Risk Analysis of Return Support Material on Gas Compressor Platform Project

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Abstract. On a fixed platforms project are not only carried out by a contractor, but two or more contractors. Cooperation in the construction of fixed platforms is often not according to plan, it is caused by several factors. It takes a good synergy between the contractor to avoid miss communication may cause problems on the project. For the example is about support material (sea fastening, skid shoe and shipping support) used in the process of sending a jacket structure to operation place often does not return to the contractor. It needs a systematic method to overcome the problem of support material. This paper analyses the causes and effects of GAS Compressor Platform that support material is not return, using Fault Tree Analysis (FTA) and Event Tree Analysis (ETA). From fault tree analysis, the probability of top event is 0.7783. From event tree analysis diagram, the contractors lose Rp.350.000.000, - to Rp.10.000.000.000, -.

1. Introduction
Offshore platform is a structure used for the exploration and exploitation of oil and gas. Fixed platforms which are jacket structure are commonly used in Indonesia [1]. Fixed platform project is dynamic, if the contractors want optimum benefit, it must be responsive to conditions that occur on the project. The contractor makes a careful planning to anticipate the problems that may occur so that the project can still be done without having problems [2]. Management of a large-scale investment activities and the level of complexity is very difficult requiring a proven method, quality resources, and the application of up to date science [3]. On a fixed platforms project are not only carried out by a contractor, but two or more contractors. It takes a good synergy between the contracting parties to avoid any miss communication that could result in the emergence of problems and even loss on the project. One example of the problems that often occur is the support material used in the process of transporting a jacket structure into operation often does not return to the contracting company that has ownership rights to the material. Problems of this material are often overlooked, whereas this issue has the potential risks and substantial losses after the project is completed [4-5].

GAS Compressor Platform is one of PT. ABC Indonesia projects in the oil and gas sector. This platform is an order from the KLM company. This project has been completed. but there are problems related to support material. The material has not been returned by PT. XYZ while the transporting process has been completed. These materials are owned by PT. ABC. Total value of these materials is estimated to USD. 700,000. The approaches of risk based decision making used in this paper consist of FTA (Fault Tree Analysis) and ETA (Event Tree Analysis) which called bow tie analysis [6-7].
This paper analyses the root causes, consequences, preventive and mitigation measures did not return support material. The objectives of this paper are:

1. Investigating the root causes of support material is not returned using FTA
2. Determining the consequences of support material is not returned using ETA
3. Determining risk index of the consequences using risk matrix

2. Bow Tie Application
A bow tie is the combination method of fault tree analysis on the left and event tree analysis on the right. These bow ties are the basis for the application of the methodology. The bow tie diagrams help to understand clearly through graphical visualization the relationship between the potential causes and their possible consequences. This paper will only discuss the factors contributing to the support material is not returned.

Step 1: Building the complete fault tree
Fault tree analysis is a deductive approach to resolve the top events into all possible initiating events. It is useful to test the most probable sequence of events which lead to the undesirable top event. Probabilities of undesirable outcomes can be calculated with most probable outcome identified. FTA is a graphic “model” of the pathways within a system that can lead to a foreseeable, undesirable loss event. The pathways interconnect contributory events and conditions, using standard logic symbols. Numerical probabilities of occurrence can be entered and propagated through the model to evaluate frequency of the foreseeable, undesirable event. This paper used support material is not returned as a case study and involves twenty experts to elaborate the fault tree diagram. The detail of fault tree diagram can be seen from Figure 1 to Figure 5.

![Figure 1. FT Model Support Material is Not Returned](image1)

![Figure 2. FT Model the Contract Agreement is Not Good.](image2)
Figure 3. FT Model Bad Management System.

Figure 4. FT Model Weak Oversight.

Figure 5. FT Model Bad Communication Owner & Contractor
Step 2: Determining Frequency of Occurrence

The frequency of occurrence in fault tree is obtained from the twenty experts based on questionnaire. The frequency index used in this paper is based on Table 1. The FTA result for support material is not returned is shown in Table 2. Total probability of support material is not returned is 0.7783. The frequency of occurrence derives from the result of FTA which is then used as the frequency of initiating event in ETA.

