

PERFORMANCE ANALYSIS ON FREIGHT TRANSPORTATION IN FURNITURE INDUSTRY, A CASE STUDY IN BANTUL, YOGYAKARTA, INDONESIA

C. H. Soekamto

Board of Human Resources Department, Ministry of Transportation, Republic of Indonesia
Email: cornelihariyanto@yahoo.com

S. Priyanto

Department of Civil and Environmental Engineering, Universitas Gadjah Mada
Email: spriyanto2007@yahoo.co.id

ABSTRACT

The Supply Chain Management is a new philosophy encouraging internal and external integration which encompass all the aspects, from the supplier until down to the customers. Transportation plays a major role in achieving efficiency and effectiveness because the role of transportation in the Supply Chain is as the intermediary help to distribute the physical goods from one entity to another entity. For this reason, the objective of this research is to analyse and measure the effectiveness and efficiency of inbound and outbound logistics in the furniture industry in Bantul, Yogyakarta. Firstly, the author will try to draw the supply chain mapping in order to gain more understanding about the entities in the supply chain. Secondly, performance of the transportation modes that will be used to move the furniture will be assessed through questionnaire. Thirdly, the author will try to analyse the response if rail transportation is proposed as an alternative transportation mode to move the goods. Lastly, conclusion and recommendation regarding the issue will be derived as implied in the result from data analysis.

Keywords: Supply chain management, transportation, performance, furniture industry.

1 INTRODUCTION

1.1 Background

Bantul is one of the districts in Yogyakarta Province which is located in the middle of the Province, where furniture making is the most common manufacturing industry. The furniture products are made of bamboo, wood or rattan. In the year 2000, it is reported that this industry is approximately 14.6% while in Bantul itself this industry is approximately 41.55% from the total industry in Bantul. It can be concluded that this industry is the largest industry in Bantul which is later followed by the textile and food industries.

Transportation becomes one aspect that influences the effectiveness and efficiency of the supply chain. Rondinelli and Berry (2000) supported the idea by stating that there are four major aspects that drive the emergence of transportation in the supply chain, which are economic globalisation, speed to market product delivery, integrated supply chain and agile manufacturing and business practices.

Ruijgrok and Tavassy supported Rondinelli and Berry (2000) and stated that international trade is the main driving force of international and intercontinental

freight transport. The World Trade Organisation reported that the export trade merchandise rose by 9 percent, which has been the best performance since 2000. The World Trade Organisation also reported that transportation service has increased by 23 percent to \$500 billion.

Furthermore, after the emergence of Just In Time in the early 1980s, organizations need the materials to be delivered not only in number of days but also in several hours. If the materials are not delivered on schedule, it will cause interruptions along the supply chain. In other words, late delivery of productions will cause loss in profit or even bad influence on the reputation.

Besides Just In Time, the type of transportation modes used depends on many other factors, which include the location of each entity such as the warehouse and consumers. Revenue is considered as one of the factors affecting the choice of a transportation mode. Then accessibility is also one of the factors affecting transportation usage. Because of these factors, organisations try to maximise the usage of transportation modes in order to improve the supply chain activities.

Due to different factors affecting the usage of transportation modes, the author will try to analyse the logistics chain in the furniture industry located in Bantul. At first, author tried to analyse the entities along the supply chain in the industry. Furthermore, it was also defined the transportation modes used to move raw materials from each entity and the reasons for each chosen transportation mode. Afterwards, there was an analysis on the response if rail transportation was proposed as alternative solution to improve the industry's performance.

1.2 Objectives

The objective of this research is to analyse the performance in the delivery from the first tier supplier to the first tier consumers. The performance measurement was preceded by analysing Bantul furniture supply chain. This research was finalised by measuring the probability of the furniture industries in choosing freight transport between rail transport and road freight transport.

1.3 Research Scope

- a) The research was conducted in Bantul, Yogyakarta, Indonesia
- b) Supply Chain Mapping was limited only to the first tier supplier and the first tier consumers
- c) The performance was measured using performance importance matrix, factor analysis and regression model
- d) Stated preference was conducted to see the demand for rail as freight transportation. Only five attributes were provided in the survey. The reason was time limitation and easiness for respondents.

