IMPLEMENTATION, CHALLENGES AND OPPORTUNITIES IN 8D BIM FOR SAFETY AND HEALTH OF OIL AND GAS INDUSTRY (GAS STATION)

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FACULTY OF ENGINEERING
UNIVERSITI MALAYSIA SABAH
2022

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ABSTRACT

8-Dimension Building Information Modelling (8D BIM) is known as a modern technology used in the construction industry which works as a tool to manage the physical and functional characteristics in the form of digital representation for safety and health parameter. However, recent studies for 8D BIM show that the application and execution of this technology are still low for most sectors, including the oil and gas industry with the lack of current construction projects with BIM implementation and there are many safety requirements needed to design an oil and gas building. Therefore, this research paper aims to study the execution of 8D BIM for safety & health adoption, to analyse the implementation, challenges and opportunities of BIM in oil and gas industry and lastly to exhibit the 3D modelling of a gas station occupied with standard safety measurements. The significances of the study from this research paper are to ensure the increase of 8D BIM level for safety and health adoption for construction industry, to acknowledge readers especially organisations and individuals related to oil and gas industry in implementing BIM and lastly to give a systematic and well-organized 3D modelling using BIM software and tools. The literature review shows the evaluation of the previous study on 8D BIM. The survey questionnaire illustrates the analysis from 50 respondents using SPSS with three tests: frequency, chi-square, and cross-tabulation. 3D modelling of a gas station displays an oil and gas industry building. From the survey questionnaire, it is found that 52% of respondents agree that the safety and health in construction are low in Malaysia. The top 3 challenges in implementing 8D BIM are lack of enforcement, complex BIM software, and lack of training programs. 3D model of the gas station. The benefit of 8D BIM based on questionnaires is it can improve coordination and communication. The challenges and opportunities obtained from the result significantly impact the collaboration of training and software between the academic field and industry.

Keywords: Building Information Modelling, Safety & Health, Oil and Gas, Construction, Modelling

ABSTRAK

PELAKSANAAN, CABARAN, DAN PELUANG DALAM 8D BIM BAGI KESELEMATAN DAN KESIHATAN DI INDUSTRI MINYAK DAN GAS (STESEN MINYAK)

Pemodelan Maklumat Bangunan 8-Dimensi (8D BIM) dikenali sebagai teknologi moden yang digunakan dalam industri pembinaan yang berfungsi sebagai alat untuk mengurus ciri-ciri fizikal dan fungsian dalam bentuk perwakilan digital untuk parameter keselamatan dan kesihatan. Walau bagaimanapun, kajian terbaru untuk 8D BIM menunjukkan bahawa aplikasi dan pelaksanaan teknologi ini masih rendah untuk kebanyakan sektor, termasuk industri minyak dan gas dengan kekurangan projek pembinaan semasa dengan pelaksanaan BIM dan terdapat banyak keperluan keselamatan yang diperlukan untuk mereka bentuk minyak. dan bangunan gas. Oleh itu, kertas penyelidikan ini bertujuan untuk mengkaji pelaksanaan BIM 8D untuk penggunaan keselamatan & kesihatan, untuk menganalisis pelaksanaan, cabaran dan peluang BIM dalam industri minyak dan gas dan akhir sekali untuk mempamerkan pemodelan 3D stesen minyak yang diduduki dengan ukuran keselamatan standard. Kepentingan kajian daripada kertas penyelidikan ini adalah untuk memastikan peningkatan tahap BIM 8D untuk penggunaan keselamatan dan kesihatan bagi industri pembinaan, untuk memberi penghargaan kepada pembaca khususnya organisasi dan individu yang berkaitan dengan industri minyak dan gas dalam melaksanakan BIM dan akhir sekali untuk memberi gambaran yang sistematik dan pemodelan 3D yang teratur menggunakan perisian dan alatan BIM. Kajian literatur menunjukkan penilaian kajian terdahulu ke atas 8D BIM. Soal selidik tinjauan menggambarkan analisis daripada 50 responden menggunakan SPSS dengan 3 ujian iaitu ujian kekerapan, ujian khi kuasa dua, dan ujian tabulasi silang. Pemodelan 3D stesen minyak memaparkan bangunan dalam industri minyak dan gas. Daripada tinjauan soal selidik, didapati 52% responden bersetuju bahawa keselamatan dan kesihatan dalam pembinaan adalah rendah di Malaysia. 3 cabaran teratas dalam melaksanakan BIM 8D ialah kekurangan penguatkuasaan, perisian BIM yang kompleks dan kekurangan program latihan. Model 3D stesen minyak. Faedah dalam BIM 8D berdasarkan soal selidik adalah dapat meningkatkan koordinasi dan komunikasi. Cabaran dan peluang yang diperoleh daripada keputusan memberi impak yang ketara dalam kerjasama latihan dan perisian yang digunakan antara bidang akademik dan industri.

