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DISASTER RISK MITIGATION OF OIL AND GAS PIPELINES PROJECT IN JAVA ISLAND INDONESIA

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ABSTRACT

The pipelines are one of the most necessary parts of infrastructrure in the oil and gas industry. It has function as support the process of oil and gas transmission and distribution. The activities of oil and gas pipelines project that is so long and passing through several regions certainly creates a risk that has a negative impact on the environment, especially if the pipeline project is in a densely populated area. The risks can be caused by leakage of pipeline. The risks of the pipeline project are also explained in various relevant research results. The results of the study cite the project in oil and gas pipelines has very complex risk. In other head, it project make some dangerous thing namely a disaster. At present, oil and gas companies have applied risk management to minimize the risks that exist, but in practice the risks still have a negative impact. This is one of the ineffective risk management applications. This study is intended to analyze risk mitigation efforts in the oil and gas pipeline project on the island of Java. From the results of research conducted based on literature studies that can be carried out regarding risk mitigation in the oil and gas pipeline project, it can support environmental, social and economic factors and natural disasters. Data was obtained using a questionnaire distributed to the oil and gas pipeline project. Most of the factors that must be discussed are social aspects (40%) and other factors contribute 31% for disasters, 15% for the economy, 14% for the environment. These factors must be calculated in the design as a priority.

Keywords: risk management, analytical hierarchy process (AHP), mitigation.

1. INTRODUCTION

One of the most important industries which is becoming contributor of the economy of a country is the oil and gas industry, besides that the industry is also support national energy security (Sheirazi, 2010). However, the complex activities of the oil and gas industry have caused the industry have a very large impact on the surrounding environment (Mojtahedi *et al*, 2008). One of the activities in the oil and gas industry that has a negative impact on the environment is the activity of pipeline construction projects, where the project has a very long trajectory and passes through various fields of cultivation, rice fields to residential areas (Rodhi *et al,* 2018).

Hossam and Hossam, (2010) state that pipelines are an important infrastructure in the oil and gas industry. This is because the transportation of oil and gas through pipelines is considered safer, more effective and efficient compared to other transportation methods. But the method of transportation with pipelines also has very complex risk, Nielsen (2006), while the risk factors found in projects in the oil and gas industry include environment, economy and social (Rodhi *et al,* 2012). Risk is a situation from internal and external that can affect and change the initial situation and affect time, cost and security (Hasan, 2016).

Impact is something that arises because of the risks that are not managed properly (Thuyet *et al*, 2007). According to Nielsen (2006), the oil and gas pipeline project has very complex risk. Ogwu (2011), states that oil and gas pipeline projects have a very large impact on the environment, social and economy. Risks in oil and gas pipelines that are not managed properly can potentially disastrous (Hasan, 2016).

In the field of engineering, disasters are defined as the failure of engineers, construction managers, developers, planners, and other leaders in calculating environmental vulnerabilities. Beside of environmental vulnerability, in engineering leadership there are anthropogenic aspects of disasters that must be considered, that is poor health or economic consequences derived from human decisions (Vallero and Letcher, 2012). Disaster risk is a potential loss directly or indirectly caused by an event that threatens and disrupts various aspects of life and livelihood caused by natural and non-natural factors. The aspects of life and livelihood include economic, environmental and social aspects (Lam and Adey, 2016).

Basically disaster can not predictable and can occur at any time. Nevertheless a disaster can be anticipated, namely by planning prevention and control measures. (Voogd, 2004). According to Al-Khalil *et al* (2005), the Analytical Hierarchy Process (AHP) method is very suitable to be used to develop the concept of risk management in terms of supporting decision-making systems in the aspects of oil and gas pipeline maintenance.

