HUMANIS
(Humanities,Management and Science Proceedings)

Vol. 5 • No. 1 • Desember 2024

Pege (*Hal.*) : **502 – 513**

ISSN (*online*) : 2746 - 4482
ISSN (*print*) : 2746 - 2250

JL.Surya Kencana No.1 Pamulang, Tangerang Selatan–Banten
Telp. (021) 7412566, Fax (021) 7412491
Email : humanismanajemen@gmail.com

Special Issue:
ICOMS 2024
The 5th International Confrence on Management and Science

Website. :
http://www.openjournal.unpam.ac.id/index.php/SNH

Digitizing Building Blueprints with BIM Technology for Enhanced Infrastructure Management at Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA)

Abdul Razli bin Abdul Rahim[1)]; and Norani Abd Karim[2)]

[1-2] *Civil Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Persiaran Usahawan, Sec.U1, 40150 Shah Alam, Selangor, Malaysia.*

E-mail: [a)]arazli@psa.edu.my
[b)]norani@psa.edu.my

Abstract: The digitization of building blueprints for the Civil Engineering Department (DCE) and Al-Jazari Hall (AJH) aims to convert existing paper-based building buleprints into digital formats by using Autodesk Revit software for Building Information Modelling (BIM) system. This project was initiated by findings revealed from the fieldwork study was done at the Building and Infrastructure Unit (UBI) facility prior to identify the main issues with the existing blueprints conditon. The study had revealed that the original blueprints were worn, faded, and outdated, its necessitating an initiative to digitize them for better preservation and usability. The digitized blueprints had provided multiple benefits, including aiding UBI in maintenance planning, reducing reliance on physical document storage, and enabling improvements to existing buildings. For instance, changes such as repainting walls and creating a refreshed environment can be visualized and planned effectively. The project involved interviews with a Civil Engineering Assistant Engineer at PSA, providing insights into the challenges and expectations of blueprint digitization. The project was successfully achieved the main objective by digitizing all building blueprints for DCE and AJH. This initiative not only modernizes the management of building blueprints but also enhances the planning and maintenance process, that contributing to the overall efficiency and functionality of campus facilities. The project also demonstrates the potential of BIM technology in preserving, visualizing, and optimizing building information for improved infrastructure management in the future.

Keywords: Digital Building Plans, Building Information Modelling (BIM), Civil Engineering Department (DCE), Al-Jazari Hall (AJH), Infrastructure Management

INTRODUCTION

Building Information Modelling (BIM) is the strategy that is enabled by information technology and encompass the application and maintenance of a data repository that serves as a comprehensive digital representation of all building information during various stages of the project lifecycle (Davtalaba & Delgadob,2014). BIM also involved an integrative process for producing precise construction drawings and an accurate information channel for a project, that encompassing the design, construction, and operational data systems (Sacks, 2018). Architects, structural engineers, electrical engineers, mechanical engineers, contractors, and owners may standardise the projects by utilising coordinated information and digital design documentation with BIM technology. It also enables the development of more precise 3D representations and simulations that are pertinent to design aesthetics, performance, cost estimates, and timetables, so that its has ensuring that projects could be completed more rapidly at a lower cost, with a decreased an environmental effect (Sacks, 2018).

BIM is also capable of integrating Gantt chart visualization methods with 4D scheduling visualization (Wang & Chien, 2014). The main issue prompting this project was the deteriorated and faded condition of the existing building blueprints for the Department of Civil Engineering (DCE) and Al-Jazari Hall (AJH), which made it challenging for the Building and Infrastructure Unit (BIU) to plan maintenance for specific damaged areas within these buildings. Additionally, the disorganized and un-structured arrangement of the hardcopy blueprints further complicated the identification and detailing of each block in DCE and AJH. Therefore, the primary objective of this project was to produce 2D and 3D digital drawings for the entire DCE and AJH buildings by using a BIM software. The target stakeholder of this project is the Building and Infrastructure Unit (BIU), as they manage all aspects of building maintenance and layout planning management at Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA).

LITERATURE REVIEW

BIM is an innovative technology and process to virtually design and manage construction projects (Azhar, 2011). BIM has been adopted in the construction sector over the last two decades and it has the capacity to transform and enhance performance by decreasing inefficiencies, improving productivity and increasing collaboration among project stakeholders (Abanda et al., 2018). Adoption of BIM offers the visualisation of design, fast creation of alternative designs, automatic examination of model reliability, production of reports and building performance forecasting (Sacks et al., 2010).

