

# Supply Chain Risk Management Material, Equipment and HR Construction of Quality Bendon Road Pavement Works with Buton Asphalt in the Large Implementation of VI National Street of Jakarta

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**Abstract:** Roads are transportation infrastructure that affect economic development efforts. A good road is a road where users feel safe, comfortable and efficient for the community. Supply chain, supply chain, network logistics, or supply network is a coordinated system consisting of organizations, human resources, activities, information, and other resources involved together in moving a product or service in the form of either physical as well as virtual from a supplier to customer. The purpose of this study is to determine the extent of risk control over the use of asphalt. This study uses a statistical analysis of Statistical Package for the Social Sciences (SPSS) to get the results of the high risk category in the management of asphalt material supply chains. From the 4 research hypotheses conducted by the researchers, the results were accepted or proven that there was an effect of joint risk management of supply chain materials, equipment and human resources on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI.

**Keywords:** Quality Supply Chain Management

## 1. Preliminary

Roads are transportation infrastructure that affect economic development efforts. A good road is a road where users feel safe, comfortable and efficient for the community. Road performance is assessed from durability, economic value, planned life, comfort, flexibility, applicability and so on (Director General of Highways, 2010). Each component in the road works affects the quality of road services to traffic. Quality road services can be achieved if the process of carrying out road works is carried out in accordance with the standards and regulations set by the Director General of Highways (2010).

Indonesia is one of the producers of natural asphalt (Asbuton - Asphalt Buton), natural asphalt contained in natural deposits found on the island of Southeast Sulawesi. With a total of 650 million tonnes of asphalt asphalt, making Indonesia the world's largest producer of natural asphalt. Until now the use of buton asphalt is still not comparable with so many deposits due to the exploration of better technology for the processing and use of asbuton.

### Formulation of the problem

- 1) How to manage material supply chain risk for the quality of flexible pavement work with buton asphalt at the Jakarta National Road Implementation Center VI.
- 2) How is the equipment used for the quality of flexible pavement road work with buton asphalt at the Jakarta National Road Implementation Center VI.

- 3) How does material HR affect the quality of flexible pavement work with buton asphalt at the Jakarta National Road Implementation Center VI.
- 4) How to manage the risk of supply chain materials, equipment and construction human resources together on the quality of the flexible pavement work with buton asphalt at the Jakarta National Road Implementation Center VI.

### Research purposes

- 1) To determine the risk management of material supply at the Jakarta National Road Implementation Center VI.
- 2) To determine the factors that hamper the availability of the Asphalt Buton supply chain at the Jakarta National Road Implementation Center VI.
- 3) To determine the structure of the buton asphalt supply chain at the Jakarta National Road Implementation Center VI.
- 4) To determine the risk management of supply chains, equipment and construction human resources together on the quality of flexible pavement works with buton asphalt at the Jakarta National Road Implementation Center VI.

## 2. Theoretical basis

### Asphalt

Asphalt is a dark brown or dark black hydrocarbon compound formed from the elements of asphaltenes, resins, and oils. Asphalt in the pavement layer functions as a

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binding material between the aggregates to form a compact mixture, so that it will give the strength of each aggregate (Kerbs and Walker, 1971). The main constituents of asphalt are bitumen which is found in nature or obtained from the processing of petroleum. Asphalt has properties as an adhesive, and high resistance to water (Asphalt Institute, 2001). Aside from being an adhesive, asphalt also serves to fill the cavity between the aggregate grain and the pores that exist from the aggregate itself.

Asphalt is a thermoplastic material that will become harder or thicker if the temperature decreases and will be softer or more fluid if the temperature increases. This property is called sensitivity to temperature changes, which is influenced by the chemical composition of asphalt although it may have the same penetration or viscosity value at a certain temperature. Asphalt containing wax is more sensitive to temperature compared to asphalt which does not contain wax. This can be seen on asphalt which has the same viscosity at high temperatures but very different viscosity at low temperatures. Sensitivity to temperature will be the basis for the age difference of asphalt to crack or harden.

