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Identification of Potential Ergonomic Risk Factors and Mitigating Measures for Malaysian Oil and Gas Drilling Industries: A Conceptual Research Proposition

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Identification of Potential Ergonomic Risk Factors and Mitigating Measures for Malaysian Oil and Gas Drilling Industries: A Conceptual Research Proposition

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Abstract. This research article briefly highlights the proposed research framework for identification of potential ergonomic risk Factors and mitigating measures for Malaysian oil and gas drilling industries. Because ergonomic hazard is considered as one of the major causes of lifedrainning injuries and life time disabilities among oil and gas drilling crew. In this proposed research study, mix method research design will be adopted with explanatory research design. Whereas, industrial survey and semi structure interviews will be conducted to from oil and gas drilling crew (150) and safety and health experts (09) for identifying the potential ergonomic hazards with their effective mitigating measures. Whereas, descriptive statistics, What-If analysis and thematic analysis approach will be used in this proposed research study. The expected outcome of this proposed research framework is to provide the most potential ergonomic risk factors associated with oil and gas drilling operations at onshore and offshore domain with their most suitable hazard controlling measures at Malaysian industries. Similarly, this proposed study will provide a comprehensive mitigating approaches and strategies to safety and health officials to design effective safety trainings and instructional designs based on ergonomic safety professionals' opinions.

1. Introduction

In the Malaysian economy oil and gas industries play a vital role [1]. Therefore, in Malaysian GDP exploration and production of oil and gas operations have significant contributions [2]. oil and gas exploration and operation are one of tough job, because it has involved a lot of physical and ergonomic activities at onshore and offshore drilling domains [4]. Due to the nature of this job there are several physical and ergonomic hazards are involved during well drilling, dripping and cementing operations which can cause critical injuries such as falling hazards, tripping and ergonomic hazards among older oil and gas workers [3]. According to the previous studies, it has been identified that the ergonomic hazards are badly affect the oil and gas drilling workers as compare to others because they need to perform performed they activities for large span of time [5]. Similarly, the findings in various studies



have revealed that the long-term ergonomic activities practicing have been associated with high prevalence of musculoskeletal disorder (MSD) [6].

Occasionally the oil and gas workers are confronted with the risk of muscle and spinal cord injuries and accidents. Also, majority of worker are facing problems of low back and spinal strain [1-3]. Because they expose with awkward postures most of their working times [2]. This adds further complexity on the problem of workers' health. Similarly, the recovery time of the ergonomic injuries effected by oil and gas drilling crew are longer and painful [4]. Therefore, this proposed study tends to focus on the identification of those potential ergonomic risk factors which cause major health problems to aging workers at Malaysian oil and gas industries along with their preventive controlling measures. In this study exploratory research design will be adopted and the gathered data will be identified based on qualitative and quantitative findings.

2. Problem Statement

Onshore and offshore oil and gas drilling operations which are associated with several safety, ergonomic and environmental hazards and therefore they are considered as most challenging profession worldwide [2]. There are high injuries and accidents rates among oil and gas drilling crew has been reported for more than a decade, due to the lack of effective health and safety awareness of safe oil and gas drilling activities [5]. In the years 2007–2012, the occupational fatality rate of the oil and gas drilling industry was 2.5 times higher than the construction industry and 7 times higher than general industry [6]. Furthermore, there are many underlying risk factors such involved in high rate of oil and gas drilling fatalities, critical accidents and life-threatening injuries [1-2]. Whereas, due to the rapid change in environment and advancement in drilling technology drilling crew and safety professionals have to face new challenges every day regarding health and safety [5-7]. Oil and gas drilling workforce have to deal with life-threatening conditions and injuries while performing their jobs [8]. In which ergonomic hazards are most prominent and common due to the large number of injuries cases and disabilities recorded.