2. METHODOLOGY

The mitigation efforts in this study begin with identification of risk factors that have the potential to cause disasters in the oil and gas pipeline project on the Indonesian island of Java, then analyzed using Analytical Hierarchy Process (AHP). To obtain analytical data, these factors are arranged in a questionnaire and addressed to Senior Pipe Engineers and Senior Inspection Engineers

The data is then processed in the form of paired comparisons of each criterion and sub criteria so that the weight of each factor and each stage of the project have been identified. The final step that must be done at the AHP stage is checking consistency, if the consistency value is <10% then the research is considered consistent and accountable.

The AHP stages are:

a) Define the problem and determine the desired solution
b) Create a hierarchical structure that begins with the main purpose.
c) Calculate the priority evaluation value
d) Calculate the priority Vector Evaluation Value of Factors

3. RESULTS AND DISCUSSIONS

A. Identification Results

The results of the identification of variables can be seen that the risk factors found in the oil and gas pipeline project are environmental, social, economic and natural disasters. This can occur in every project life cycle, namely Design, construction and operational. Based on the identification data, the hierarchical structure can be built as shown in Figure-1 as follows:

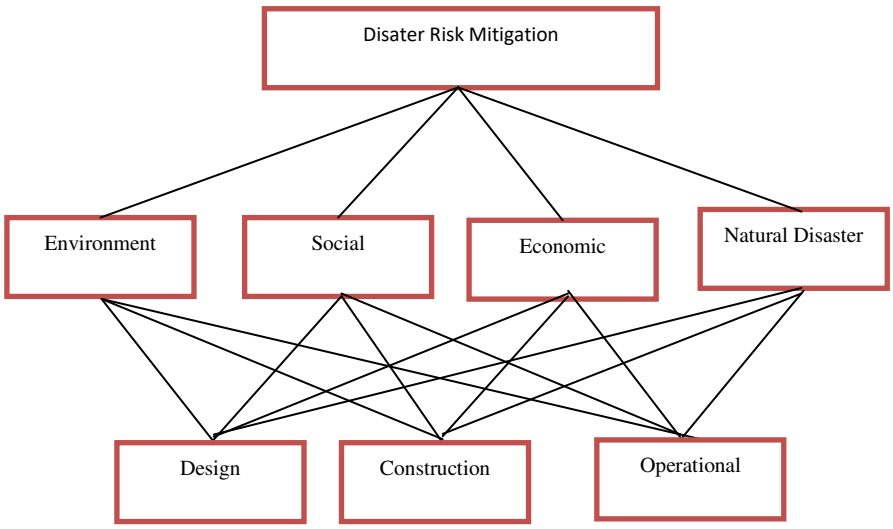

Figure-1. Structure of the research hierarchy.

Table-1. Pairwise Comparison and Calculate the the Weighted Sum Vector of disaster risk mitigation.

Disaster Risk Mitigation	Environment	Social	Economic	Disaster	weight
Environment	1	1/2	1/2	1/2	14%
Social	2	1	3	2	40%
Economic	2	1/3	1	1/4	15%
Disaster	2	1/2	4	1	31%

Table-2. Pairwise Comparison and Calculate the weighted Sum Vector of environment to sub criteria.

ENVIRONMENT	Design	Construction	Operational	Weight
Design	1	2	6	55%
Construction	1/2	1	7	37%
Operational	1/6	1/7	1	7%

B. Data analysis

The first step in the analysis using the AHP method is to collect data in pairs comparison based on the hierarchy that has been prepared as in Figure-1 while the data input done in this research is based on the average result from the questionnaire. The first pairwise comparison is performed on the criteria stage. From the results of pairwise comparison in the criteria stage we can know the weight of environmental factors is 14%, social factors is 40%, economic factors is 15% and disaster factors is 31%. The results are obtained based on the results of calculations in Table-1.

After computation of pairwise comparison and consistency check on criteria stage, then also done the same thing in sub criterion stage.

As for the calculation phases at the sub criteria stage can be seen in Table-2, Table-3, Table-4 and Table-5. While for the weighting results of each stage in sub criteria can be seen in Table-6.

