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Present Knowledge and Future Direction for Risk Management in Offshore Oil and Gas Project

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Abstract
Oil and gas offshore projects generally characterized as very high risk. The activities are well known exposed to a high level of risk that can't be ignored, but it still can be able to manage. In the past two decades since the 1980s, there are many studies in various aspects of managing risk in oil and gas projects have been conducted. The studies conducted includes risk identification, risk assessment, risk response and risk monitoring, and control. Although the number of studies conducted has been increasingly focused on risk management in offshore oil and gas projects, there are still limited number of published studies that summarise the literature. Hence, this paper aims to examine the present published studies on managing risk in oil and gas projects from a holistic outlook which may be used as a future guideline. To fulfil this paper aims, a systematic literature review was carried out by giving the areas focused on areas fields in oil and gas projects, studied approaches used by others researchers, by showing the pattern in research through the previous years. These paper also discussed the research gap found which might be used for future prospective studies.

Keywords: *Risk Management, Managing Risk, Oil, and Gas, Offshore Project*

1 INTRODUCTION

Offshore oil and gas project defined by [1] as an activity involves the installation, operation, and decommissioning of structure in an oceanic. Normally, these activities refer to the activities production and transmission of electricity, oil, gas, and other resources.

Offshore oil and gas project is generally composed of high-level risk due to high investment, numerous stakeholders, complicated, unique technology [2], where the uncertainty comes from various sources [1]. It has an inherited risk in all of the processes from the conceptual phase of the project starting with Front End Engineering Design (FEED), procurement, construction and fabrication, installation to hook-up and commissioning.

The threat to successful project deliverable is mostly during the execution phase of the offshore oil and gas project faced by project managers during the execution phase. Some risks, such weather

risk as caused by meteorological conditions, are beyond the contractor's control, resulting in high possibilities of failure to complete the project scope of work as per contractual timeframe [3]. According to [4] as cited in [5], although the project management team is trying to eliminate all the risks, the process Risk Management (RM) should be conducted in proper manner to ensure all risk can be managed.

Generally, conducting a systematic RM can assist many offshore project managers in determining and mitigating the impact of uncertainties in different project phases [6]. RM approach is an essential part of the project where it is a process of responding to an event that offers negative or positive consequences. This approach aims to maximize from positive consequences certain risk and optimize the loss from adverse risk [7]. As cited by [8][9], risk has been defined in ISO 31000 as an outcome from uncertainty on the purposes and risk factor is defined as a condition that increases the risk likelihood such as an increasing number of stakeholders, extended period of the project, and boundary response between the external and internal environment. While in the Project Management Body of Knowledge (PMBOK) of project risk management, there are several orderly and official methods for identifying, evaluating, classifying, responding and managing risks during the life cycle of a project [10]. Hence, conducting RM in offshore oil and gas projects is about determining any related sources of uncertainty, evaluating the impact of uncertain event or condition, creating suitable response plan of estimated result [11].

Initially the process of RM begins with risk identification, whereby individual projects risk is defined substantiated with the documentation of overall project risk and types [6]. Even though it is challenging to determine and evaluate the risk, this initial process is critical to decide on any possible source of risk as early as possible. Therefore, managing risk in projects inappropriately manner, the first essential steps which should be performed during project initiation stages is an identification of risk [5]. The next stages of in risk management is risk analysis which the process is focusing on evaluating identified risk, including identifying likelihood and the severity of the risk [12]. There are two methods that can be applied in this process, namely, quantitative and qualitative analysis [5].

The next stage in RM process is identifying risk response plan which is the process of developing alternative, choosing suitable plan or strategies on action to be taken to address the overall risk exposure to the projects and finally implementing the risk response plans [13][14]. The final stage in RM process are monitoring and controlling the implementation of a selected risk response plan, tracking identified risk [13]. According to [18], this process should be carried out to ensure that all fact and figure generated during the process is captured, used, and maintained.

There are many RM cases studied by many researchers since the 1980s, and the numbers of papers were keep increasing since then. Survey or interview technique and mathematical modeling are the most popular method which many researchers proposed for conducting RM. In addition, theoretical mathematical modeling also can be adopted as an efficient tool in managing risk. Although many papers or literature published focused in the construction project area, no study has presented the specific RM in oil and gas project. Thirty years have been

passed since then; it is the suitable time to review the progress of RM research in oil and gas project. Hence, this paper aims to examine the existing literature related to oil and gas RM and at the end, may offer some guidance for future studies on RM in offshore oil and gas projects.