2 LITERATURE REVIEW

2.1 Supply Chain Management in Brief

Ismail (2008) and Simchi-Levi (2003) stated that supply chain management is a business model which strategically coordinates all the members in the supply chain. The aim of the supply chain management is to improve long-term performance of the companies by improving the supply chain as a whole.

2.2 Transportation Role in Supply Chain

In supply chain, transportation role is to deliver one material or might be products from one point to another. Morash and Clinton (1997) supported the idea by stating that in order to compete globally, transportation role in a supply chain is critical. Transportation enables a corporate to source raw materials and finished goods from other countries. Furthermore, transportation may be in an ideal

position to integrate and coordinate flows throughout the supply chain.

2.3 Delivery Link Performance Measurement

Brewer (2001) in his book stated that measurement is undertaken to enable the comparison of an activity against a standard goal, over time, between different activities at one time or combination of these. Mentzer and Konrad (1991) in Hung Lai et al (2004) supported the idea by defining measurement as how efficient and effective a manufacturer to accomplish the task given.

Measuring the performance in delivery links is always challenging because significant results can be achieved. Furthermore, it is challenging because the delivery process takes places in a dynamic and ever changing environment.

In order to increase the delivery performance, several things can be done such as reduction in lead time attributes and on time delivery. Gunaserkan et al (2004) also added that on time delivery can be defined as delivery reliability and the quality. In other words, it can be defined as right time, right place and right quality.

Furthermore, the delivery speed is also another metric that determines the performance. Many factors affect the delivery speed, namely vehicle speed, driver reliability, frequency of the delivery and location of depots. Moreover, flexibility in delivery can also be another metric to be improved. Flexibility can be defined as the flexibility in meeting the customers' requirement such as place, time, and transportation modes

The performance in delivery can also be measured through faultless notes. In the delivery process, when the products are received by the customers, quality check must be done. The product received can be compared to the agreement made by the customers. Areas of discrepancy should be detected to find the areas of improvement.

2.4 Comparisons between Rail Transport and Road Freight Transport

Land transport in logistics plays a major role in connecting the delivery service for air and sea transport from airports and seaports. The characteristic of land transport is high level of accessibility in the land area. In general, there are three types of land transports, which are railway, road freight and pipeline. However, in Indonesia, the most common land transports are railway and land freight transport. In each of these land transports, it offers

different advantages and disadvantages which will be discussed below.

Tseng et al (2005) reported that railway transport offers advantages like high carrying capacity. Saenz (2008) also added the idea by stating that, in terms of cost in delivering high volume, railway transport will offer much lower cost compared to road freight transport. Van der Ven (2009) supported the idea by stating that the cost per kilometre of delivering goods using railway transport will be lower compared to road freight transport if the distance is over 700 km as shown in Figure 1.

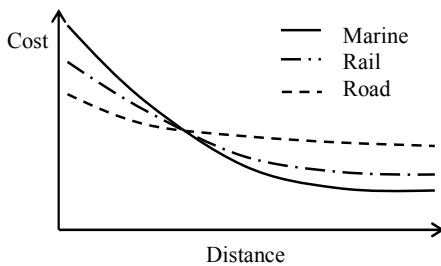


Figure 1. Cost comparison between rail and truck transportation (Van der Ven, 2009)

Furthermore, in terms of energy consumption and pollution, railway transport proved to consume less energy and pollute less compared to road freight. Taufik (2005) in his article also added several important numbers to show the disadvantage. Based on the Federal Railway Administrator (1991) in Taufik (2005), road freight transport consumes approximately 1.4 until 5.61 fuel compared to railway. For travel distance less than 100 km, road transport consumes 9 times of fuel compared to railway transport.

However, road freight transport offers advantages that cannot be offered by railway transportation such as high flexibility and versatility. This condition results in the increase in the number of trucks as freight transport each year. Furthermore, Railway network is not as extensive as road network which restrains the goods movement and increases the number of handling, transit time and frequency of services.

3 RESEARCH METHODOLOGY

The research focuses on the distribution of materials from the first tier suppliers to the furniture industry for processing and further on the author analyses the delivery of the products to the nearest port, which is Tanjung Mas Port in Semarang. In other words, the author has to map the supply chain and find out the distance from the origin to the destination. From that

result, the reasons for choosing the transportation mode can be explained.