Kata Kunci: BIM, Keselamatan dan Kesihatan, minyak dan gas, pembinaan, pemodelan

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LIST OF ABBREVIATIONS

AEC	-	Architecture, Engineering & Construction
BIM	-	Building Information Modelling
CIDB	-	Construction Industry Development Board
JKR	-	*Jabatan Kerja Raya*
PWD	-	Public Works Department
SPSS	-	Statistical Package for Social Science

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In construction industry, new technologies are growing rapidly parallel with other industry to move with the times. Traditional work-flows in this industry are being replaced by new ones. Construction industry has always been known by its vast methods and the complexity of processes. One of the sectors in construction industry is AEC (Architecture, Engineering, and Construction) Sector. This sector is considered as the modern era of construction industry. Conventionally, these three main sectors are divided as it is not related to each other. However, when the technologies used in construction evolve, these 3 sectors (Architecture, Engineering, and Construction) are merged collaboratively as it can give many benefits to the modern construction industry (Rahman et al., 2013).

Generally, each and every three sectors provide different services with different skillsets of workers. Architecture sector develops the design concept of construction for new buildings and restoration of current and existing building in term of drawings and models. This sector emphasizes on the aesthetics value of visual representation. Architects is responsible towards the quantifying and qualifying of project such as budget allocation, characteristic of sites and terms and regulation from client. Engineering sector oversee the construction projects, such as buildings, dams, roads and other infrastructure. This sector also undergoes inspection and maintenance process with the collaboration of safety officer. Engineers conduct and coordinate the site inspections, feasibility studies and ensuring the specifications comply with the standard rules and regulations. Construction sector involve in managing, hiring and coordinating with the workers (contractors and

subcontractors). This sector works cooperatively with architecture and engineering sector to in term of project planning and cost. Project manager is responsible in construction sector to identify and internal and external risks of before, during, and after construction to minimize the accidents rate in construction industry.

In AEC Sector, one of the method and tools used to assist the 3 main sector is BIM. Building Information Modelling is a process of creating intelligent 3D model that replaces a 2D sketch model, enabling document management, coordination, and simulation throughout the life of the project which are planning, design, construction, operation, maintenance phase (Alizadehsalehi et al., 2020). BIM creates and organizes information about construction projects for the entire duration of the project. One of the most important consequences of this process is the building information model, which is a digital description of all the functions of the built system. This model is based on information that is generated and updated together during the major phases of the project. Creating a digital building information model helps individuals interacting with the facility to optimize their activities and increase overall asset value. Digital representations are often expressed both aesthetically and mathematically. The possibilities for providing plant information are beginning to expand. The methods of providing information in term of facility are evolve from analogue to digital.

Building Information Modelling method is divided subsequently into many for of dimensions. The dimension of BIM shows the level of information and data needed with the aid of 3D model using modelling software such as AutoCAD, Revit, Civil 3D and Navisworks. Currently, there are 8 dimensions of BIM with each dimension focuses on different information in a project. 3D BIM is perhaps the most recognized version of BIM, and involves the process of collecting graphical and non-graphical information to generate 3D models. 4D BIM incorporates temporal information into the mix to produce an even deeper source of information for the project. This information might include installation time, period till operational, curation of materials etc. 5D BIM contains information connected to costs e.g., the capital cost of acquiring a component, the user being able to extract precise cost data from the model, and also view changes in the cost data over time. 6D BIM is focused on the sustainability of an asset, and is known as the 'project-life-cycle information' or often

referred to as Facilities Management. Data may contain information from the manufacturer including, maintenance regimens, configuration of the component for maximum performance, projected lifetime etc. 7D BIM is all about operations and facilities management by building managers and owners. The dimension is used to track key asset data such as its status, maintenance/operation manuals, warranty information, technical specs, etc. to be utilised at a future stage. Figure 1.1 shows the tabulated definition of dimensions in BIM (3D-7D).