2. METHODOLOGY

The methodology approached in this paper of RM in oil and gas projects literature review is adopted from [19] with aims to minimize any prejudice over in-depth literature tracking from the previous paper studies. There are two phases procedure of these adapted method.

For the first phase, a systematic review was performed to determine any crucial scientific contributions in the RM area. These methodology approach. A systematic literature review began by using a scientific database, namely Elsevier, Emerald, and Taylor & Francis. From these databases, related articles identify explored on construction projects and oil and gas environment-related journals were identified such as Journal Reliability Engineering & System Safety (JRESS) and Journal Safety Science (JSS) by using "risk management" and "offshore oil and gas project" keyword. Keywords for “risk management” and “offshore oil and gas projects” search from the selected journals were being used from 1980 until 2019. As a result, 3050 papers retrieved for further analysis, including book reviews, forum, and editorials. However, only 84 articles were considered as the most relevant to this paper and were review in detail.

For the second phase, the result of the review was synthesized throughout a meta-analysis approach. This approach was adapted from previous studies conducted by [20] with similar aims to correlate focused areas and discovering emergent or abandoned matters. At this stage, the meta-analysis approach will be utilised by using a reviewed result, which has been synthesized earlier. The result is meta-classification framework, as shown in Table 1.

Table 1: Research framework

Category	Subcategory
Year	Date of the paper published
Scientific database	Elsevier, Emerald, Taylor & Francis
Journal	Name of the Journal
Keyword	"Risk Management" and "Offshore oil and gas project."
Research focus	Risk Identification Risk assessment Risk response Risk monitoring and control
Category of analysis	Project level Firm level Sector level
Source of information	Review Case study Survey/interview
Research output	General description Statistic result Theoretical modeling Mathematical modeling The experimental modeling
Future direction	Identified future studied for this paper

3. DATA ANALYSIS & RESULT

RM in offshore oil and gas projects was analyzed accordingly by using a meta-classification framework, as per Table 1. It shows 84 papers published on keywords "risk management" and "offshore oil and gas project."

Table 2 shows the summarized distribution of selected papers in five consecutive years. The chosen keyword consequently indicates an increasing tendency over the year. To note that

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Elsevier journal database published half of these papers.

Table 2: Distribution summary of selected papers

Database	Journal	≤1995	1996 - 2000	2001 - 2005	2006 - 2010	2011 – 2015	>2015	
Taylor & Francis	PPC				2		1	[21][22]23]
	IJMSEM				1			[24]
	CME					2		[25][26]
	PJ					1		[27]
	RR			1	1			[28][29]
	IOR					1		[30]
	IAPA				1		1	[31][32]
	AJMOA					1		[33]
	SIE					1		[34]
	PCT			1				[35]
	IJHERA				1	1	1	[36][37][38]
	SR	1					1	[39][40]
	SOS					1	3	[41][42][43][44]
	IES			1		1		[45][46]
	EE						1	[47]
	MET			1			1	[48][49]
	ORS	1						[50]
Elsevier	JRESS		2		2	3	1	[51][52][53][54] [55][56][57][58]
	JSC			1	2	1	2	[59][60][61] [62][63][64]
	SPE					1		[65]
	OMAE				1			[66]
	ARCOM				1	2		[67][68][69]
	OG				1			[70]
	ESREL			1	1			[71][72]
	MTS/IEEE						1	[73]
	IJSSE					1		[74]
	RESS				1			[75]
	MS			1			2	[76][77][78]
	IECR					1		[79]
	JS			1				[80]
	OE						1	[81]
	OPE					1		[82]
	JT		1					[83]
	IEI						2	[84][85]
	OMAE						1	[86]
	ISCRAM					1		[87]
	OE						1	[88]
	SS					1	2	[89][90] [91]
	PSEP					2		[92] [93]
	IJISE						1	[94]
	IJDPM						1	[95]
Emerald	E		1	1				[96][97]
	IJMPB					2	1	[98][99][100]
	IJESM					2		[101][102]

Database	Journal	≤1995	1996 - 2000	2001 - 2005	2006 - 2010	2011 – 2015	>2015	
	IJOPM					1		[103]
	AQ					1		[104]

Table 3 also presents the published papers from 1980 until 2019, which focuses on ten categories namely, risk identification, risk assessment, risk response, and risk monitoring and control and its combinations. Although most of the papers focused on risk analysis or assessment and risk identification a significant total of papers studied another RM process combining with risk analysis or assessment subject being conducted by many researchers. In addition, it is observed that risk response and combination of risk identification and risk response seem like has been lacking in number of paper relevant to RM processes.