Moreover, most of the oil and gas drilling crew reported the ergonomic injuries such as back stain, damage of back bone, muscle injury and sever fractures during rig assembling, tripping and cementing operations at both drilling domains [6-9]. There are some underlying causes which has been reported by previously are due to wrong posture while lifting objects, lack of safety and health practices and insufficient engineering and personal protective requirements. According to the report published by Department of Occupational health and Safety Malaysia in 2014, the number of musculoskeletal diseases cases has been increased in oil and gas and manufacturing industries workforce from last four years due to ergonomic industries and accidents at sites as shown in Figure 1 [3].

Therefore, there is an urgent need to identify the most effective preventive measures to address the potential ergonomic risk factors associated with oil and gas drilling operations for reducing the work place risk at onshore and offshore oil and gas industries in a resourceful manner for the suitable decision making in hazardous conditions [6]. Since the improved and suitable occupational health and safety surveillance measures can help to reduce and eliminate the on-job injury and illness during well drilling operations [5-7].

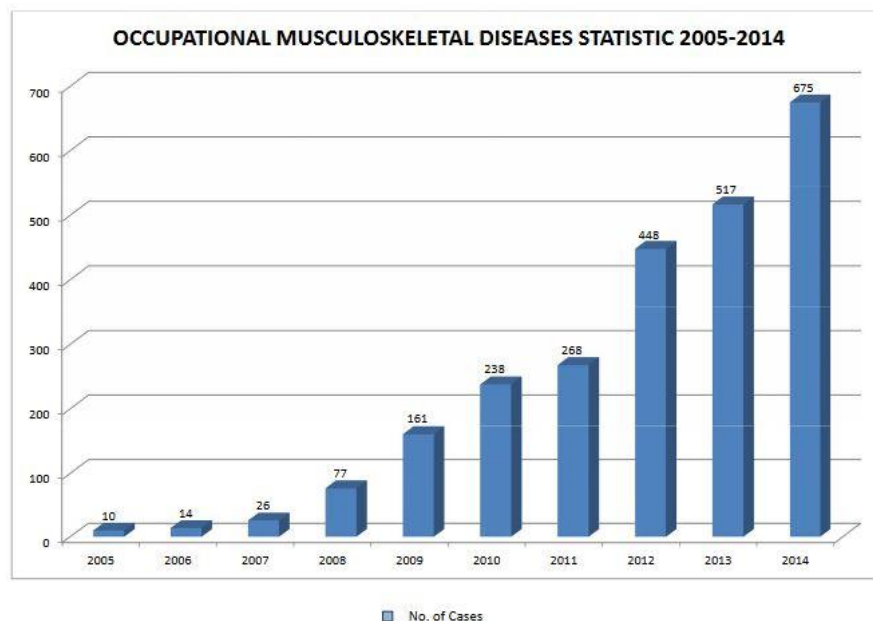


Figure 1. Occupational Musculoskeletal Diseases Statistics 2005-2014 (DOSH 2014)

3. Research Objectives

This study will aim to achieve following research objectives:

1. To identify the potential ergonomic risk factors associated with Malaysian oil and gas drilling industries.
2. To recognize the effective mitigation measures for potential ergonomic risk factors associated with Malaysian oil and gas drilling industries.

4. Research Questions

This proposed study will focus to answer listed research questions.

1. What are the potential ergonomic risk factors associated with Malaysian oil and gas drilling industries?
2. What are the mitigation measures for potential ergonomic risk factors associated with Malaysian oil and gas drilling industries?

5. Significance of Research

The significance of this proposed study is:

1. This proposed research will facilitate health and safety officials and Malaysian oil and gas drilling industries to provide maximum ergonomics protection to workforce.
2. This study will provide detailed experts recommendations for controlling potential ergonomic risks according to the hierarchy of controls for Malaysian oil and gas drilling industries.
3. This study will provide awareness to oil and gas workers for protecting themselves against ergonomic hazards for controlling spinal cord related injuries.

6. Methodology

The population of this proposed study will be drilling crew and health and safety experts from Malaysian (Petronas) oil and gas industries. Whereas, explanatory mix method approach will be adopted for this study, to achieve the aforementioned research objectives, for quantitative study 150 respondents (oil and

gas drilling crew) will be selected for answering the survey research questionnaire for identifying the potential ergonomic risk factors among drilling crew of Malaysian oil and gas industries. Similarly, for qualitative study, from Malaysian palm oil industrial sector, nine 09 Health and safety expert will participate in this proposed study for semi structure interview.