### 2.1 Asbuton (Asphalt Buton)

Asbuton is a natural asphalt in the island of Buton (Indonesia), in the form of powder to chunks consisting of a mixture of minerals and bitumen (SNI 6749: 2008). Buton stone asphalt or commonly called asbuton was discovered in 1924 on Buton Island, Southeast Sulawesi. Asbuton began to be used in asphaltting roads since 1926. Based on available data, asbuton has a deposit of around 677 million tons, equivalent to 170 million tons of oil asphalt. Asbuton is the largest natural asphalt deposit in the world (BALITBANG Ministry of Public Works, 2012). In 1936 Hetzel mapped the Asbuton deposit on Buton Island. Asbuton deposits are scattered in several sub-districts in Buton Island, including in Kabungka, Lawele, Ereke, Winto, Waisiu, Wariti and others,

The term asphalt comes from the ancient Greek asphaltos, then the Romans changed it to asphaltus, then adapted it into English into asphalt, and translated into Indonesian asphalt.

Type of asphalt based on how to get it:

- 1) Artificial asphalt: Oil asphalt is the result of distillation of petroleum and tar. Distillation is the result of refining coal and wood (not commonly used, sensitive to temperature changes and toxic)
- 2) Natural Asphalt: Mount Asphalt (Rock Asphalt) such as Buton Asphalt and Asphalt Lake (Lake Asphalt) for example Bermudez Asphalt, Trinidad Natural asphalt is formed from a layer of petroleum trapped in the earth's layer, over time the oil layer rises and mixes with soil and rocks.

Unlike oil asphalt which requires exploration to a depth of thousands of meters, this type of asphalt does not require very deep exploration because it can usually be found at a depth of 1.5 meters, even on the surface of the earth.

Asbuton is one example of natural asphalt. Asbuton was discovered by Dutch geologist WH Hetzel Asbuton in 1924, and was first used in asphaltting a road two years later.

Buton asphalt is a natural asphalt originating from Buton Island, Indonesia. Asphalt is a mixture of bitumen with other minerals in the form of rocks. Because buton asphalt is a natural material, the bitumen content varies from low to high. Based on bitumen levels, buton asphalt is divided into B10, B13, B20, B25, and B30 (Buton B10 asphalt is buton asphalt with an average bitumen content of 10%).

### 2.2 Definition and type of pavement

Pavement is a layer of pavement that is located between the basic layer of soil and the wheels of the vehicle which functions to provide services to transportation facilities and during the service period it is expected that no significant damage occurs. So that the pavement is in accordance with the expected quality, then knowledge of the nature, procurement and processing of the building blocks of pavement materials is needed.

Sukirman (1999) explains that a pavement structure can be divided into 3 (three) types, namely:

- a) Flexible pavement construction, which is pavement using asphalt as a binding material. The layers of pavement are carrying and spreading the burden of traffic to the subgrade.
- b) Rigid pavement construction, namely pavement that uses cement (portland cement) as a binder. Concrete plates with or without reinforcement are placed on the subgrade with or without the bottom foundation layer. Traffic loads are mostly borne by concrete slabs.

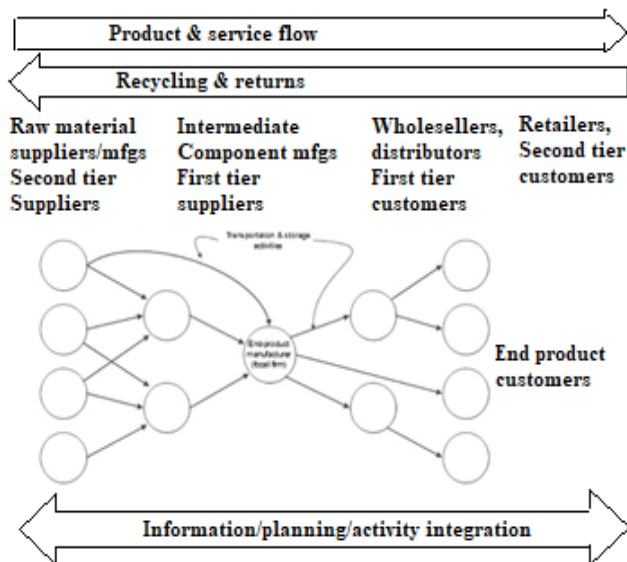
Composite pavement construction (composite pavement), i.e. rigid pavement combined with flexible pavement can be a flexible pavement over a rigid pavement.