Table 3: Summarised of the research focus based on selected papers

	≤1995	1996 - 2000	2001 - 2005	2006 - 2010	2011 – 2015	>2015	Total No papers within a period
1. Risk Identification	0	0	0	1	7	3	11
2. Risk Assessment	1	3	3	3	10	10	30
3. Risk Response	0	0	0	0	0	0	0
4. Risk Monitoring and Control	0	0	0	1	1	1	3
5. Risk Identification + Risk Assessment	0	0	4	4	7	7	22
6. Risk Identification + Risk Response	0	0	0	0	0	0	0
7. Risk Assessment + Risk Response.	0	0	0	1	1	0	2
8. Risk Assessment + Risk Monitoring and Control	0	0	0	1	1	0	2
9. Risk Identification + Risk Assessment + Risk Response	0	0	1	2	2	0	5
10. Risk Identification + Risk Assessment + Risk Response + Risk Monitoring and Control	1	0	1	2	2	3	9

Table 4 shows the analyzed papers based on the most commonly used keywords. 29.38% from the total papers analyzed shows that the "risk" keywords are the most significant used in many researchers published their papers. Meanwhile, "offshore" keyword contributes to the second-highest rated with 27.38%. This is followed by other keywords such as "oil and gas" (10.12%), "risk assessment" (8.33%); "risk management" (7.74%); "risk analysis" (3.57%); "project management" (1.79%); "risk identification" and "risk indicator" (1.19%); managing risk; "risk modelling" and "risk engineering" (0.60%).

Table 4: Analysis of selected papers according to the keywords

Keywords	Number of Papers	Frequency %
Project management	3	1.79
Risk	50	29.76
Offshore	46	27.38
Offshore project	5	2.98
Oil and gas project	5	2.98
Oil and gas	17	10.12

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Keywords	Number of Papers	Frequency %
Offshore industry	2	1.19
Risk assessment	14	8.33
Risk management	13	7.74
Risk analysis	6	3.57
Risk identification	2	1.19
Risk indicator	2	1.19
Managing risk	1	0.60
Risk modeling	1	0.60
Risk engineering	1	0.60

In this paper, the study level also conducted within three levels, namely project level, firm level, and sector level, as shown in Figure 1. The result indicates that the selected papers are commonly studied at the project level. This result is due to most of the researches focused on the RM within the offshore oil and gas. They also show the risks and effects within the oil and gas business/ sector, concentrated in early 2006. However, analysis shows the growth to the number of paper published focusing on the project level. There are few studies which concentrated on RM related issues discussed at the firm and sector level.

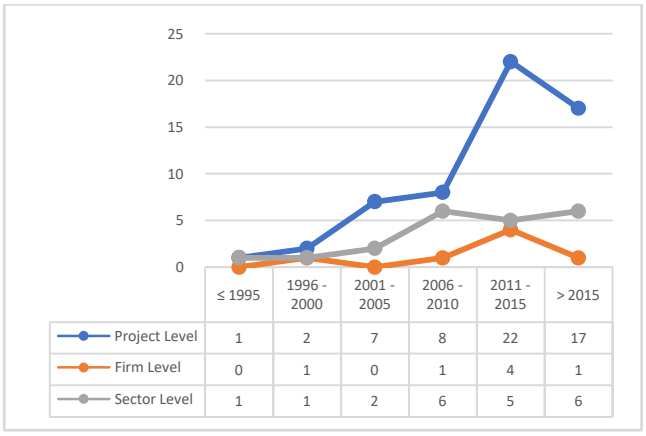

Figure 1: Selected paper analysis by level.

Information from different sources is used in these analyzed papers, which then classified as case studies, survey/interviews, and paper reviews. As seen in Figure 2, review papers and case studies are the leading sources. Subsequently, from the year 2005, case studies and survey/interviews techniques indicated a rapid increase in numbers of paper published. It shows that the primary source of information in the analysis papers came from secondary data or data collected from professional sectors. However, after 2015, reviews and survey/interview are comparatively less preferred information source compare to case studies for RM researches.

