THE CHALLENGES OF FACILITY MANAGER INVOLVEMENT AT DESIGN STAGE USING BUILDING INFORMATION MODELING

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DEDICATION

To my beloved father, mother and brothers,

Thanks for understanding and all the financial and moral supports.

To my respected supervisor,

Assoc. Prof. Dr. Rozana Zakaria

Thanks for your guidance, encouragement, advice and knowledge

And to friends who encourage me to move forward.

Thanks for the support and encouragement all the way

Thank You from the bottom of my heart

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ABSTRACT

Facilities management is commonly known and plays an important role and function throughout the operation and maintenance of a building. Apart from that, facility managers should have the responsibility to ensure that facilities in a building are all well designed, constructed, operated and maintained. 'Clash' is a common problem in building installation which creates more problems in future maintenance and replacement. In order to resolve this problem, clash detection should be carried out during design stage with the aid of Building Information Modeling (BIM) tools to ensure the minimum requirement of building facilities maintenance during operation and maintenance stage is met. This project report highlights the roles of facility manager in the design stage, especially in clash detection. At the same time, integration of BIM tools is expected to help all parties involved including facility manager to visualise the buildability and constructability of the building facilities. The questionnaire survey was carried out to gain information on the level of awareness, challenges and barriers in the employment of facility managers. Impact of clash detection toward operation and maintenance stage and strategies to encourage the involvement of facility manager are focused in this study. Frequency analysis, measurement of central tendency and average index were utilized to analyse the result obtained. This study concluded that facility manager has a significant role in design stage which later benefits the development of a building project especially during operation and maintenance stage on the organizational, financial, governance, training, and regulatory aspects.

ABSTRAK

Pengurusan fasiliti adalah biasanya dikenali dan memainkan peranan dan fungsi penting sepanjang operasi dan penyelenggaraan bangunan. Selain itu, pengurus fasiliti mempunyai tanggungjawab untuk memastikan bahawa fasiliti dalam bangunan semuanya direka, dibina, dikendalikan dan dikekalkan dengan baik. 'Clash' adalah masalah yang biasa dalam pemasangan bangunan dan akan mewujudkan lebih banyak masalah penyelenggaraan dan penggantian pada masa depan. Untuk menyelesaikan masalah ini, pengesanan *clash* perlu dijalankan semasa peringkat reka bentuk dengan bantuan peralatan *Building Information Modeling (BIM)* untuk memastikan keperluan minimum penyelenggaraan fasiliti bangunan semasa operasi dan tahap penyelenggaraan adalah mencukupi. Laporan projek ini menyoroti peranan pengurus fasiliti semasa peringkat reka bentuk, terutamanya dalam pengesanan *clash*. Pada masa yang sama, integrase peralatan BIM dijangka boleh membantu semua pihak terlibat termasuk pengurus fasiliti untuk membayangkan kebolehkerjaan dan kebolehbinaan fasiliti bangunan. Kajian soal selidik telah dijalankan untuk mendapatkan maklumat mengenai tahap kesedaran, cabaran dan halangan dalam penggajian pengurus fasiliti. Impak pengesanan *clash* terhadap peringkat operasi dan penyelenggaraan dan strategi untuk menggalakkan penglibatan pengurus fasiliti akan difokus dalam kajian ini. Analisis kekerapan, pengukuran kecenderungan pusat dan indeks purata digunakan untuk menganalisis hasil yang diperolehi. Kajian ini menyimpulkan bahawa pengurus fasiliti mempunyai peranan penting dalam peringkat reka bentuk dan kemudiannya akan memberi manfaat kepada pembangunan projek bangunan terutamanya semasa peringkat operasi dan penyelenggaraan mengenai aspek organisasi, kewangan, tadbir urus, latihan, dan peraturan.

