and OTIF performance in the company, to identify to what extent the readiness of spare parts can affect OTIF performance, and to provide a solid understanding basis for companies to make strategic decisions related to improve company processes and optimal OTIF performances.

2. Research Methods

This research was carried out in a statistical approach using Pearson correlation method with the help of software Minitab. The collected data is primary data that was gained from the company's SAP system. It was decided that 5 company branches that will be samples for the research, which are Jakarta (JKT), Medan (MDN), Banjarmasin (BJM), Ujung Pandang (UPG), dan Sorong (SRG). To make the research flow easy to comprehend, a research flow diagram is made, see Figure 1.

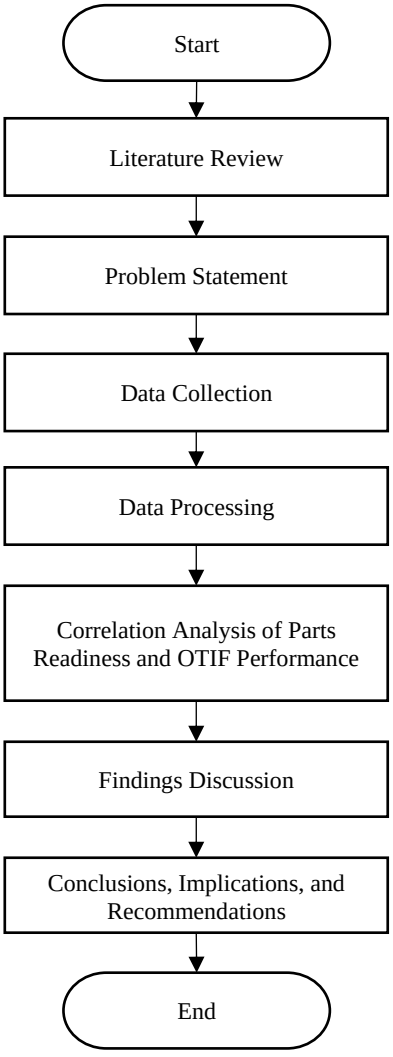

Figure 1: Research Flow Diagram

Correlation analysis is a statistical method that is used to determine a quantity that states how strong the relationship between a variable and another, questioning whether a particular variable depends on other variables (Sekaran & Bougie, 2016). Correlation makes no distinction between explanatory and response variables. Correlation needs both variables to be quantitative (Fligner, 2015). The used correlation method is called Pearson correlation because it is first introduced by Karl Pearson in year 1990 (Firdaus, 2009). Pearson correlation measures the linear relationship between two variables. If the relationship between the two variables is not linear, then the coefficient does not show the relationship of the two variables, even if the two variables have a strong relationship. Interval-scaled data or ration can use Pearson correlation (Kountur, 2009).

$$r = \frac{n\sum_{i=1}^{n} X_i Y_i - \sum_{i=1}^{n} X_i \sum_{i=1}^{n} Y_i}{\sqrt{n\sum_{i=1}^{n} {X_i}^2 - (\sum_{i=1}^{n} X_i)^2}\sqrt{n\sum_{i=1}^{n} {Y_i}^2 - (\sum_{i=1}^{n} Y_i)^2}} \quad (1)$$

If the coefficient is not equal 0, then it can be assumed there is a relationship. The possible range of values for the correlation coefficient is -1.0 to 1. In other words, the value cannot exceed 1.0 or be less than -1.0, where -1.- indicates a perfect negative correlation which means the significance from variable x against variable y is weak and 1.0 indicates a perfect positive correlation which means the significance level of variable x against variable y is very strong (Sudjana, 2005).

Table 1: Interpretation of Correlation Coefficient Values (Sugiyono, 2018)

Correlation Coefficient	Interpretation
0,00-0,199	Very weak
0,20-0,399	Weak
0,40-0,599	Moderate
0,60-0,799	Strong
0,80-1,000	Very strong

For negative correlation (-) indicates an inverse correlation, means that if one variable increase then the other will decrease, and vice-versa. For interpreting the correlation coefficient values, this research uses the guide above (Table 1).