6.1 Data Analysis

For analyzing the quantitative data, descriptive statistic methods such as mean and standard deviation and independent T-Test will be utilize through SPSS 22. Whereas, for the identification of potential ergonomic risk factors researcher will select What-if Analysis approach for extracting meaningful and detailed information through in-depth semi structured interviews from health and safety experts. What-If Analysis is an effective method for determining the hazard controls by asking questions on the basis of potential hazards for making judgments regarding the acceptability of those risks and determining a recommended action for those risks judged by field experts. Because of the nature of this potential ergonomic risk identification technique researcher also required to identify the associated risk factors related with ergonomics.

Further, In the reference of identifying potential ergonomic risks and their mitigations thematic analysis approach will be adopted for interpreting the findings of this proposed study. Main themes will be developed on the bases on the characteristics of hazard and their appropriate controls. Similarly, sub themes for each activity and their controls will be sorted out on the bases of identified ergonomic risks and their recommended and suggested mitigating measures by experts from Malaysian onshore and offshore oil and gas industries as shown in Figure 2.

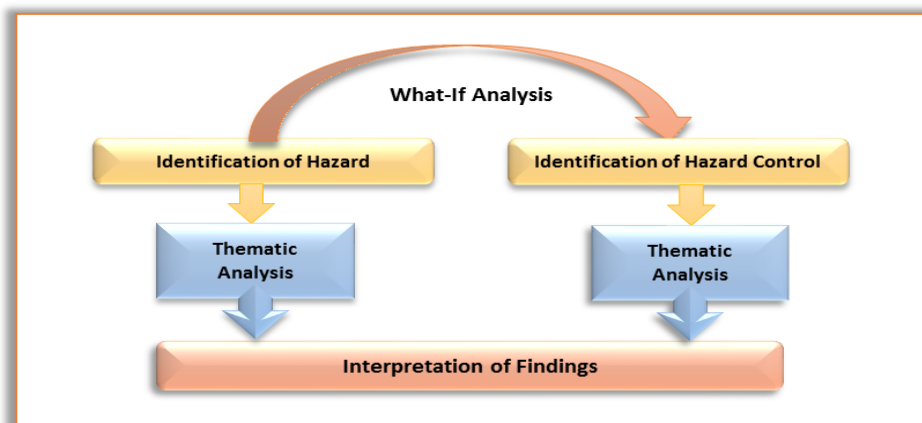


Figure 2. Proposed Data Analysis Framework

6.2 Mixed Method Research Design

Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry (Creswell, 2003). It involves philosophical assumptions that guide the direction of the collection, analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process. As a method, it focuses on collecting, analysing, and mixing both quantitative and qualitative data in a single study or series of studies [2]. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone [7].

6.3 Explanatory Research Design of Proposed Study

In this proposed study, the sequential explanatory research design will be used of different methods rather than the integration of data analysis. The sequential (Explanatory, Exploratory, and Embedded) method uses both quantitative and qualitative data, which are implemented and connected at different phases [5]. In sequential explanatory research design, quantitative follows the qualitative findings. It

means that quantitative research is conducted firstly and based on the attained findings, qualitative research is conducted for the in-depth understanding and validity of quantitative research findings [6]. This design is relatively effective to implement and describes findings well where mixed methods are employed [7]. Furthermore, a sequential explanatory mixed-methods research design is chosen because multiple methods and techniques can be used to provide the most complete understanding of the research problems [1-2]. The block diagram of explanatory research design as shown in Figure 3.