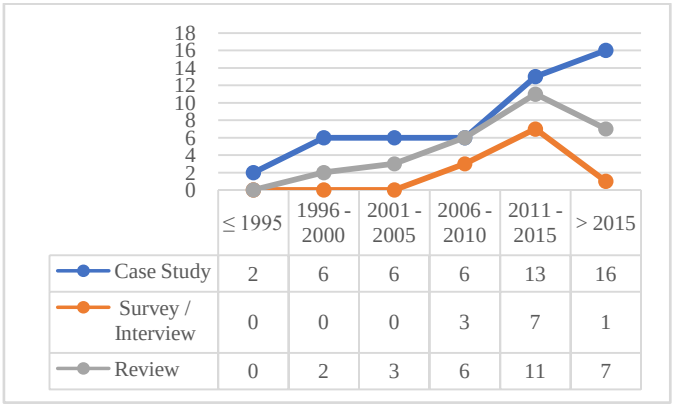

Figure 2: Selected papers analysis based on technique analysis.

Finally, in Figure 3, the key outcome of this paper was grouped into five categories, namely general descriptions, statistical results, theoretical modeling, mathematical modeling, and experimental modeling. The significant contribution is comprehensive general descriptions followed with the statistical result. Subsequently, majority papers accepted a research technique based on case studies and review; it is equitable that the research outcomes show a higher trending in general descriptions. Mathematical modeling, theoretical modeling, and experimental modeling are less accepted techniques compared with others. Because most of the papers adopt research methods based on case studies and surveys, it is reasonable that research output shows a high tendency for global views and descriptions. Mathematical models, theoretical models, and experimental / prototype models are less preferred methodology than others.

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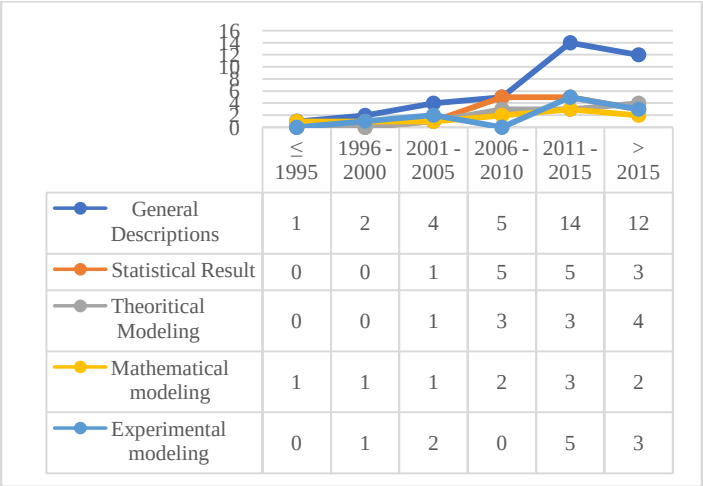

	≤ 1995	1996 - 2000	2001 - 2005	2006 - 2010	2011 - 2015	> 2015
General Descriptions	1	2	4	5	14	12
Statistical Result	0	0	1	5	5	3
Theoritical Modeling	0	0	1	3	3	4
Mathematical modeling	1	1	1	2	3	2
Experimental modeling	0	1	2	0	5	3

Figure 3: Selected papers based on studies outcome.

4. CONCLUSION

None in any offshore oil and gas projects is free from any risk. However, the risk can be managed, eliminate, shared or transferred and minimized. Oil and gas project companies should adopt an appropriate RM approach to meet and comply with project objectives. Many researchers have taken serious note of each step of the RM process, the examination of state-of-the-art literature through analyzing research is the main objective of the paper.

The subject RM established in the previous papers have revealed to a saturation point. However, in offshore oil and gas projects, many researchers are still studying the different aspects of RM using numerous research techniques. Mostly, the literature found are focusing on risk identification and risk assessment. Meanwhile, risk response and combination risk identification and risk response, are seemed to be neglected.

In this paper review, risk which related to the keywords revealed as RM; numerous categories of risk; managing project; risk assessment including score and rating; risk analysis; risk identification; risk modeling; risk response; risk control; and risk mitigation, respectively. The finding revealed managing risk, and risk modeling and risk engineering are the areas been lacking in numbers of paper relevant to RM process. There are a vast number of published literature dealing with RM at the projects level as the researchers are more focusing on risk management. On the other hand, the studies on RM at the firm and sector levels also been lacking. The previous RM researchers focused on risk identification and assessment within offshore oil and gas projects. Therefore, most of the RM researchers adopted review and case studies techniques. As a result, General Descriptions category is the primary research outcome.

In conclusion, this paper review has proved that the direction made by the researchers only in the first two steps in conducting the process of the RM. Therefore, for future studies, risk response and, risk monitoring and control should not be neglected as part of RM process. This expected systematic review carried out will contribute to the offshore oil and gas projects profession by clarifying the research gaps and provide future directions for prospect studies.

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