Many research projects are correlational studies because they investigate the relationships that may exist between variables. Prior to investigating the relationship between two quantitative variables, it is always helpful to create a graphical representation that includes both variables. Such a graphical representation is called a scatterplot (Mindrila & Phoebe Balentyne).

Direction indicates whether the overall pattern moves from lower left to upper right, from upper right to lower left, or neither. If the scatterplot almost perfectly in a straight line, it is said there is a strong straight line relationship. If the scatterplot is widely scattered around a straight line, it is said the relationship is weak (Fligner, 2015).

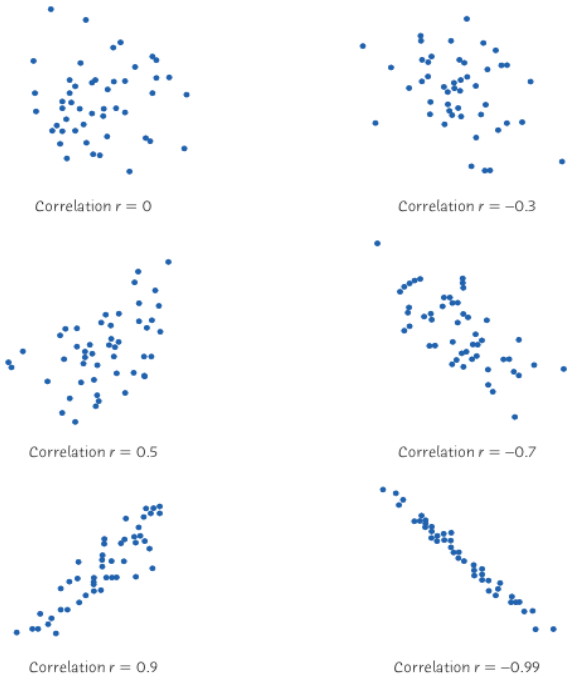

Figure 2: Strength of Linear Relationship in Scatterplot (Fligner, 2015)

The usage of OTIF in company is to find out the company's ability in following the scheduled date for each order. A product can be considered OTIF if the on time and in full values are both fulfilled. If one of them is not fulfilled or achieved, then it cannot be considered as OTIF. Below is the formula to determine on time (OT), in full (IF), and on time in full (OTIF) value from an order.

On time (OT) is a time-oriented measure and addresses whether the products are delivered on time or exceed the deadline (Mandl, 2023). OT is calculated by:

$$\text{OT} = \frac{\text{Number of on time deliveries}}{\text{Total number of deliveries}} \times 100 \quad (2)$$

In full (IF) is a quantity-oriented measure and addresses whether the delivery quantity matches with order quantity (Mandl, 2023). IF is calculated by:

$$\text{IF} = \frac{\text{Delivery quantity}}{\text{Order Quantity}} \times 100 \quad (3)$$

On time in full (OTIF) (also known as delivery in time on full (DiFoT) or purchase order accuracy) addresses both on-time delivery and correct delivery quantity regarding the right item and the right time (Mandl, 2023). OTIF is calculated by:

$$\text{OTIF} = \frac{\text{Number of deliveries OTIF}}{\text{Total number of deliveries}} \times 100 \quad (4)$$

Below is the dataset that has been conducted for all items that were delivered as OTIF in 2023. There are 5 company branches as sample data, which are Jakarta (JKT), Medan (MDN), Banjarmasin (BJM), Ujung Pandang (UPG), Sorong (SRG).