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LIST OF ABBREVIATIONS

2D	-	2-Dimensional
3D	-	3-Dimensional
4D	-	4-Dimensional
5D	-	5-Dimensional
6D	-	6-Dimensional
7D	-	7-Dimensional
AEC	-	Architectural, Engineering and Construction
AI	-	Average Index
BIM	-	Building Information Modeling
CAD	-	Computer-aided design
FM	-	Facility Manager
HLI	-	High Learning Institution
HVAC	-	Heating, Ventilation and Air-Conditioning
ICT	-	Information Communication Technology
IT	-	Information Technology
KMO	-	Kaiser-Meyer-Olkin
MEP	-	Mechanical, Electrical and Plumbing
MRL	-	Machine-Room-Less
IOT	-	Internet of Things
ROI	-	Return on Investment
SPSS	-	Statistical Package for Social Package
SSP	-	Sungai Buluh-Serdang-Putrajaya

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Facilities management is vital in the construction industry from the pre-construction stage to the post-construction stage. It comprises of many things from the planning aspects, financial aspects, operations aspects, till the maintenance aspects including all the equipment and furniture in order to enhance the organizations' ability to compete in the competitive industry (Abdullah et al., 2014).

The facility manager is a professional who acts as the linkage between facilities management and facility design processes (Jensen, 2009). He or she acts as an organizer of a project who is responsible in managing all the tasks including management, services, processes from pre-planning to the operation and maintenance stage that help to meet the requirements of a project. Throughout the whole construction process, the facility manager has constant contact with building users in order to give services about the building facilities. During the design stage, the facility manager will provide valuable advice based on the users' requirements in order to develop high valuable facility with cost reduction in operation and maintenance (Okoroh et al., 2003).

Clash is defined as components that make up a built asset are not coordinated and conflict (Dey, 2016). Whereas, clash detection is a process of inspecting and identifying the interferences which occur in coordinating process of 3D models created in different Building Information Modeling (BIM) software (Valunjkar, 2017). Clashes that spotted since the design stage able to reduce the variation order, reduce in cost for design changes, prevent delay of work progress and reduce the repair and maintenance. Clash detection covers 3 main aspects which are the installation of

facility, design and location and user ability of facility and future maintenance and repair.

Today, BIM offers integrated solutions in all stages of building life cycle from pre-planning to operation and maintenance. With the adoption of BIM in a construction project, it not only provides green sustainable design analysis and evaluation but also helps in the process of fabrication, maintenance, and operation management as well as the occupant behavior-modification (Guangbin et al., 2011, Wong and Zhou, 2015). The integration of BIM with Facilities Management (FM) decreases the chances of errors, ease the documentation system, increases the efficiency (Aziz et al., 2016a). Besides that, with the implementation of BIM with the integration of facilities manager in a construction project, it helps in clash detection during the design stage.

1.2 Problem Statement

In the construction industry, clash detection is a popular topic among the construction parties as they know the consequences of detecting inconsistencies. Detecting inconsistencies can be known as a failure in detection of the potential clash during the design stage and cause extra repair and maintenance work in operation stage. Detecting inconsistencies can bring serious effect, result in project delay, budget overruns and severe modifications of the building which does not meet the client's requirement.

According to Becerik-Gerber et al. (2011), involving facilities management in clash detection during design stage has the potential to reduce the future efforts of repair and maintenance work during the occupation stage of the building. Besides that, the general manager of Farnek Services, David Graham (cited from Dawson, 2007) also agrees that roles of facilities management in the design stage of a building is very important. The money which developers spend on employing facility manager in the design stage and consultancy can be easily recovered during the remainder of the building's life due to the cost of maintenance can be optimized.

The involvement of a facility manager in the design stage can lead to a direct impact on the Return on Investment (ROI) of the building (Guangbin et al., 2011). It reduces the problems of high cost of maintenance and facilities management fees in the operation stage. During the design stage, clash can be detected by a 3D BIM model and facilities manager can help to visualize from all disciplines includes architectural, structural, mechanical, electrical, plumbing. Therefore, in this study, it will discover the importance of facility managers' role during the design stage in identifying clash detection in construction building's facilities.

Additionally, a news report from Siddiqi (2007) stated that during the commencement of Abu Dhabi's contract on the Lagoon Club development, cited the speech from David Graham that the involvement of facilities management in the design stage able to provide consultancy in order to get a cost-effective result. In Malaysia, the involvement of facilities management in the design stage of construction projects is still not yet widely implemented. Therefore, identify the problems and challenges of possibility for employing facility manager during the design stage is interesting issues that needed more exploration and justification in Malaysia building construction with the advancement of the Internet of Things (IoT), the facilities management on the BIM implementation at design stage should also be taken into consideration.