The author then analyses the performance of the existing delivery process and distribution process. The key performance indexes that are going to be measured are quality, cost, delivery time and flexibility. Based on the survey, author an alternative transportation mode, which is rail, is provided. Through the stated preference survey, the author analyses the probability of the industry to change the transportation modes to rail transportation.

In this research, the number of sample is decided based on the Slovin method which is shown in the equation below. Based on the data collected, there are 40 medium and large industries in Bantul Regency. Error rate (e) used in this research is 10%, which means 0.1. The minimum samples that should be collected in this research are 20.

3.1 Questionnaire Survey

Questionnaire survey was done within two weeks, from 6 September 2011 till 20 September 2011. The purpose of this research is to collect data related to the delivery performance of inbound and outbound delivery process and supply chain entities for supply chain mapping through a list of questions which has to be answered by the manager, HRD staff of Logistic staff in the furniture industries

3.2 Stated Preference Survey

Stated Preference survey was done together with the questionnaire survey for the sake of efficiency and for reason of time limitation. The purpose of the stated preference survey is to understand the demand for rail freight transport through mode choice. The attributes that are used in this survey are cost, time, frequency, delay and quality.

3.3 Data Analysis

Data that are collected are first be analysed with SPSS for reliability and validity. They are analysed using factor analysis and multiple linear regression. Several tools are used to support the data analysis process such as Microsoft Word and Microsoft Excel.

4 BANTUL FURNITURE SUPPLY CHAIN

In a very simple supply chain, furniture supply chain consists of forests, producers and consumers or customers as shown in Figure 2.

Forest is the main source the raw materials in the furniture industry, which is wood. There are three sources of raw material in Bantul Furniture Industries

which are Perhutani (State Forest Enterprise), community forest and old furniture collectors. As for the Bantul Furniture Industry, approximately 50% of the industry bought the wood from Perhutani. Furthermore, there are approximately 35% of furniture industry which has the wood for production from the internal Yogyakarta area and it is usually bought from old wood traders. Approximately 15% of the wood is bought from community forest outside Java Island. In general, the wood is gathered from Kalimantan and Sulawesi.

Producer will refer to the furniture industries. The furniture industries in Bantul fall into two main categories. The first type is the integrated industries

which have all the production process done in one workshop. In other words, this type of industries produced finished goods from the unprocessed wood. In the second type of industries, however wood processing is done in a separate place by a different enterprise and later on the processed wood will be sent to the next enterprise to be processed into finished products.

Based on the sampling, it can be concluded that the consumer chain in Bantul Furniture Supply Chain consists of domestic furniture retailers, exporters and international retailers.