Table 2: Brand X OTIF Products 2023

Brand X OTIF Products (%)					
Month	**JKT**	**MDN**	**BJM**	**UPG**	**SRG**
Jan	81%	98%	83%	98%	100%
Feb	66%	89%	90%	92%	100%
Mar	84%	94%	90%	93%	100%
Apr	68%	87%	83%	77%	100%
May	76%	95%	86%	98%	100%
Jun	65%	81%	88%	93%	75%
Jul	96%	98%	92%	97%	0%
Aug	59%	98%	89%	99%	83%
Sep	83%	95%	97%	96%	100%
Oct	88%	91%	96%	96%	100%
Nov	78%	96%	86%	96%	0%
Dec	77%	87%	96%	98%	100%

Table 3 is the dataset of parts readiness in all 5 branches for 2023.

Table 3: Brand X Spare Parts Readiness 2023

Brand X Spare Parts Readiness (%)					
Month	**JKT**	**MDN**	**BJM**	**UPG**	**SRG**
Jan	87%	73%	56%	67%	100%
Feb	89%	75%	59%	73%	71%
Mar	91%	83%	61%	76%	50%
Apr	90%	56%	71%	67%	57%
May	90%	72%	61%	81%	38%
Jun	87%	61%	61%	65%	40%
Jul	94%	79%	74%	80%	40%
Aug	90%	80%	76%	90%	45%
Sep	92%	97%	75%	85%	28%
Oct	89%	91%	69%	86%	60%
Nov	90%	67%	68%	88%	0%
Dec	87%	69%	92%	83%	100%

3. Results and Discussion

3. 1 Results

This interested subject is situated in the 5 company branches. Five sampling points were carefully chosen, with the data period concludes the whole 12 months of 2023, that are Jakarta (JKT), Medan (MDN), Banjarmasin (BJM), Ujung Pandang (UPG), and Sorong (SRG). The research was conducted by computing Pearson's correlation coefficients (R) between the two variables and creating scatterplots with Minitab software.