#### Pavement layer function

Pavement consists of several layers which aim to accept the burden of vehicles passing through it, then forward it to the layers below it. Generally, the material used is increasingly down the layer, the quality of the material decreases. This is because the layers underneath hold less weight than the layers above.

#### Supply Chain

Supply chain is a process that starts from gathering existing resources followed by management to finished products for further distribution and marketing to end customers by paying attention to cost, quality, availability, after sales service, and reputation factors. The supply chain involves suppliers, manufacturers, and retailers who synergize with each other and work together directly or indirectly. (Wisner, Tan, and Leong, 2012: 6)



**Gambar 2.1:** A Generic Supply Chain (Wisner, Tan, dan Leong, 2012, p.6).

Chopra and Meindl (2007: 6) state that the supply chain involves all parts, either directly or indirectly, to meet consumer demand. The supply chain is not only related to manufacturers and suppliers, but also involves transportation, warehouses, retailers, and the customers themselves. The purpose of the supply chain is to maximize overall value. Meanwhile, according to Hugos in Faharani, Asgari, and Davarzani (2009: 4) states the supply chain includes companies and business activities needed to plan, source, produce and deliver. Entrepreneurs depend on their supply chain to provide them with what they need to survive and develop. Every business fits into one or more supply chains and has a role to play in each of them.

### 3. Research Methodology

#### Place and time of research

In this study, data samples will be taken from the large national highway VI Jakarta

#### Data Type

According to Indriantoro (2002), data sources can be divided into two groups, namely:

- 1) Primary data, Data obtained directly from the source is through a questionnaire: Namely data collection techniques carried out by way of a set of questions or written statements to respondents to answer. Questionnaires can be closed or open questions / statements, can be given to respondents directly or sent by post, or the internet.
- 2) Secondary Data, Secondary data is data obtained from theories related to supporting the general description of explanations and data in the form of organizational

records or finished data that has been provided by the organization

#### a) Direct Quotation

Quotation of data and information needed regarding the theories of discussion obtained from opinions determined by experts written in books and other sources related to the thesis.

- 3) As explained in this study using the interview method, which is an investigation conducted to obtain facts from the symptoms that exist and look for information factually from secondary data.

#### Method of collecting data

This research was conducted with a multiple case approach (multiple case study). Case studies were conducted on three KDP in the PJN Region Region II Banten Province. One KDP was chosen as the object of research considering the amount of project availability and the complexity of the actors involved in project activities with different expertise.

### 4. Implementation and Discussion of Research Results

#### 4.1 Implementation

Before entering the discussion regarding the management of supply chain risk materials, equipment and construction human resources on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI, the author first presents a description of the respondent's identity. In this study the number of respondents studied was 36 respondents who had fulfilled the characteristics of the study population, as research subjects obtained an overview based on gender, age, last education, marital status, and respondent's working period. The results of the respondents' data are then further investigated using the SPSS program ver.25.00.