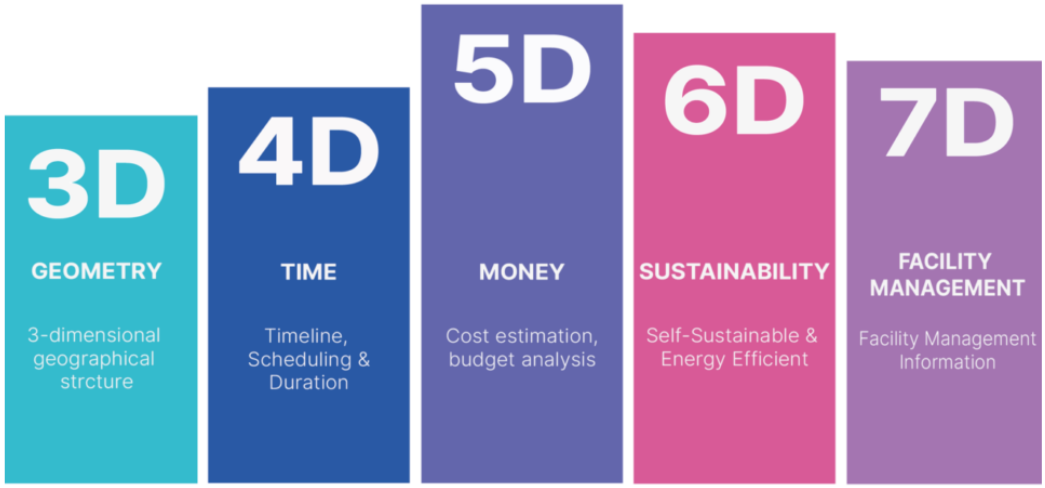

Figure 1.1 : Definition of Dimensions in BIM (3D – 7D)

Source : BIM Spots (2019)

The last dimension in BIM is 8D BIM which emphasizes mainly in safety and health in construction industry. This dimension adds safety information to the geometric model of the build throughout the design and execution stages. The construction industry's occurrence rate for workplace injuries has continuously stayed at nearly twice that of all other sectors. There has been many solid evidence that many safety concerns are developed in the early design stage of projects. Hence, it may be claimed that one of the most successful strategies of dealing with a danger is to eradicate it at source, that is, Prevention through Design (PtD). But until recently the means for successfully addressing the linkages between design and safety on site have not been accessible. The purpose of utilising 8D BIM is to have an overall image of the building site already at the planning stage in order to eliminate probable dangers and hazards for employees (Mordue & Finch, 2019). By visualising the building site in advance and in a realistic way, it becomes simpler and more efficient

to examine all conceivable scenarios and avert hazards and critical circumstances at every project stage.

There are many construction sectors utilising the Building Information Modelling (BIM) process in their projects with regard to its systematic flow and new emerging technologies that can ease the project in term of cost and time. Over the years, Oil and Gas Industry is known for its speciality and expertise in safety and health. This industry emphasizing on safety and health for workers and its design of building. Workers in oil and gas industry need to undergo training before entering the industry for offshore sector. The design of oil rig in offshore sector is planned with different level of safety and considered many aspects to ensure the accidents is in low rate. Gas station is one of the common buildings found in Oil and Gas Industry. Even though the level of safety is not as strict as offshore and onshore sector, it is important for gas company to ensure the safety inside and outside of construction site is in satisfactory level.

There are many companies in Malaysia who involve in designing and construction of a gas station such as Petronas, Shell, Esso, Caltex and Mobil. Each company have different set of safety rules and regulations encoded whether for their general workers, project manager, engineer, architect and safety officer. Gas station is one of the buildings designed by Oil and Gas Company. Gas station facilitates the selling of fuel and lubricants for motorized vehicle. There are two common types of fuel that can be found in gas station, specifically in Malaysia namely petrol and diesel. Figure 1.2 shows the number of gas station in Malaysia in 2017.

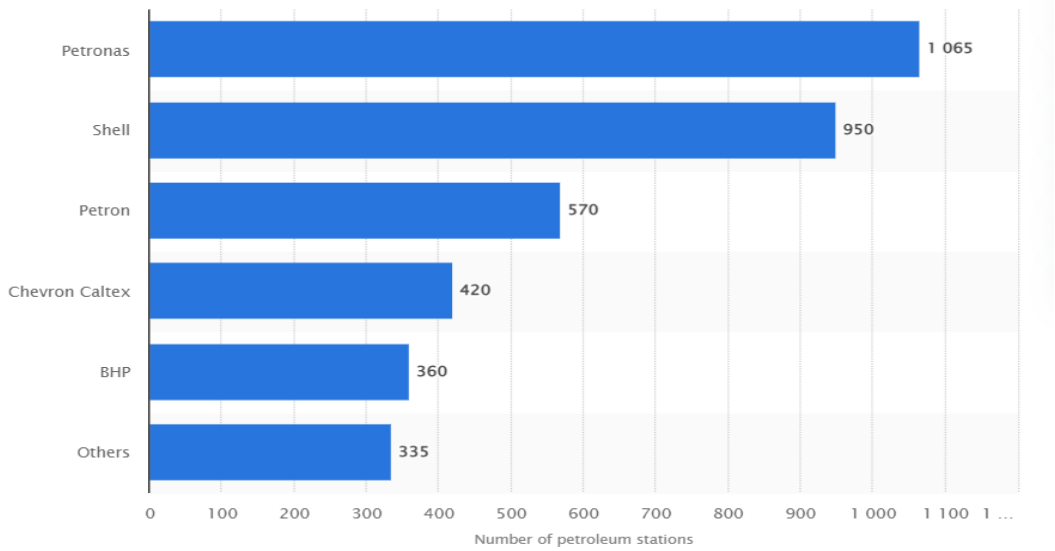

Figure 1.2 : Number of Gas Stations in Malaysia (2017)

