

Implementation of Risk Management in Manufacturing of Wellhead and Christmas Tree Equipment (Risk management framework)

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Abstract. Wellheads and Christmas trees are the main equipment for oil production. They are manufactured in the plant and installed on the casing head to seal the annular space between casing and tubing. They are used to transport oil to pipeline in well field. The loss of wellhead and Christmas tree integrity can result in major accidents, presenting a severe risk to the environment. Therefore a purpose of this study is to investigate of an organization perception for risk management implementation in manufacturing wellhead and Christmas tree equipment. The responses were analysed using SPSS software by using Cronbach's α , mean-value and standard deviation. Data was collected by posting a Google link form, or sent to the email of the companies listed in the Malaysia and Batam, Indonesia. This quantification of the risk management process and a risk identification tool onto the risk management process framework. The model can support and indicate the contribution of an industrial risk manager towards achieving project objectives, as well as making comprehensive decisions regarding analysis of risk management in manufacturing project and operation.

1 Introduction

Oil exploration and production has played a significant part in the financial success of Asia and the Middle East. The main companies supplying wellhead and Christmas tree are FMC Technologies, Aker Solutions, GE Oil and Gas, with market shares in that order. Past accident analysis for offshore oil and gas rigs [1] confirm that accidents are related to the following causes: equipment failure, equipment malfunction (electrical and mechanical), corrosion, and safety system malfunction. In the report, proper risk management was suggested as a way to reduce the number and severity of the accidents. To execute a manufacturing project smoothly, it is important for a project manager or team to use systematic models and tools. These tools can be used to control the project through every stage and process to meet project

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objectives such as budget, safety plans, and deliverables according to schedule. Key objectives in performing project risk management is to increase the probability of project success by minimizing or eliminating negative risk events and increasing the probability of positive events [2]. To achieve the manufacturing project objectives and meet deliverables, a good planning and risk management model should be implemented before commencing with the manufacturing process, and performing improved material used [3,4]. The model should include all work tasks, engineering design tasks, estimate and cost control sheets, project scheduling and time sheets, the corresponding record sheets in a communication circle with customers, and the internal organizational and vendors/contractors involved for the entire period necessary to complete the project successfully [5,6,7]. These risks and failures will be anticipated by the engineering side as they perform design calculation and analyses prior to releasing approval of the scenario, meeting client requirements, and providing project deliverables [8]. Recent research on risk management is related to adaptive risk management, which starts out with a conceptual view of the risk and focuses on the consequences and uncertainty involved in the project [9]. Risk model is developed from literature studies and research findings related to organizational behavior.

1.1 Manufacturing of wellhead and Christmas tree equipment

Generally, manufacturing refers to any business that uses an assembly process that involves machines, tools, manual labour, quality control and inspections to convert raw materials into saleable goods [10]. Wellhead and Christmas tree equipment are oil and gas equipment that are produced and fabricated in the plant. After the tender and sales order has been completed, the manufacturing organization can start the process, taking into consideration the technical aspects, lead time, and overall client requirements.

1.2 Risk management in manufacturing project

According to [11], risk is a risk factor that can affect the progress and process of the project. Risk was defined as a function of the likelihood of loss that can arise for an activity, process, and situation [12]. Meanwhile [13] argued that a risk was a sensitive issue or a weakness that companies or organizations did not want to publish in order to maintain market value and keep their competitive edge. Another researcher said that risk was an exposure or a probability of the occurrence of a loss and events [14]. [15] defined risk as an adverse factor that influenced the success of any situation where it is present. The general meaning of the word 'risk' implies a negative attitude towards the environment in question [16]. A risk can be a significant barrier to success [17]. [18] explained how to handle risk factors through three key dimensions: control, elimination and avoidance. In this case, risk cannot be considered a known negative and should be assessed as a likelihood. [19] defines risk as an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives. When put into context, it seems that risk can have a two-dimensional meaning (namely, a negative as well as a positive implication). It is of great interest to be able to separate the meanings of risk.

2 Objectives

The aim of risk management is to develop and establish a risk management framework that includes and combines risks in Safety Health and Environment (SHE) and financial objectives.

3 Method Approach

A risk management method for the study was collected and developed after reviewing available literature. The survey was conducted among the managers, project managers/leaders, engineers, supervisors, and lead technicians to measure their perceptions of the degree of influence of different variable factors on effective risk management implementation. The field study involved observing the manufacturing process of wellhead and Christmas tree equipment at several companies in Batam, and Malaysia. A questionnaire was developed based on existing literature and experts practitioners in manufacturing in order to refine the primary risk management variable factors of company risk management culture.