#### 4.2 Discussion

To determine the management of supply chain risk, equipment and construction human resources on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI, the test is carried out by multiple regression testing. Multiple regression test is used to test the hypothesis of the influence of independent variables on the dependent variable either partially or jointly. In testing its regression the author uses the help of SPSS version 22.00

Below are the results of the mamerial supply chain risk management test, equipment and construction human resources on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI as follows:

**Table 4.17:** Regression of Mamerial Supply Chain Risks, Equipment and Human Resources Construction on the Quality of Flexible Pavement Pavement Road Work with Buton Asphalt at the National Road Implementation Center VI Jakarta

Model		Coefficients <sup>a</sup>						
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	,237	3,058		,077	,939		
	Material Supply Chain Risks	,346	,131	,366	2,648	,012	,648	1,543
	Equipment	,307	,113	,343	2,713	,011	,776	1,288
	HR Construction	,384	,133	,357	2,886	,007	,806	1,240

a. Dependent Variable: Quality of Work

Source: Data processed with SPSS ver.22.00

**1) Equation**

The regression results in table 4.17 above can be seen that the magnitude of the constant value is 0.237, the regression coefficient b1 value is 0.346, the b2 value is 0.307, and the b3 value is 0.348. From these results can produce the following equation:

$$Y = 0.237 + 0.346X_1 + 0.307X_2 + 0.384X_3 + \epsilon$$

This equation shows that:

- a) Material supply chain risk variables have a positive and direct effect on the quality of work. The result of a b1 value of 0.346 means that if there is an increase in the value of one unit of material supply chain risk, it will improve the quality of work by 0.346 assuming construction equipment and human resources are considered constant or constant
- b) Equipment variables have a positive and direct effect on the quality of work. The result of b2 value of 0.307 means that if there is an increase in the value of one unit of equipment, it will improve the quality of work by 0.307 assuming the risk of material supply chain and construction human resources is considered constant or constant
- c) The variable HR construction has a positive and direct effect on the quality of work. The result of a b3 value of 0.384 means that if there is an increase in the value of one unit in construction human resources, it will improve the quality of work by 0.384 with the assumption that the supply chain risk of material and equipment is considered constant or constant

From the three variables above, it can be concluded that the variable that most influences the quality of the flexible pavement road work with buton asphalt at the Jakarta National Road Implementation Center VI is the variable of construction human resources with a large influence of 0.384.

**2) T test**

**a) H1: There is an Effect of Material Supply Chain Risk on Work Quality**

Based on table 4.17 shows that there is a significant influence between the risk of material supply chains on the quality of work, this can be seen in the sig column which shows a significance value of 0.012 smaller than the significance level of 0.05. Then the conclusion of the hypothesis is that Ho is rejected and H1 is accepted, thus the first research hypothesis (H1) is accepted. This means that supply chain risk management has an influence and is significant in improving the quality of flexible

pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI.

**b) H2: There is the Effect of Equipment on the Quality of Work**

Based on table 4.17 shows that there is a significant influence between equipment on the quality of work, this can be seen in the sig column which shows a significance value of 0.011 smaller than the significance level of 0.05. Then the conclusion of the hypothesis is that Ho is rejected and H2 is accepted, thus the second research hypothesis (H2) is accepted. This means that the equipment has significant and significant influence in improving the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI.

**c) H3: There are Effects of Construction Human Resources on the Quality of Work**

Based on table 4.17 shows that there is an influence and significant between construction human resources on the quality of work, this can be seen in the sig column which shows a significance value of 0.007 smaller than the significance level of 0.05. Then the conclusion of the hypothesis is that Ho is rejected and H3 is accepted, thus the third research hypothesis (H3) is accepted. This means that construction human resources have significant and significant influence in improving the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI.