The adoption of BIM technology in Malaysia was began to grow when the Director of the Public Works Department (PWD) proposed its introduction to the construction industry in 2007. The initial goal of using BIM was to enhance inter-disciplinary coordination, reduce errors and waste, provide better visualization, optimize costs and time, and improve information management efficiency (Kasim et al., 2017). To further this, Malaysia had developed strategies to make BIM implementation more effective through the Construction Industry Transformation

Programme (CITP) 2016–2020 (CIDB, 2015). Under this program, BIM serves as a platform to foster collaboration among stakeholders, starting from the planning, design, and construction phases by using 3D models (Lorek, 2018). The effectiveness of BIM can be seen in its application in Malaysia's first BIM-based project at the construction of the National Cancer Institute (NCI) building in 2010 (Haron et al., 2017). Furthermore, the Malaysian Anti-Corruption Commission (MACC) Administrative Complex was another significant milestone in the application of BIM technology to create the building structures (Latiffi et al., 2013).

METHODOLOGY

The project was carried out in two (2) phases: (1) fieldwork study and (2) the production of digital architectural and structural drawings, which was established the final outputs for this project.

Phase 1: Fieldwork Study

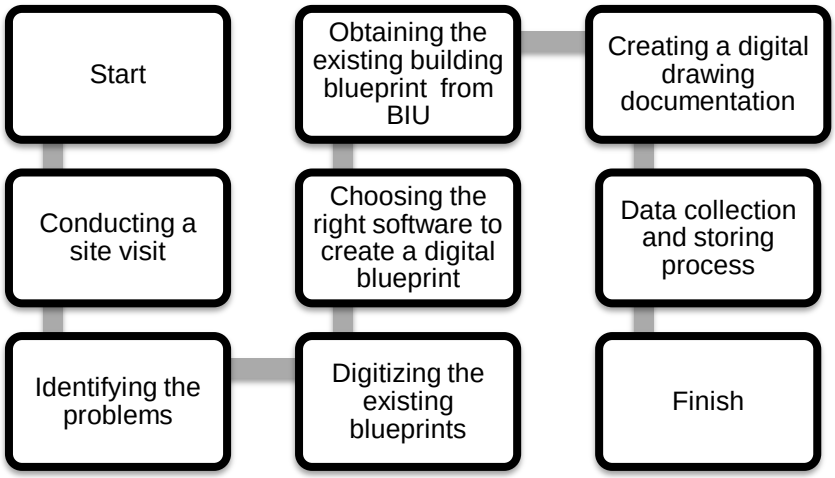


Figure 1: Flowchart of the process for digitizing architectural and structural drawings for DCE and AJH.

Figure 1, shows the flowchart of the process for the fieldwork study conducted on March 6, 2024, at the Building and Infrastructure Unit (BIU) facility. The process was carried out to assess the current condition of the existing blueprint for DCE and AJH buildings. After the study, it was revealed that the existing blueprints were worn, faded, poorly maintained, and stored in an unorganized manner. To address this issue, the solution was taken by initiated to digitize the original blueprints by adopting the Building Information Modelling (BIM) technology system. Before digitizing the blueprints, the appropriate software needs to be selected. The preferred software was Autodesk Revit. After all the blueprints were digitized, the documentation process was carried out and compiled all the data collections before obtaining the feedbacks from the stakeholder.

Phase 2: The Digitization Process of the JKA and DAJ Plans using Building Information Management (BIM) software, Autodesk Revit.

Before the digital plans can be produced in Portable Document File (PDF) format, two (2) types of drawings must first be created using an Autodesk Revit software: (1) architectural drawings and (2) structural drawings. Each type of drawing has specific steps that need to be followed. Once all the drawings are produced, the documentation process was continued to generate the blueprint into digital format.