Source : Statista (2017)

1.2 Problem Statement

New emerging technology in construction industry have been widely spread to minimize the project's duration and cost. This technology helps to ease the workflow and increase the level of communication between parties before, during, and after construction. Building Information Modelling (BIM) acts as a tool to aid the industry with emerging technologies in term of designing, planning, maintenance etc. In spite of that, only certain sector in construction industry uses BIM as its method. 8D BIM which emphasizes on the safety and health in construction should be implemented in many sectors. Oil and Gas Industry is known for its high level of safety and health that can be set as an example to other industry. However, this industry does not fully emphasize the emerging technology of BIM in its project. Gas station projects under Oil and Gas Industry can act as a head start in adoption of BIM. In Malaysia, the use of 8D BIM in construction is at low level in general, and specifically for gas station compared to other developing countries.

Based on the previous study on BIM, there are 3 problem statements from this research. The first problem statement is that the exposure and adoption of 8D BIM in construction industry is still low. Hence, the objective for this problem is to

study the execution of 8D BIM for safety & health adoption in current construction industry in Malaysia. The second problem statement arises when there is a lack of construction projects with BIM implementation in Oil and Gas Industry. Therefore, this thesis aims to analyse the implementation, challenges and opportunity of BIM in Oil and Gas Industry. The last problem statement arises when there are many aspects of safety requirements in terms of BIM needed in designing a gas station. Therefore, this report aims to exhibit the 3D modelling of gas station occupied with standard safety measurements as it will gives exposure to the industry.

1.3 Objective

The implementation of BIM in Oil and Gas Industry has not been widely reported in research paper and previous study. The aim of this thesis was to enlighten the adoption of BIM in Malaysia, specifically in 8D BIM (Safety and Health) for gas station. The objectives of this thesis are list down below:

1. To study the execution of 8D BIM for safety & health adoption in current construction industry in Malaysia
2. To analyse the implementation, challenges and opportunity of BIM in Oil & Gas Industry
3. To exhibit the 3D Modelling of Gas Station occupied with standard safety measurements

1.4 Scope of Work

Building Information Modelling adoption is not widely used in Malaysia. Hence, this thesis is focusing on 3 level of research scope with difference range or area of study. These research scopes were chosen to have a clear understanding on how BIM can be implemented throughout three different scopes.

For Scope 1 is 8D BIM in Malaysia. Safety and health have always been the top parameter in construction sector. It is vital for each party in construction to

administrate the safety and health protocol either to the workers or the structure itself. Construction industry is a high hazard industry with the workers engage in many dangerous activities such as exposal to hazardous material, unguarded machinery, electrocutions, and falling from the rooftops of building. Hence, it is important for construction industry to implement 8D BIM as it focuses on safety and health that can reduce accidents and failure during construction.

For Scope 2 is BIM in Oil and Gas Industry. Oil and Gas Industry consist of many complex projects that takes a lot of effort from all parties such as architects, engineers, contractors and project managers. Complex projects differ from other projects as it requires a lot of skilled workers, high cost of construction and time consuming. In spite of the differences, most of oil and gas company are using the conventional method of project implementation instead of modern tools and technologies. This scope focuses on how BIM can be implemented in Oil and Gas Industry, specifically in Malaysia with the aid of survey questionnaire from industry.

For Scope 3 is 3D modelling of gas station. Over the years, services provided in gas station have been upgraded such as e-wallet for payment, self-service petrol pump, and vehicle service kiosk in some station. All of these services cannot be done if the safety and health parameter does not been upgraded and emphasized before, during, and after construction. BIM can be used to ensure the workflow of construction at ease alongside with the reduction of accidents rate. This scope focuses on the usage of BIM, in term of its safety features in constructing the gas station with the aid of 3D modelling, safety rules and regulations from oil and gas company, and journals.

1.5 Significance of Study

BIM can initiate many levels of benefits to construction projects. 8 Dimensional BIM can give a better project workflow in terms of safety and health. There are some potential advantages that can be gained to construction companies especially in Oil and Gas Industry after the completion of this study. There are 3 significances of study for this research in which it relates to the problem statement and objectives. The first