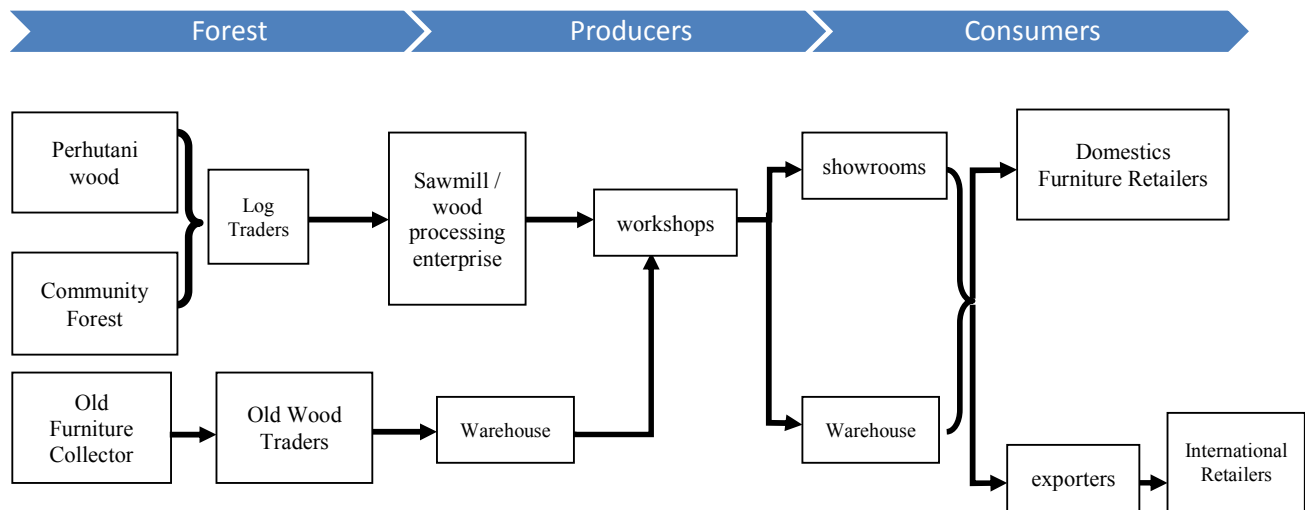


Figure 2. Bantul’s furniture supply chain

Table 1. Coefficient resulting from multiple regression analysis for the delivery performance measurement from supplier to producer

Regression Model	Coefficient											
	Test	c	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10
Linear (First Scenario)	Coefficient	-1.14	1.52	1.40	1.68	1.27	0.58	4.08	0.71	-0.58	1.20	0.06
Sum Scores by Factor	Coefficient	-0.83	1.01	1.01								
second Scenario												
Weighted Sum Scores	Coefficient	0.01	0.99	1.01								
Third Scenario												

Based on the coefficient resulting from the multiple regression analysis in Table 1, the performance in the delivery process from the simple linear regression is 87.20%. The different results are generated from the sum scores and weighted sum scores. As mentioned in the previous section, in sum scores and weighted sum scores, several variables are grouped into two factors

based on the factor analysis result. The different value also resulted from sum scores and weighted sum scores which are 74.03% and 80.87%. The source of different value resulting from sum scores and weighted sum scores is the loading factor. In sum scores, all items in a factor are giving an equal weight by ignoring the loading factors, while in the weighted

sum scores, the loading factors must be multiplied with the scaled scores. On the average, the performance of the delivery from supplier to producer resulted in 80.7%. This number can be categorised as good performance.

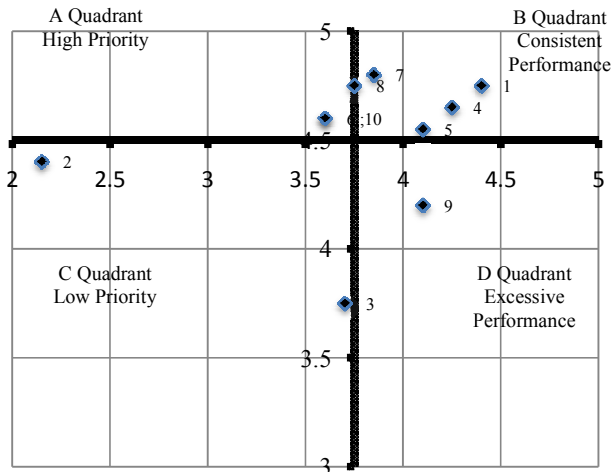


Figure 3. Importance performance matrix delivery performance attributes based on the furniture industry as the consignee point of view

4.1 Quadrant A- High Priority

In the first quadrant, High priority will refer to a situation where the delivery attribute is rated as important by the furniture industries, but the supplier does not perform well.

There are two attributes, namely the ability of the supplier to give prompt services in an emergency situation and the willingness to be responsible for late delivery. The supplier should put more attention to keep improving its performance. As mentioned previously, several disasters that happened a few years ago in Yogyakarta Province such as earthquake and volcano eruption posed several problems related to the furniture supply chain in Bantul. The responsiveness of the supplier in keeping on the continuity of the delivery of raw material supply greatly affects the result of the whole supply chain performance.

The same case is also true for the willingness of the supplier to be responsible for late delivery. Several factors that cause late delivery are the availability of the raw material, the availability of the vehicle, and the traffic condition. The reasons why this attribute is located in this quadrant is that for some reasons, there is nothing they can do, especially if the delay is caused by the traffic condition.

4.2 Quadrant B- Consistent Performance

In the second quadrant, Consistent performance refers to a situation where the performance and the importance are almost equal, which also means that the attribute's performance grouped in this quadrant should be maintained.

There are approximately five attributes that are plotted on this quadrant. The first is the ability of the supplier to perform the delivery based on promises. The second is provision of services based on the promises. The third is communication between the supplier and the furniture industry about when the next delivery will be performed. The fourth is the willingness of the supplier to help the furniture industry such as delivery using the alternative road due to a disaster. The last is the timely response to request for furniture such as delivery arrangement.