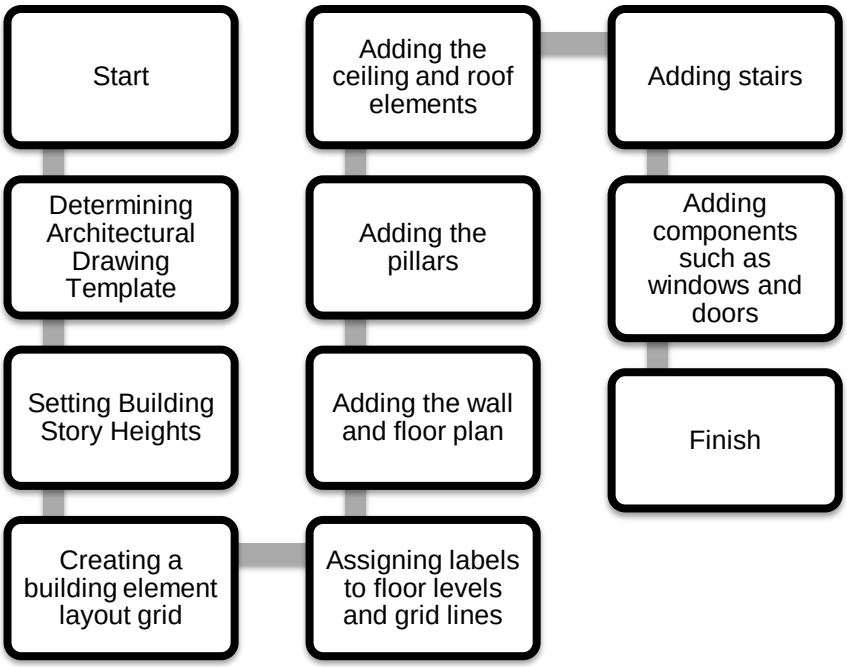


Figure 2: Flowchart of the process for creating digital architectural drawings using Autodesk Revit software.

Figure 2, shows the flowchart of the process for creating digital architectural drawings using Autodesk Revit software. There are six (6) main elements required to produce a complete an architectural drawing such as the grid, walls, floors, columns, ceilings, roofs,

stairs, and other components such as windows and doors. Furthermore, this template is an important element for determining the type and units of the architectural drawing to be produced.

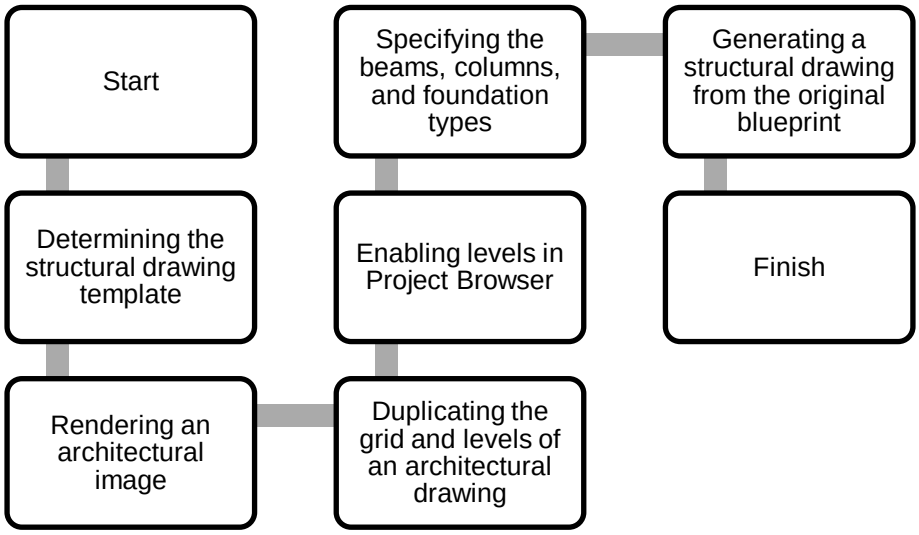


Figure 3: Flowchart of the process for creating digital structural drawings using Autodesk Revit software.

Figure 3, shows the flowchart of the process for creating digital structural drawings by using an Autodesk Revit software. The grid and level systems must be established from the architectural drawings before proceeded with the design of beams, columns, and foundation bases. The replication of the original grid and level systems from the architectural drawings is essential for the accurate positioning of beams, columns, and foundation bases, thus ensuring the integrity of the structural drawings.