Table 1. Frequency Index

| Rating          | Qualitative                                      | Quantitative |
|-----------------|--------------------------------------------------|--------------|
| Frequent         | Likely to occur in each production of platform   | $10^{-1}$    |
| Reasonably Probable | Likely to occur once in the range of 5 times production of platform | $10^{-2}$   |
| Remote           | Likely to occur once in the range of 25 times production of platform | $10^{-3}$   |
| Extremely Remote | Likely to occur once in the range of 75 times production of platform | $10^{-4}$   |
| Extremely Improbable | Likely to occur once in the range of 100 times production of platform | $10^{-5}$ |

Table 2. Top Event Probability

| Rank | Intermediate Event                                      | Probability |
|------|--------------------------------------------------------|-------------|
| 1    | The contract agreement is not good                     | 0.2317      |
| 2    | Weak Oversight                                         | 0.2257      |
| 3    | Communication between the contractor and subcontractor is not good | 0.1679      |
| 4    | Bad management system                                  | 0.1530      |
|      | Total                                                  | **0.7783**  |

Step 3: Building the event tree

The frequency of initiating events multiplied by the pivotal events will result the frequency of occurrence of the outcomes. Generally, there are several possible outcomes deriving from the initiating event followed by the pivotal events which include the success or failure possibility. Once the event tree diagram is constructed, the frequency of occurrence can be applied to the diagram for each path.

Figure 6. Event Tree Diagram
Event tree diagram for support material is not returned can be seen in Figure 6. Event tree is binary analysis with the initiating event support material not return. Initiating event consist of several pivotal events namely contract agreement done, good management system, strict monitoring and good communication between contractor. Each of the pivotal event have two path yes and no, yes path showing that the pivotal events is succeed and no path showing that the pivotal events is not succeed. There are five outputs based on the event tree, namely:

a. Output A is financial loss more than Rp. 125.000.000,- Less than Rp. 300.000.000,-
b. Output B is financial loss more than Rp. 350.000.000,- Less than Rp. 500.000.000,-
c. Output C is financial loss more than Rp. 600.000.000,- Less than Rp. 2.500.000.000,-
d. Output D is financial loss more than Rp. 2.500.000.000,- Less than Rp. 5.000.000.000,-
e. Output E is financial loss more than Rp. 10.000.000.000,-

Table 3 shows the frequency index, severity index and risk index for determining the risk level. The probability of each output is determined based on frequency index as shown in Table 1. Then the respondents give their judgment for the severity index. Once the frequency index and severity index have been determined, the next is to calculate the risk index.

| No | Output | Frequency Index (FI) | Severity Index (SI) | Risk Index (RI) |
|----|--------|----------------------|---------------------|-----------------|
| 1. | Output A | Frequent | Minor | 5       | Moderate |
| 2. | Output B | Reasonably Probable | Minor | 4        | Moderate |
| 3. | Output C | Reasonably Probable | Moderate | 8        | Moderate |
| 4. | Output D | Frequent | Moderate | 10       | Moderate |
| 5. | Output E | Frequent | Serious | 15       | High |

Table 4 describes the risk matrix of each output based on event tree diagram. Risk matrix consist of two axis. The x axis shows the severity index while the y axis shows the frequency index. From the risk index it can be seen that output A,B,C,D are in the Moderate risk level and output E is in the High risk level.

Table 4. Risk Matrix of Each Output
3. Conclusion
The main objectives of this paper have been accomplished and the conclusions were shown below:
1. The root causes of support material not returned is due to the contract agreement not good, bad management system, weak oversight and leak communication between contractor and owner.
2. The consequence is the contractor losses up to Rp.10,000,000,000,-. Beside financial losses, the other consequence is the company's reputation declined and bad publicity from the media.
3. The output A,B,C,D are in the Moderate risk level and output E is in the High risk level.

4. References
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