**3) F test**

H4: There Is A Joint Effect Of Material Supply Chain, Material And Human Resources Supply Risks On The Quality Of Flexible Pavement Pavement Road Work With Buton Asphalt At The Jakarta National Road Implementation Hall VI

**Table 4.18:** ANOVA results

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	35,219	3	11,740	16,272	000b
	Residual	23,087	32	,721		
	Total	58,306	35			

Source: Data processed with SPSS ver.22.00

- a. Dependent Variable: Quality of Work
- b. Predictors: (Constant), Construction HR, Equipment, Material Supply Chain Risks

Source: Data processed with SPSS ver.22.00

Based on table 4.18 shows that there is a significant joint effect between the risk of supply chain materials, equipment

and construction human resources on the quality of the flexible pavement road work with buton asphalt, this can be seen in the sig column which shows a significance value of 0,000 less than the level significance of 0.05. In column F, the calculated F-value is 16,272, because the F-calculated value of 16,272 is greater than the F-table value of 3,529 then the hypothesis conclusion is that Ho is rejected and H4 is accepted, thus the fourth research hypothesis (H4) can be accepted or proven . This means the risk of material supply chains,

## 1. Coefficient of Determination

Test results of the coefficient of determination between the risk of supply chain materials, equipment and construction human resources together on the quality of the work of flexible pavement roads with buton asphalt at the Jakarta National Road Implementation Center VI

**Table 4.19:** Coefficient Determination of Supply Chain Risk of Construction Materials, Equipment and Human Resources on the Quality of Work

Model Summary <sup>b</sup>				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,777a	,604	,567	,849

a. Predictors: (Constant), Construction HR, Equipment, Material Supply Chain

b. Dependent Variable: Quality of Work

Source: Data processed with SPSS ver.22.00

From table 4.19 above to show Correlation coefficient values together amounted to 0.777, meaning that the relationship between the risk of supply chain materials, equipment and construction human resources to quality work on flexible pavement roads with buton asphalt at the Jakarta National Road Implementation Center VI have a strong relationship. The determination value R<sup>2</sup> (Adjusted R Square) is 0.604 or 60.4%. This means that the contribution of supply chain risk variables for materials, equipment and construction human resources together towards quality work on flexible pavement roads with buton asphalt at the Jakarta National Road Implementation Center VI is 60.4% while the remaining 39.6% is explained by other variables not examined.

## 5. Results and Discussion

### 5.1 Conclusion

Based on the results of the analysis that has been carried out regarding risk management of supply chain materials, equipment and human resources construction on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI, the conclusions obtained are as follows:

- 1) The first hypothesis can be accepted or proven that there is an influence of material supply chain risk management on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI. This can be proven from the t-value greater than the t-table value and significant. Material supply chain risk has a significant effect on the

quality of flexible pavement pavement work with Buton asphalt at the Jakarta National Road Implementation Center at 0.364, meaning that if the material supply chain risk is improved, it will increase the quality of the flexible pavement pavement with Buton asphalt at the Balai Besar The implementation of the VI National Road Jakarta amounted to 0.364, assuming construction equipment and HR are considered permanent.

- 2) The second hypothesis can be accepted or proven to have an influence between the equipment on the quality of the flexible pavement road work with asphalt buton at the Jakarta National Road Implementation Center VI. This can be proven from the t-value greater than the t-table value and significant. Equipment has a significant effect on the quality of flexible pavement road works with asphalt at the Jakarta National Road Implementation Center VI of 0.307, meaning that if the equipment improves, the quality of the flexible pavement road work with buton asphalt at the Jakarta National Road Implementation Center is 0.307 .
- 3) The third hypothesis can be accepted or proven to have an influence between construction human resources on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI. This can be proven from the t-value greater than the t-table value and significant. Construction human resources have a significant influence on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI, by 0.384, meaning that if the construction human resources improve, it will increase the quality of the flexible pavement road work with buton asphalt at the National Road Implementation Center VI Jakarta, amounting to 0.384.
- 4) The fourth hypothesis can be accepted or proven that there is an effect of joint risk management of the supply of materials, equipment and construction human resources on the quality of flexible pavement road works with buton asphalt at the Jakarta National Road Implementation Center VI. This can be proven from the calculated F-value greater than the F-table value and significant. The magnitude of the contribution of risk management of supply chain materials, equipment and construction human resources together to the effect of the quality of the work of flexible pavement roads with buton asphalt at the Jakarta National Road Implementation Center VI is 60.4%, while the remaining 39.6% is explained by other variables that are not included in the research model.