Figure 4, shows the flowchart of the documentation process for architectural and structural digital drawings to produce the digital blueprint in a Portable Document File (PDF) format. The Title block serves as a standardized format for digital blueprints, ensuring clarity and accuracy through the inclusion of essential information like measurements and drawing perspective.

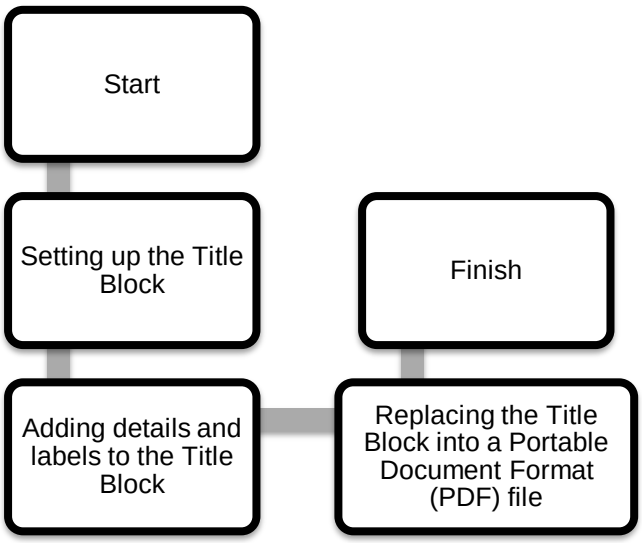


Figure 4: Flowchart of the process for documenting structural digital drawings using Autodesk Revit software.

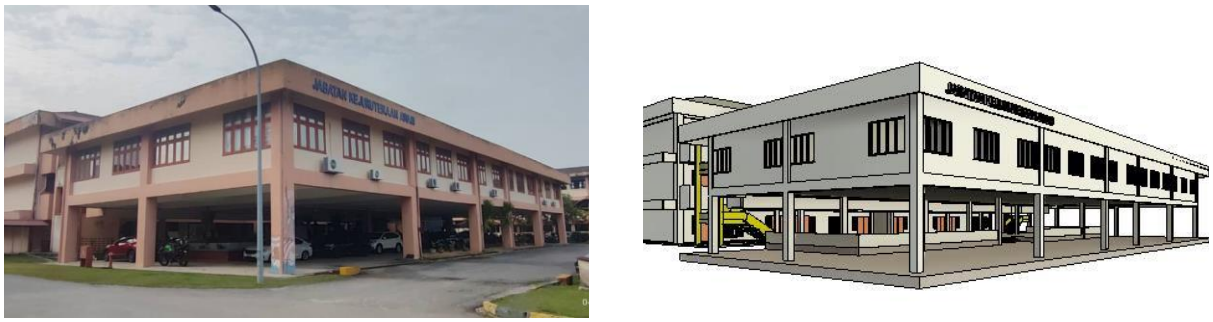
Interview Process with the Stakeholder

This interview process is the method used to gather the feedbacks regarding the implementation of this project. This process is necessary to identify the strengths and weaknesses of the digitized blueprints. The respondent involved in this interview process is Mr. Kasyfi Yahya, who is the Assistant Engineer at the Department of Civil Engineering (DCE). Twice interview process were conducted for collecting the feedbacks from him before and after the blueprints were digitized.

RESULT AND DISCUSSION

There are two types of blueprint that have been successfully digitized in this project: (1) digital architectural blueprint and (2) digital structural blueprint. The digital blueprints also can create an additional output, such as an emergency building blueprint and seating layout plan in AJH. However, there are still have a limitation with these digitized blueprints, such as not all measurements of elements in the digital plans correlate with the actual dimensions in the building, especially in the room area.