3.1 Reliability and validity

The internal consistency of the pilot was analysed by using Cronbach's α - the most widely used indicator for internal consistency [20]. A desirable result for Cronbach's α should be greater than 0.60 [21]. SPSS Ver 20 was used to measure and calculate the coefficient of reliability of the instruments, "Cronbach Alpha Formula" – developed by [22] – was used. The questionnaire was reviewed by industrial experts who contributed to the theoretical questions and validated them. The contributions were related to the validity of foundation of the survey content and the dimensions of construct for the risk management culture as a factor dependent on the implementation stage of risk management [23]. The results for the pilot study were analysed by using SPSS. The individual score for each questionnaire construct ranged from 0.705 - 0.826. The reliability test for the working environment construct showed a satisfactory range of 0.705 - 0.826. Based on these tests, all the constructs were found to be reliable, and did not require changes for further analysis

4 Result

This group of questionnaire consists of questions related to company facilities, assessment procedures, activities, and standards. The data was used to understand the needs and behaviours of a company/organization. The strength of association between risk management culture and other variable data were shown in Table 4.1.

Table 4.1. Current research of respondent feedback for risk management (culture vs implementation)

Item	Dimension	Overall mean	F stat	X ²	Level of Sig (p)	Sig (yes or no)
Company Risk Management culture	Culture (n=5)	17.9922	3.448	89.023	.000	yes
	Project knowledge (n=5)	17.3798	2.843	45.403	.001	yes
		17.2791	1.988	42.147	.022	no
	Competency (n=5)	18.1395	3.683	75.574	.000	yes
	Motivation (n=5)					
Implementation stage of Risk management	Organizational (n=6)	21.4651	3.169	79.992	.000	yes
	Risk assessment (n=5)	17.7287	4.307	85.147	.000	yes
		16.8140	2.871	94.628	.001	yes
	unlikely events (n=5)	26.1783	1.914	60.891	.032	no
	Risk utilization (n=7)	28.9225	2.425	84.349	.004	yes
Control Risk (n=8)						

P < 0.05 is significant test

Associate analysis of factors that affected risk management implementation was performed. The association between company risk management culture and implementation was measured using the following variables: culture, project team knowledge, competency,

motivation. The Phi (ϕ) test was conducted in this analysis and produced significant results when a Cramers V test was used. The values are reported in Table 4.2.

Table 4.2. Current research of regression analysis

Variable	Phi (ϕ)	Interpretations
Culture (n=5)	0.406	Moderate
Project team knowledge (n=5)	0.471	Moderate
Competency (n=5)	0.419	Moderate
Motivation (n=5)	0.496	Moderate

N = 216. Less than 0.1 is weak. 0.1-0.5 is moderate. Above 0.5 is high

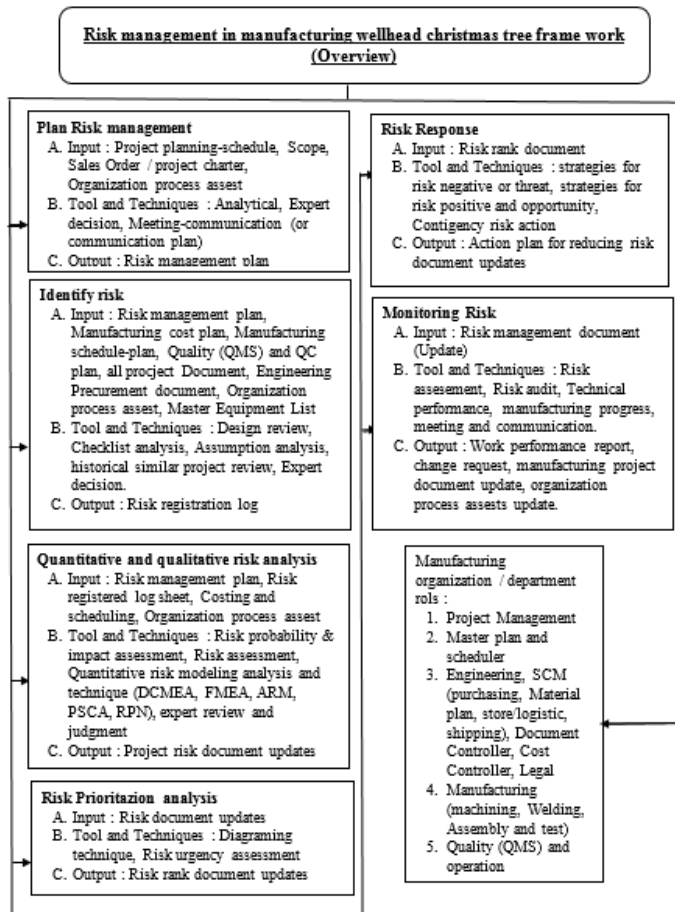


Fig. 4.1. The figure Risk management process in manufacturing wellhead Christmas tree framework (overview)

It is important for static risk and dynamic risk assessment to be implemented during the initial stages in order to detect any risks or unwanted hazard. The risk management framework also considered the input and advice of experts. Reviewers were selected based on their relationships between personnel, work experience requirements, knowledge, positions, and competency.

5 Conclusion

This framework model is emphasized in front of the risk management process to identify risk and proactive risk management processes and used a risk identification tool and technique in practice accordingly. The framework should be involved anyone related to the production of wellhead and Christmas tree equipment such as contractors, suppliers, or sub-contractors for components, services and accessories.

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