### 5.2 Suggestion

- 1) The management of the Jakarta National Road Implementation Center VI should maintain or further enhance the positive influence of supply chain risk management which has shown a good effect on the quality of flexible pavement road works with asphalt buton, for example asbuton hauling systems ordered from suppliers to always be on time, and the partnership relationship between the Jakarta National Road Implementation Center VI and suppliers has been improved for the better

- 2) The equipment owned by the Jakarta National Road Implementation Center VI is good and complete. To be able to further increase the use of equipment, the Jakarta National Road Implementation Center VI should better deliver the equipment sent to the flexible pavement road work site with buton asphalt on time.
  - 3) Construction human resources at the Jakarta National Road Implementation Center VI are good and can be improved again by means of employees receiving job training in order to support productivity and safety at work using personal protective equipment is needed by every employee
  - 4) It is better for the management of the Jakarta National Road Implementation Center VI to continue evaluating the sustainability of the risk management of supply chain materials, equipment and construction human resources because in improving the quality of flexible pavement road works with buton asphalt, it is necessary to have a better management of supply chain material, equipment and human resources as well as serious efforts from the management so that they can provide better progress on the quality of flexible pavement road works with asphalt asphalt of the Jakarta National Road Implementation Center VI.
  - 5) For further research, the results of the contribution of the studied variables indicate that there are still other variables that must be considered in this study. Further studies, should add other variables such as the distribution of shipments, design work, and others that if it can affect the quality of the work of flexible pavement roads with asphalt buton Balai Besar Implementation of National Road VI Jakarta.
- [9] **Nugroho, Bernardus Y., Saragih, Ferdinand D., & Eko., Umanto,**2012, Quantitative Methods, Decision Making Approaches for Social and Business Sciences. Jakarta: Salemba Humanika
  - [10] **Santoso, Singgih,** 2014, Complete Guide to Mastering Statistics. Jakarta: Alex Media Komputindo.
  - [11] **S.ugiyono,** 2003, "Statistics for Research", Alfabeta, Bandung,
  - [12] **Sugiyono,** 2012, Quantitative Research Methods, Qualitative and R&D, Bandung, Publisher: Alfabeta
  - [13] **Tampubolon, MP,** 2014, Operations and Supply-Chain Management, Publisher Mitra Wacana Media, Jakarta.

## References

- [1] **Anwar, SN,** 2011, Supply Chain Management: Concepts and Nature, Journal of Information Dynamics at the University of Stikubank Semarang, vol. 3, no. 2
- [2] **Ardiansyah, Vicky Rahman,** 2000, "The Influence of ISO 9000 on Cost Performance in Reducing Rework, Especially in Structural Work During Construction", Thesis, T. Civil, University of Indonesia
- [3] **Arikunto, Suharsimi,** 2006. Research Procedure A Practical Approach. Revised Edition V. Jakarta: PT. Rineka Cipta.
- [4] **Kimpraswil Department,** 1996, "Road Pavement Planning", XX-2002 Guidelines Dipohusodo, Istimawan, "Project Management and Construction" of Indonesia,
- [5] **Director General of Highways,** 2010, "Technical Guidance Materials"
- [6] **Elbheiry, M., Khaled, A. Kandil, & Akram, S., Kotb,***Investigation of Factors Affecting Pevement Roughness.* Engineering Research Journal, 132 (December 2011) C1 - C13.
- [7] **Ghozali, Priest,** 2011, Multivariate Analysis Applications with the IBM Program. SPSS 19 (fifth edition.), Semarang, Publisher: Diponegoro University.
- [8] **Ministry of Public Works (KPU),** 2013, Construction Development Guidance Center for Investment Resource Development, Study of Supply Chain Material and Construction Equipment in Support of Investment in Sustainable Construction, Bandung.