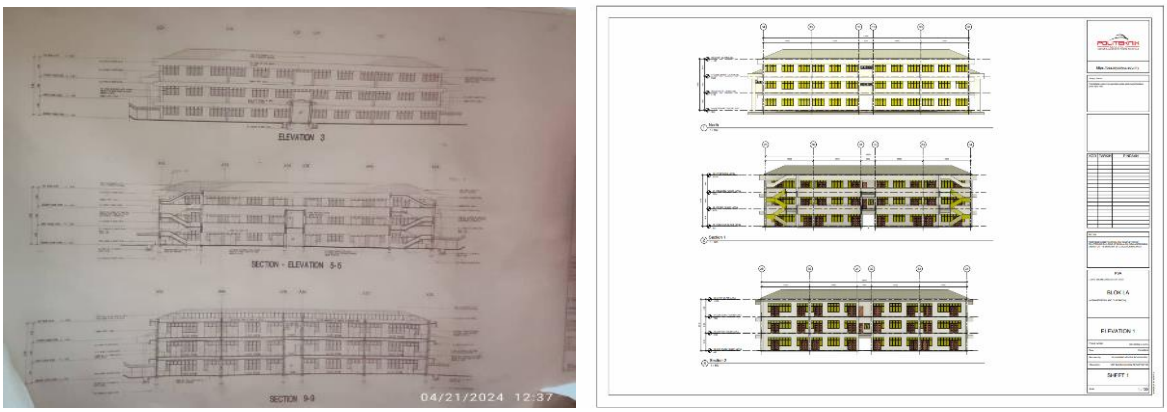
Digital Plan of the Department of Civil Engineering (DCE) Building



(a) (b)

Figure 6: (a) shows the actual LA Block, while (b) shows the digitized LA Block.

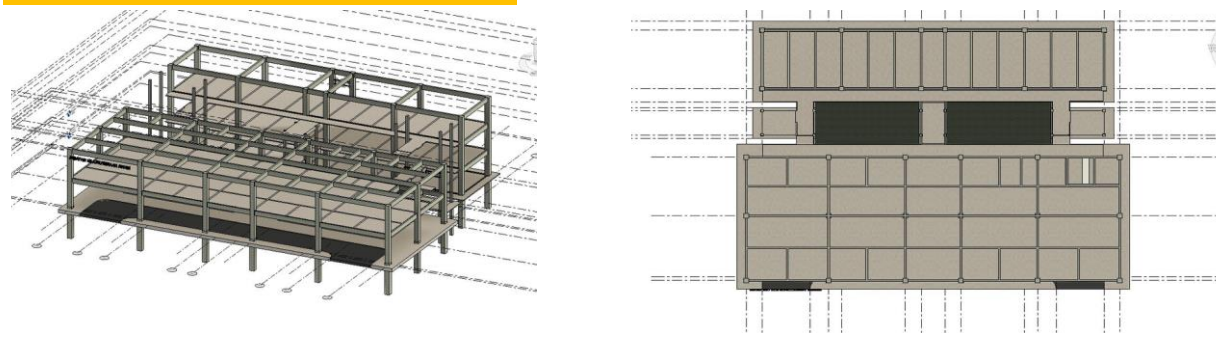
Figure 6 shows the difference between the actual LA Block at DCE (a) and the architectural drawing that has been digitized using Autodesk Revit software (b).



(a) (b)

Figure 7: (a) shows the original architectural plan, while (b) shows the digital architectural drawing of the LA block at DCE.

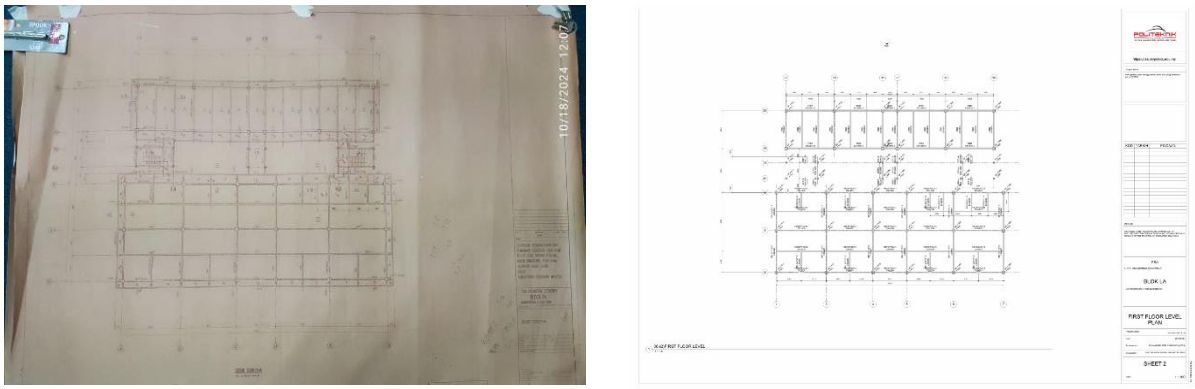
Figure 7 shows the difference between the original architectural plan of the LA Block (a) and the architectural plan that has been digitized using Autodesk Revit software (b).