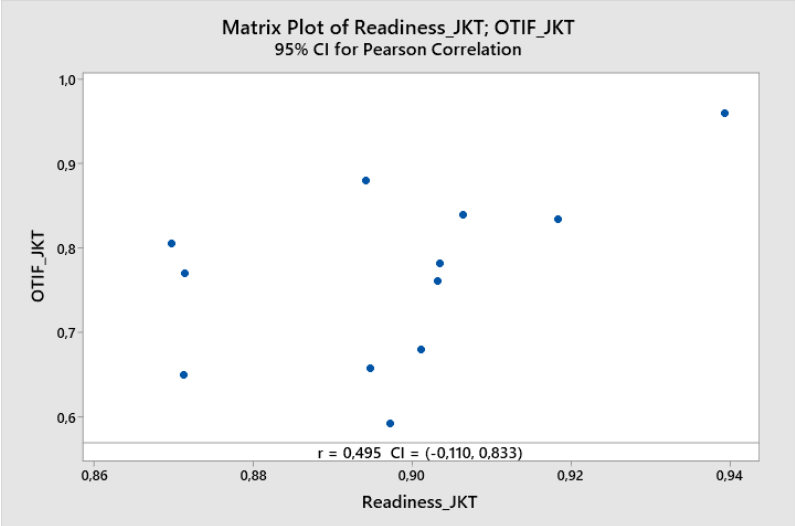

Figure 3: Jakarta Branch Correlation Scatterplot Using Minitab

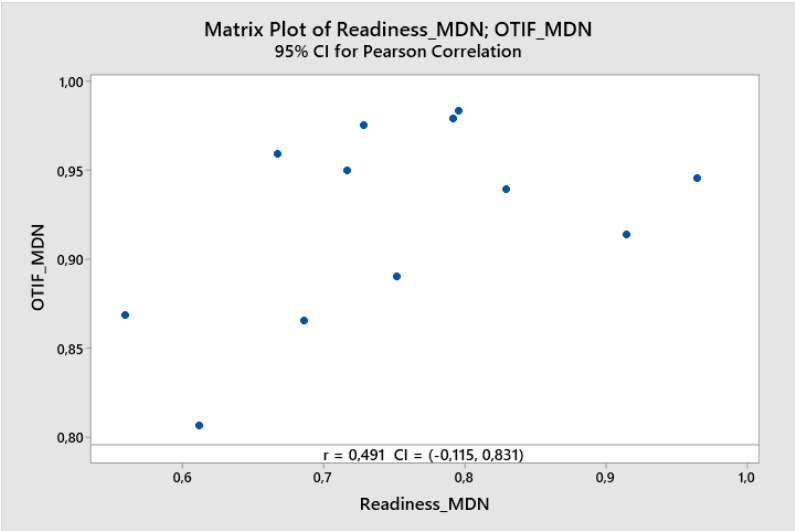

Figure 4: Medan Branch Correlation Scatterplot Using Minitab

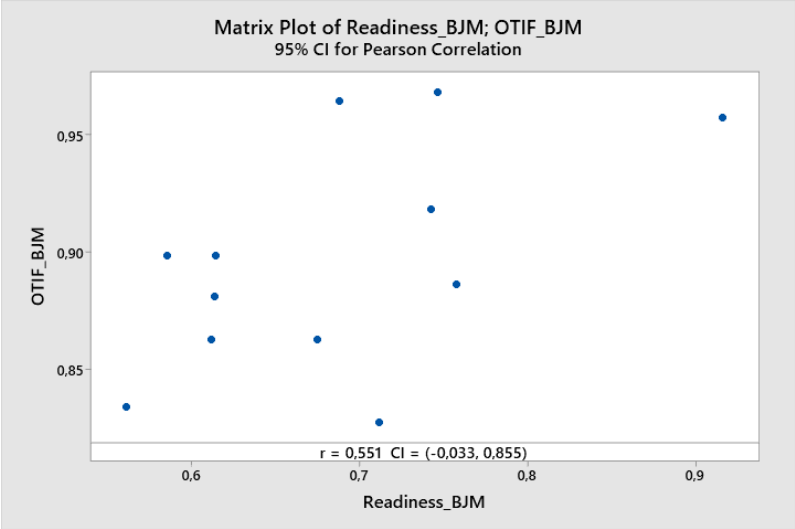

Figure 5: Banjarmasin Branch Correlation Scatterplot Using Minitab

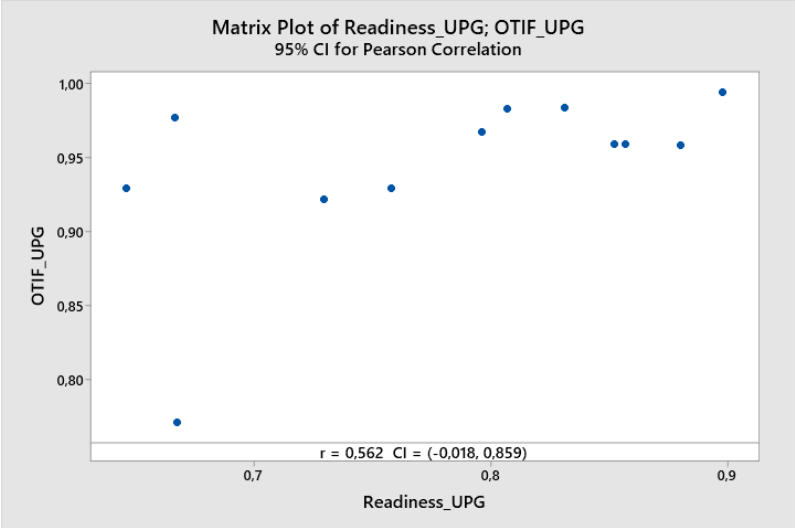

Figure 6: Ujung Pandang Branch Correlation Scatterplot Using Minitab

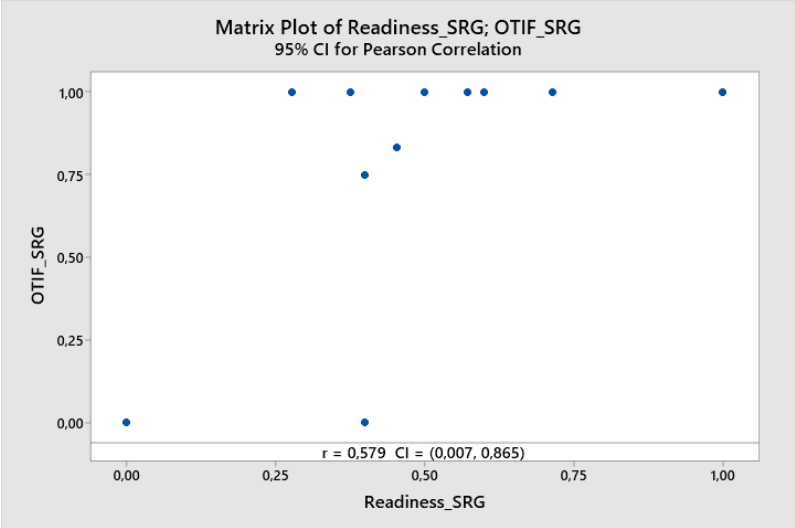

Figure 7: Sorong Branch Correlation Scatterplot Using Minitab

After the test was performed, the outcomes are presented in Table 4.

Table 4: Correlation Between Parts Readiness and OTIF Performance

Plant	R	Interpretation
JKT	0,495	Moderate
MDN	0,491	Moderate
BJM	0,551	Moderate
UPG	0,562	Moderate
SRG	0,579	Moderate

3. 2 Discussion

From the scatterplots above, it can be interpreted that:

a. In Jakarta (JKT) branch, the scatterplot displays a positive relationship. As the parts readiness increases, the OTIF performance also tends to increase. Stronger relationships produce a tighter clustering of data points. While in the Figure 3 shown above, the data points scatter widely indicate a moderate to weak relationship.

b. In Medan (MDN) branch, the scatterplot displays also a moderately positive relationship. Values tending to rise together indicate a positive correlation. Same as in Jakarta branch, Figure 4 displays a dataset of widely scattered points, indicates a moderate to weak relationship.

c. In Banjarmasin (BJM) branch, the scatterplot displays also a moderately positive relationship. The dataset from Figure 5 shows an uphill pattern. Its movement from left to right indicates a positive relationship between two variables. The points are widely scattered, the relationship can be defined as moderate to weak.

d. In Ujung Pandang (UPG) branch, the scatterplot displays also a moderately positive relationship, as shown in Figure 6. The movement of the data points are left to right and lower to upper.

e. In Sorong (SRG) branch, the scatterplot displays also a moderately positive relationship, as shown in Figure 6. The movement of the data points are left to right and lower to upper, same as the other branches.

In general, it is difficult to determine how strong a linear relationship is, or how big the amount of space around the cloud of points in a scatterplot. That is the reason why statisticians use numerical measures to supplement the graph. Correlation is the measure that can be used (Fligner, 2015).

From Table 4, it is mentioned the correlation values in Jakarta branch is 0,495 or in the percentage form is 50%, while in Medan, Banjarmasin, Ujung Pandang, Sorong are, by order, 49%, 55%, 56%, 58%. Of all 5 branches, none of them has achieved “strong” or “very strong” correlation and the majority is in the “moderate” positive range. Indicates that between parts readiness and OTIF performance in the company is correlated, but it does not signify that the OTIF performance is constantly affected by the readiness. There are cases where the OTIF performance stays high, but the readiness is low, or vice versa. This phenomenon can be caused by several factors. Some causes involve effective strategies and good management

of the company. The passage following is several factors that possibly cause the phenomenon.