Table-3. Pairwise Comparison and Calculate the weighted Sum Vector of social to sub criteria.

SOCIAL	Design	Construction	Operational	Weight
Design	1	2	4	53%
Construction	1/2	1	5	37%
Operational	1/4	1/5	1	10%

Table-4. Pairwise Comparison and Calculate the weighted Sum Vector of economic to sub criteria.

ECONOMIC	Design	Construction	Operational	Weight
Design	1	7	6	75%
Construction	1/7	1	2	15%
Operational	1/6	1/2	1	10%

Table-5. Pairwise Comparison and Calculate the weighted Sum Vector of disaster to sub criteria.

DISASTER	design	construction	operational	weight
design	1	3	7	53%
construction	1/3	1	6	37%
operational	1/7	1/6	1	10%

Table-6. Calculate the weighted of sub criteria.

Factor	Environment	Social	Economic	Disaster	Wight
Design	0.08	0.21	0.12	0.16	0.57
Construction	0.05	0.15	0.02	0.11	0.33
Operation	0.01	0.04	0.02	0.03	0.10

From the Table-6 it can be seen that the design weight of 57%, Construction weight of 33% and operating weight of 10%. From the calculated weights obtained, it can be described in the hierarchy as can be seen in Figure-2.

4. CONCLUSIONS

From the results of the discussion has been known that from 4 (four factors identified, social factors have a weight of 40%, then the second highest weight is the factor of disaster by 31%, the third is the economic factor with the weight of 15% and the last is the environmental factor With a total weight of 14%. Whereas at the sub-criteria stage it is known that the biggest weight lies in the design phase, which is 62%, the second in the construction stage with the weight of 26% and the lowest weight is at the operational stage, with weight of 12%.

Thus it can be concluded that the disaster risk mitigation project of the oil and gas pipeline project can be done by emphasizing risk management from social factors by prioritizing during the design phase.

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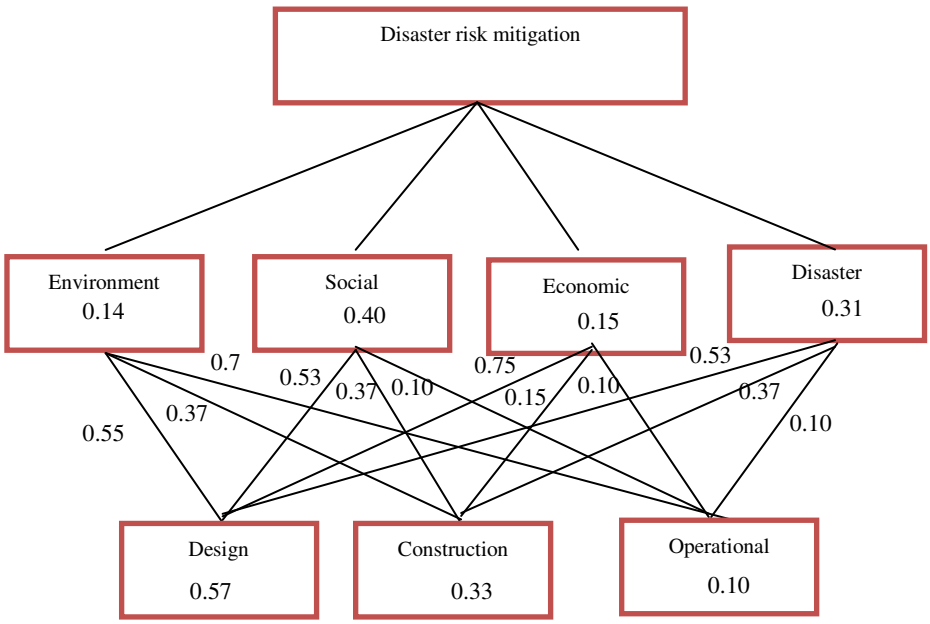

Figure-2. The weight in the hierarchical structure.

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