Developers in Malaysia have to spend extra cost to employ facility manager to help in clash detection of a building since the design stage. They prefer to get facility manager during the operational stage of the building for consultancy on repair and maintenance. The advancement of BIM today enables facilities management to be benefited as well. In this research, it explores the BIM application for the facility management tools in a construction project since the design stage in Malaysia construction industry.

Therefore, based on above-mentioned, there are questions can be arisen to motivating the research problems:

1) What is the importance of involving facility managers in the design stage?
2) What are the reasons why facilities management is not widely implemented in the design stage of construction projects?
3) Is it clash detection in design stage able to help in decreasing the operation and maintenance cost of the building?
4) What are the strategies that can be implemented to encourage facility managers to involve in the design stage by using BIM?

1.3 Aims and Objectives

The aim of this study is to study the current gaps of facilities management in clash detection by BIM integration at the design stage. In achieving the aim of the study, the objectives are identified as follows:

1) To determine the level of awareness of construction parties towards facility managers' involvement in the design stage
2) To identify the challenges and barriers in employing facility managers that have expertise in BIM
3) To determine the common situation of clashes at the design stage that effects to future repair and maintenance on the operation period.
4) To propose strategies that encourage facility manager to involve in the design stage with BIM application.

1.4 Scope of Study

This research study the roles of facility manager as well as the importance of having facility manager in the design stage of a construction project in Malaysia. Hence, for data collection, developers and facility managers involved in high rise building projects in Johor Bahru area will be selected in this survey. Respondents include facility managers and developers who are experienced in building life cycle could respond in the level of awareness towards the involvement of facility managers,

challenges in employing facility managers, clash detection during the design stage and the advantages of BIM for facilities management. The data collection will be based on building and facility manager in Johor due to the recent rapid development of high rise building. The data will only focus on facilities management for high rise buildings.

1.5 Significance of Study

The importance of this study is to determine the level of awareness of the construction industry towards the involvement of facility managers in the design stage in Malaysia. It can help construction parties to have the knowledge, understand the benefits of having a facility manager in the design stage and promote the involvement of facility manager in the design stage. Besides that, this research also determines the challenges in employing facility managers. The result of the research can be used as a guideline and reference resource for construction players to work on in order to solve the barriers and encourage the employment of facility managers in the future. Rather than that, this study also determines how clash detection in design stage benefit and give positive impacts on operation and maintenance period. This can help the developers to understand how facility managers help in common clash detection during the design stage and encourage the involvement of facility manager in the design stage. Moreover, this research will also propose strategies to encourage the involvement of facility managers by using the BIM application. Hence, it helps the construction parties to have future knowledge on the benefits of 7D BIM as part of facilities management tools. The involvement of facility managers, therefore, take a vital responsibility for the economic, social and environmental purpose of sustainable development.

1.6 Brief Research Methodology

Research methodology is procedures which researchers find the related information on a specific topic by using a systematic and scientific way (Kothari, 2004). It is one of the vital parts for research as the planning of research methodology will facilitate the achieving of research objectives. For this study, it initiates with the identification of the research field and finding of related supervisor. Next, it continues with the problem identification together with objective determination.

This project report will basically be divided into five chapters. Chapter 1 discuss on introduction, problem statement, objectives, scopes as well as the significance of the study.

The literature review will be discussed in Chapter 2 which relates to the facilities management, roles of facility manager during the design stage, clash detection and BIM. It will discuss on the level of awareness of construction players towards the involvement of facility manager, challenges and barriers on the employment of facility manager during the design stage, the relationship between facility manager and clash detection and strategies to encourage the involvement of facility manager. All the information used in the literature review will be obtained from journals, articles, newspaper, previous theses, books, and various online sources. Chapter 3 provides the research method, describes how the study to be conducted; research procedures, methods and instruments to be used in the study.

The next step will be the data collection. Data will be collected by distributing questionnaires to developers and facility managers in Johor Bahru, Malaysia. Data collected by questionnaires will be compiled, analysed and summarized. It will be analysed by quantitative methods by Statistical Package for the Social Sciences (SPSS) such as frequency distribution, measurement of central tendency, Average Index, factor analysis and regression analysis. All the analysed data will be summarized and presented in Chapter 4 in order to achieve the objectives.

Last but not least, conclusions will be made and recommendations will be identified to act as a reference for future reference in Chapter 5.

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