# DEVELOPMENT OF A NOVEL KNOWLEDGE-BASED DECISION SUPPORT SYSTEM FOR ACCIDENT PREVENTION OF OIL AND GAS DRILLING PROCESS

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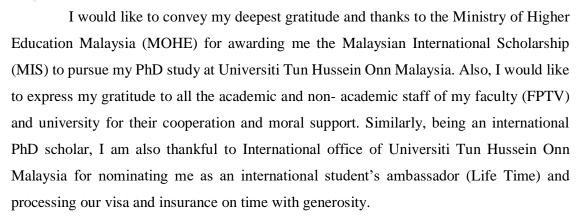
Dedicated to my beloved Uncle Haji Amjad Farooq (Late), my beloved parents, grandparents, siblings, friends and lecturers, without your support, guidance and encouragement, I might not have had this kind of achievement. Thanks for all the support and patience during my PhD research



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### ABSTRACT

Oil and gas drilling process is highly associated with numerous hazardous conditions and potential risks at onshore and offshore drilling domains due to the unpredictable nature of this procedure. Thus, there is a sheer need of an efficient Knowledge-Based Decision Support System (KBDSS) based on the most effective and innovative potential hazards controlling factors, strategies and preventive measures to overcome the accidents at drilling sites. Therefore, in this study the most hazardous drilling operations with their associated potential hazards and effective hazard controlling factors at Malaysian, Saudi Arabian and Pakistani onshore and offshore drilling industries have been identified. Moreover, based on the identified hazard controls, a new KBDSS has been developed by using MySQL and Visual Studio 2015 software. In this study, sequential explanatory and evaluation research designs have been adopted. The developed system has been implemented on targeted industries to assess its decision-making potential, effectiveness of hazard controls, level of user satisfaction and performance for vestibule safety training activities. The quantitative and qualitative data has been gathered from oil and gas drilling crew (240 respondents) and safety and health experts (9 respondents) through survey instruments and semi-structured interviews. Furthermore, the descriptive and inferential statistical tests have been used for quantitative data analysis. Whereas, "What-If Analysis" and thematic analysis approaches have been utilized for analyzing the qualitative data. According to the overall quantitative and qualitative results of this study, the developed KBDSS based on the identified effective hazard controlling factors and preventive measures, proved to be suitable for appropriate decision making during hazardous conditions as well as for vestibule training activities at both drilling domains at oil and gas industries in Malaysia, Saudi Arabia and Pakistan with in moderate (Mean = 2.50-3.49) and high (Mean = 3.50-5.0) level of mean range. In conclusion, this study has introduced a new and efficient KBDSS for accident prevention at oil and gas extraction process which covers all onshore and offshore drilling operations from different regions to achieve the latest trend of industrial IoT as per international safety standards and regulations.



#### ABSTRAK

Proses penggerudian minyak dan gas sangat berkait rapat dengan pelbagai keadaan yang berbahaya dan berpotensi memberi risiko di kawasan penggerudian di pesisir mahupun luar pesisir. Proses penggerudian minyak dan gas ini, boleh mengakibatkan pelbagai kesan kemalangan yang tidak dapat dijangkakan. Berdasarkan faktor kawalan bahaya yang inovatif, strategi dan langkah pencegahan yang sesuai, sumber terbuka sistem sokongan membuat keputusan berasaskan pengetahuan (KBDSS) yang efektif amat diperlukan bagi mengatasi kemalangan di tapak penggerudian secara berkesan. Dalam kajian ini, operasi penggerudian yang berbahaya dan mempunyai potensi yang membahayakan beserta faktor kawalan yang berkesan telah dikenalpasti di 3 negara iaitu Malaysia, Arab Saudi dan Pakistan. Oleh itu, sistem ini telah dibangunkan dengan menggunakan MySQL dan Visual Studio. Kajian ini menggunakan reka bentuk kajian penelitian eksplanatori dan penilaian berurutan yang telah diadaptasi. Sistem yang dibangunkan telah dijalankan di industri penggerudian yang terpilih bagi menilai potensi membuat keputusan, keberkesanan kawalan bahaya, tahap kepuasan pengguna dan prestasi untuk aktiviti latihan simulasi keselamatan. Data kajian yang telah dikumpulkan adalah dari krew penggerudian minyak dan gas (240 responden), dan pakar keselamatan dan kesihatan (9 responden). Data yang diperoleh adalah dengan menggunakan borang soal selidik dan wawancara separa berstruktur. Analisis deskriptif dan statistik inferensi telah digunakan untuk menganalisis data kuantitatif. Manakala data kualitatif pula, "What-If" analisis dan analisis tematik telah digunakan. Mengikut kajian ini, keputusan kuantitatif dan kualitatif KBDSS dibangunkan berdasarkan faktor kawalan bahaya yang berkesan serta mengenalpasti langkah pencegahannya, terbukti sesuai membuat keputusan semasa dalam keadaan berbahaya dan aktiviti latihan vestibula di dua bidang pergerudian dalam industri minyak dan gas asli di Malaysia, Arab Saudi dan Pakistan dengan aras purata tinggi iaitu (3.50-5.0) dan purata sederhana iaitu (2.50-3.49). Kesimpulannya, kajian ini telah memperkenalkan sistem pengurusan keselamatan dan kesihatan yang baru, cekap dan terjamin yang meliputi semua proses penggerudian dari pelbagai bidang untuk mencapai trend industri IoT terkini selaras dengan piawaian keselamatan antarabangsa.



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