4.3 Quadrant C- Low Priority

In the third quadrant, low priority refers to a situation where the attribute is not important and as a result, those attributes are neglected by the suppliers. There are two attributes that help to solve the problem faced by furniture industry as the consignee and the ability of the supplier to perform right services at the first time.

4.4 Quadrant D – Excessive Performance

In this quadrant, excessive performance refers to a situation where the attribute is grouped as less important but suppliers show good performance. There is one attribute grouped in this quadrant, which is safety assurance that the material will be delivered in right quality to the destination. The attribute that is plotted in this quadrant should be maintained; however, effort should be made and focused on the other quadrants such as the high priority quadrant.

There are four performances resulting from four different equations as shown in

Table 2. The difference between the first and second linear regression is the number of variables used. The second linear regression only eight variables are used in the equation. The variables used are the variables that are valid and reliable based on the factor analysis results. Furthermore, the same case with the previous case, sum scores and weighted sum scores is based on the factor analysis.

The performance of the delivery from producer to consumer is rated approximately 73.5%. The different results are shown in

Table 2, but all of the results are scattered around 70% - 77%.

Table 2. Coefficient resulting from multiple regression analysis for the the delivery performance measurement from producers to consumers

Regression Model	Coefficient											
	Test	c	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10
Linear (First Scenario)	Coefficient	-1.80	1.37	1.10	0.63	1.08	0.91	1.29	1.06	0.75	1.34	0.84
Linear (Second Scenario)	Coefficient	0.01	0.02	0.03	0.03	0.02	0.02	0,03	0.02	-	0.03	-
Sum Scores by Factor third Scenario	Coefficient	0.01	0.10	0.10	-	-	-	-	-	-	-	-
Weighted Sum Scores Forth Scenario	Coefficient	-0.05	0.10	0.10	-	-	-	-	-	-	-	-

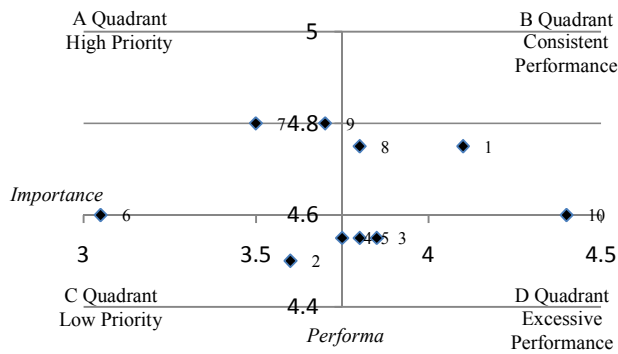


Figure 4. Importance performance matrix delivery performance attributes based on the furniture industry as the shipper point of view

4.5 Quadrant A- High Priority

There are three attributes located in this quadrant, which are the willingness of the freight forwarder to help the furniture industry, the ability of the supplier to give prompt services in an emergency situation and safety assurance that the material will be delivered in right quality to the destination.

The first attribute is the willingness of the freight forwarder to help the furniture industry. Based on the interview with the furniture industries, stuffing, packaging are all of the responsibility of the furniture industries. The freight forwarder does not interfere with the process. However, the freight forwarder must be present during the stuffing process. Due to this agreement, several freight forwarders cannot be bothered to help these processes at all.

Furthermore, the other attribute is the safety assurance that the material will be delivered in the right quality to the right destination. For the reason mentioned in

the previous paragraph, several cases in the loss of quality happened during the delivery process. Several industries also mentioned approximately 5% - 10% of the products are in bad quality because of the imperfect stuffing process.

4.6 Quadrant B- Consistent Performance

There are approximately two attributes that are plotted in this quadrant. The first is the timely response to request for furniture. The second is the responsibility for late delivery.

4.7 Quadrant C- Low Priority

There is one attribute located in this quadrant which helps to solve the problem faced by the Furniture Industry as the consignee.