a. Good relationship between branches. The simple case is when a branch, suppose Jakarta, gets order from a customer, but the spare parts or the units that are ordered is not available in that one branch. Then, the Jakarta branch can ask for help from another branch that is near, to support fulfilling the customer's orders before the scheduled delivery deadline and delivered with the right quantity. This will cause the OTIF values to increase, even if the readiness of spare parts in Jakarta is not good.
b. Lead time agreement between company and customer. The company and customer can make deals about the lead time of product before the customer officially orders it through the transaction system. This will help the company to prepare the soon-to-be ordered products, therefore OTIF will be achieved.
c. Other than that, even if the readiness is not optimal or the inventory is limited, the company has an effective inventory management system by prioritizing the fast-moving items or crucial and important items. The company can make sure the products are available and can be used on time, in full, and in one piece.
d. Good relationship between the company and principal (supplier) is another factor that causes the OTIF values good. Close cooperation with suppliers can help to avoid the risk of parts unavailability quickly by securing additional deliveries or gaining priority in the supply chain.

On the other side, there are other factors that can cause OTIF values to be less than the minimum standard even though the parts readiness is considered good. Here are some common causes:

a. Weak supply chain management such as delays in deliveries from suppliers, logistics issues, or disruptions along the supply chain (internal of external) may result in delays in order fulfillment and decrease OTIF values.
b. Although the spare parts may be available, if there were a quality issue with a product or part delivered, the customer may not receive a perfect delivery. This may affect OTIF values.
c. If the company cannot quickly adjust to changes in demand from customers or cope with urgent situations, this may cause a decrease in the OTIF value.
d. Limited knowledge and authorization. There was a case that had occurred in one of branches. A customer asked the branch about the available parts. The branch informed the customer that the spare parts they intended to buy were not available, but after being rechecked from the head office, those spare parts were available. This can be caused by two reasons: limited knowledge of SAP system or limited authorization in SAP usage.

3. 3 Managerial Implication

From results and discussions above, it can be summarized the relationship between parts readiness and OTIF performance is positively correlated. To ensure the company's operations work optimally, there are some actions that can be taken in response, such as:

a. Application of dashboard or control panel to help monitor OTIF performances and the availability of spare parts.
b. Application of search engine media to help branches or sites to find out if a specified stock is available without using SAP system, as it will be easier and inclusive.
c. Support of product review that can be conducted monthly with division head and managers to ensure the operations from branches and sites work accordingly.
d. Daily review from each sub-division to help company keep in track with issues that occurred in units or items that have been sold or are going to be sold.

4. Conclusion

Based on the results of the research and discussion that has been carried out, the conclusions that can be drawn are as follows.

a. The correlation coefficient values at the Jakarta, Medan, Banjarmasin, Ujung Pandang, and Sorong branches are 50%, 49%, 55%, 56%, 58% respectively with the average entering the "moderate" category in the correlative relationship. This means that there is a relationship between spare parts readiness and OTIF performance.
b. Poor spare parts readiness and good OTIF performance can be caused by several factors such as good cooperation between branches, smart and effective inventory management, and good cooperation with suppliers. While good spare parts readiness and poor OTIF performance can be caused by factors such as weak supply chain governance, product quality issues, lack of communication

between branches or with suppliers, and inability to manage urgent demand.

c. A strategic step that can be taken to improve the readiness value of spare parts and their OTIF performance is to build good relationships between company branches throughout Indonesia from Java Island, Sumatra Island, Kalimantan Island, Papua Island, Sulawesi Island, and other regions. In addition, the company can also build good relationships with customers so that it is easy when buying and selling activities. Constantly checking on the state of the branches is a good strategy in getting to know them well and preparing inventory so that if the need arises, nearby branches can help.

Despite these factors, it is important to remember that poor parts availability can ultimately have a negative impact on overall performance. Therefore, companies often strive to improve the value of spare parts availability to ensure smooth and efficient operations in the long run. To improve the OTIF value, companies need to ensure that not only are spare parts sufficiently available, but also that the overall supply chain process is well-managed, and responsive to changes and challenges that may arise. The company should continue to ensure the availability of spare parts, maintain good relationships with suppliers or branches, follow up items to check if there are product failures regularly, expand warehouse capacity so that small branches can increase the quantity of warehousing and readiness of spare parts.

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