Figure 3. Flow of Explanatory Research Design

6.4 Approach for Semi- Structure Interview

The detailed information obtained from the semi-structured interviews helps to confirm and improve the data findings from the survey questionnaire. However, in this proposed study, semi-structured interviews from health and safety experts will be used to further investigate and contrast the information gained in the survey questionnaire analysis for the identification of potential ergonomic risk factors and their most suitable hazard controls for accident prevention at onshore and offshore drilling sites at Malaysian oil and gas industries. To obtain more in-depth information and data that could not be gathered from the survey instrument has been collected using semi- structured interviews [6]. Whereas, the respondents of these interviews were total of nine (09) health and safety practitioners from Malaysian oil and gas industry based on their expertise in ergonomics and working experiences. While, semi-structured questions will be asked during the interview because it helps to define the areas to be explored, but also allows the interviewer or interviewee to diverge in order to pursue an idea or response in more detail on specific issue and problem [6]. Moreover, the semi structured interviews will be conducted with the help of What- If analysis approach. This approach is considered as a most suitable quantitative approach for the identification of industrial hazards and risks in sufficient way [7].

Therefore, What- If analysis approach will be used for the identification of potential ergonomic hazards associated with drilling operation along with their effective hazard controls. The interviews will be conducted in offices and meeting rooms of targeted industries. While, the average amount of time for a one interview was from 45 to 90 minutes respectively [5]. Prior to the commencement of each interview, the researcher will elaborate the purpose and objectives of the study in order to set the mood of participants. Likewise, even though the consent forms and interview information sheets were also being provided two weeks in advance and signed prior to the interview. Correspondingly, in this study all participants will be notified that the discussions would be audio recorded to enable the researcher to improve the accuracy of the transcripts. All interviews will be conducted in the English language. The interviews will be transcribed manually by using Microsoft excel and coded to identify the main and sub themes.

7. Expected Research Outcome

This proposed study will identify the potential ergonomic risk factors associated with Malaysian onshore and offshore oil and gas industries along with their mitigations and controlling measures. This study will be beneficial for oil and gas industries for overcoming the ergonomic hazards and issues and among drilling crew in their respective industries. This proposed study will provide a detailed strategic

information and recommendation to safety and health officials to develop appropriate training programs according to the expert's recommendations. Similarly, this study will provide awareness to Malaysian oil and gas workforce for taking appropriate measures to prevent ergonomic hazards and risk which may cause them to sever back pains, strains and spinal cord problems by taking appropriate safety and health preventive measures.

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References

- [1] Hassan R B, Asad M M, Soomro Q M and Sherwani F 2017 Severity of the Casing and Cementing Operation with Associated Potential Hazards in the Drilling Process in the On and Offshore Oil and Gas Industry: A Cross-Sectional Investigation into Safety Management *Pertanika Journal of Social Sciences & Humanities*
- [2] Asad M M, Asad M M and Hassan R 2015 Development of KBES with hazard controlling factors and measures for contracting health and safety risk in oil and gas drilling process: a conceptual action plan
- [3] DOSH 2014 Annual Safety and Health Report
Retrieved from: <http://www.dosh.gov.my/index.php/en/archive-statistics/2014>
- [4] Nolan D P 2014 Handbook of fire and explosion protection engineering principles: for oil, gas, chemical and related facilities *William Andrew*
- [5] Asad M M, Hassan R B, Ibrahim N H, Sherwani F and Soomro Q M July 2018 Indication of Decision Making through Accident Prevention Resources among Drilling Crew at Oil and Gas Industries: A Quantitative Survey *In Journal of Physics: Conference Series (Vol 1049 No 1 p 012022)* IOP Publishing
- [6] Asad M M, Hassan R B, Sherwani F, Ibrahim N H and Soomro Q M July 2018 Level of Satisfaction for Occupational Safety and Health Training Activities: A Broad-Spectrum Industrial Survey *In Journal of Physics: Conference Series (Vol 1049 No 1 p 012021)* IOP Publishing
- [7] Asad E M M, Hassan R B and Sherwani E F 2014 Instructional models for enhancing the performance of students and workforce during educational training *Academy Arena* 6(3) pp 27-31
- [8] Clarke S and Cooper C 2004 Managing the risk of workplace stress: Health and safety hazards *Routledge*
- [9] Salvendy G and Karwowski W 2010 Advances in human factors, ergonomics, and safety in manufacturing and service industries *CRC Press*