4.8 Quadrant D – Excessive Performance

There are four attributes grouped in this quadrant, which are provision of services based on the promises, communication between freight forwarder and the furniture industry, the ability of the supplier to perform right services at the first time, and responsibility for late delivery

The attribute plotted in this quadrant should be maintained; however, effort should be made and focused on the other quadrants such as the high priority quadrant

5 FREIGHT TRANSPORT MODE CHOICE IN BANTUL FURNITURE INDUSTRIES

In order to obtain the freight transport mode choice, parameter model estimation is done. The estimation is done based on the individual response as the dependent variables and attributes value differences

from this two-freight transport as the independent variables. Analysis process using regression analysis is done by inputting the dependent and independent variables. From this estimation process, a model for freight transport mode choice model is produced.

$$\begin{aligned} \ln(P_t/P_r) = & 2.94 - 0.00769 (C_t - C_r) - \\ & 0.0193 (T_t - T_r) + \\ & 0.6678 (F_t - F_r) - \\ & 0.029 (D_t - D_r) + \\ & 0.3123 (Q_t - Q_r) \end{aligned} \quad (1)$$

In the equation 1, it can be seen that the regression equation for freight transport mode choice. There are several terms in the equation such as $(C_t - C_r)$, $(T_t - T_r)$, $(F_t - F_r)$, $(D_t - D_r)$ and $(Q_t - Q_r)$. Each term will refer to a different meaning which is shown below.

- $(C_t - C_r)$ = cost difference between truck and rail as the freight transportation
- $(T_t - T_r)$ = time difference between truck and rail as the freight transportation
- $(F_t - F_r)$ = frequency difference between truck and rail as the freight transportation
- $(D_t - D_r)$ = delay difference between truck and rail as the freight transportation
- $(Q_t - Q_r)$ = quality difference between truck and rail as the freight transportation

Model Application

Logit biner model calibration with regression model results in equations which can be used to predict freight mode choice probability. Equations are applicable to predict the probability of mode choice in a series of different alternatives. Through this model application, a series of changes in probability of mode choice if the attributes are changed.

The changes in the attributes are done by increasing and decreasing the cost, frequency of the delivery, travel time, quality and delay. The assumption made for this model application is that the changes in one attribute do not affect the other attributes. In other words, the feedback effect is excluded in analysis.

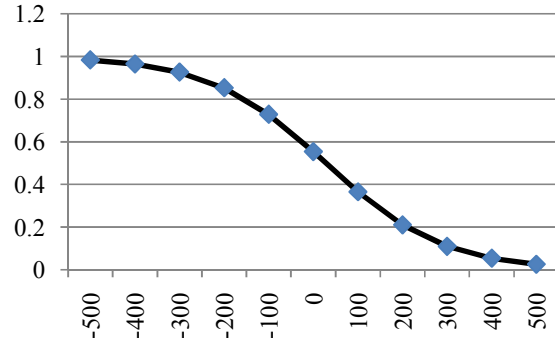


Figure 5. Percentage of the truck as freight transportation if there is cost difference

As seen in Figure 5, if the truck cost is cheaper, most of the industries will choose truck as the most preferable freight transportation.

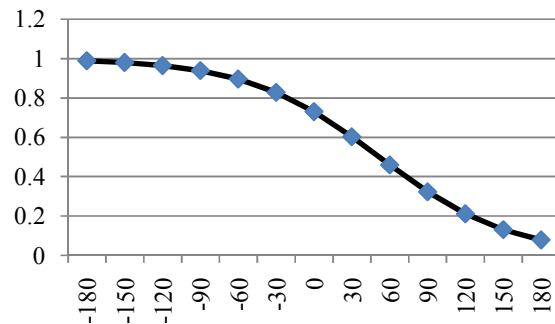


Figure 6. Percentage of the truck as freight transportation if there is time difference

As seen in Figure 6, if the truck delivery time is faster, most of the industries will choose truck as the most preferable freight transportation.

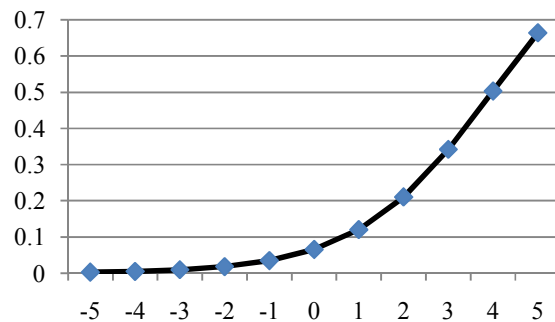


Figure 7. Percentage of the truck as freight transportation if there is frequency difference

Based on Figure 7, it can be seen that if the difference in frequency is bigger, most of the industries will choose truck as the transportation mode.

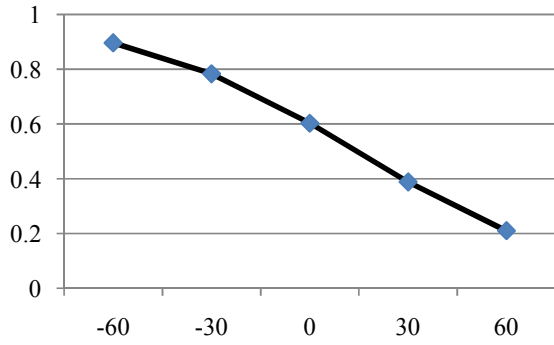


Figure 8. Percentage of the truck as freight transportation if there is delay time difference

Based on Figure 8, it can be seen that if the difference in delay time is bigger, most of the industries will choose train as the transportation mode.

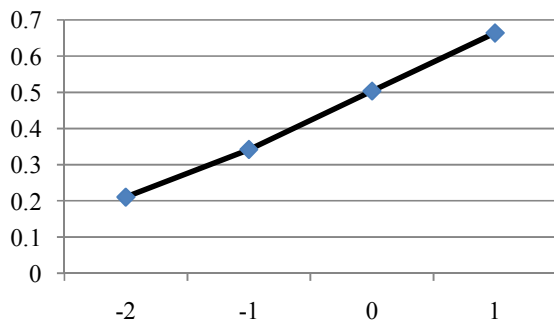


Figure 9. Percentage of the truck as freight transportation if there is quality difference

Based on Figure 9, it can be seen that if the difference is bigger, most of the industries will choose train as the transportation mode.

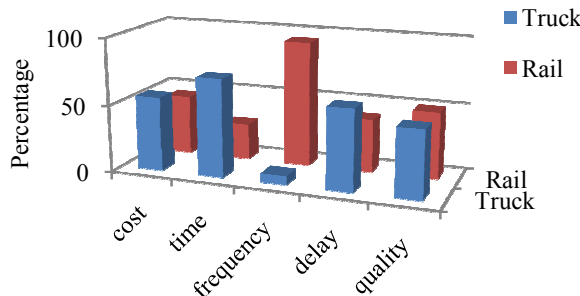


Figure 10. Percentage of mode choice between truck and rail

If there is no cost difference between truck and rail, most of the industries will still choose truck as the most preferable freight transportation. This can be

seen in Figure 10 where it shows that approximately 55.36% of the sample will still use truck as freight transportation.

Furthermore, if there is no time difference between truck and rail, most of the industries will still choose truck as the most preferable freight transportation. This can be seen in Figure 10, which shows that approximately 72.98% of the sample will still use truck as freight transportation. Even when the rail transport is 30 minutes faster than truck transportation, approximately 60% of furniture industries will still choose truck as the freight transport.

However, a different condition shows in the frequency attribute, which indicates that if there is no difference in truck and rail transportation, approximately 90 % of the industries will prefer train as the freight transportation mode. Moreover, it can be seen that if there is no difference in terms of delay in truck and rail transportation, approximately 60 % of the industries will prefer truck as the freight transportation mode. The same condition is also shown in the quality attribute, it can be seen that if there is no difference in truck and rail transportation, approximately 50 % of the industries will prefer truck as the freight transportation mode.

In brief, it can be said that rail is able to compete with truck as freight transport in cost, frequency and quality. In these three attributes, most furniture industries will still choose rail as freight transport if there is no difference in cost, frequency, delay and quality. However, in terms of time, most of the industries will still prefer truck as the freight transport.

6 CONCLUSION

In brief, it can be concluded that the delivery performance in Bantul Furniture Industry can be categorised as good performance. However, more effort should be put into improving several attributes in order to increase the efficiency of delivery.

It is true that most of the furniture industry will still prefer truck as the freight transportation mode. However, if there are no differences in cost, frequency and quality, most of the furniture industries may change their preference to rail transportation.

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