(a) (b)

Figure 8: (a) shows the 3D view, while (b) shows the top view of the digital structural drawing of the LA Block at DCE.

Figure 8 shows the digital drawing of the LA block, which has two views: the 3D view (a) and the top view (b).



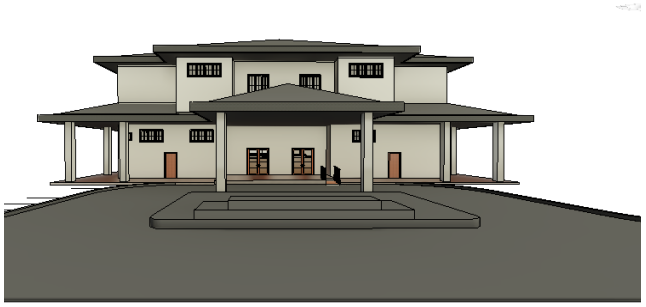
(a) (b)

Figure 9: (a) shows the original structural plan, while (b) shows the digital structural plan of the LA block at DCE

Figure 9 shows the difference between the original structural plan of the LA Block (a) and the structural plan that has been digitized using Autodesk Revit software (b).

Digital Plan of Al-Jazari Hall (AJH)

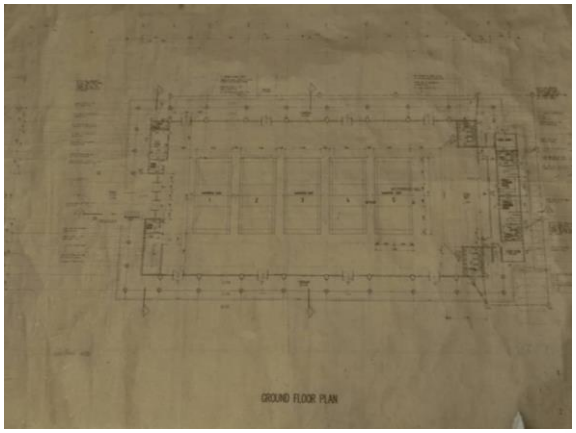
(a)

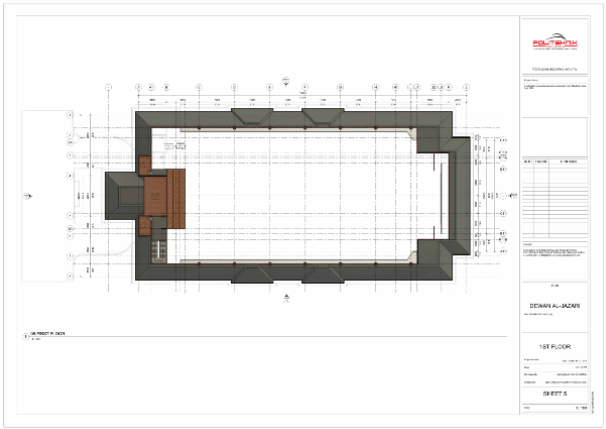


(b)

Figure 10: (a) shows the actual Al-Jazari Hall, while (b) shows the digitized Al-Jazari Hall.

Figure 10 shows the difference between the actual building of Al-Jazari Hall (a) and the architectural drawing that has been digitized using Autodesk Revit software (b).





(a) (b)

Figure 11: (a) shows the original architectural plan, while (b) shows the digital architectural plan of the Al-Jazari Hall block.

Figure 11 shows the difference between the original architectural plan of Al-Jazari Hall (a) and the architectural plan that has been digitized using Autodesk Revit software (b). Although the digital architectural and structural blueprints have been produced, they still facing an unavoidable issue, such as not all buildings having a complete original structural blueprint, particularly the LC block, where the size of the beams cannot be detected in the floor plans. Additionally, some buildings do not have an original structural blueprint, such as the LC and DAJ blocks. As a result, the digital structural blueprint could not be produced due to the lack of reference to the original building blueprints.

The original building design of components such as doors and windows from the existing building was not available in Autodesk Revit software. Therefore, all the components with similar appearances were used in the digital architectural drawings. However, to match it with the actual sizes, the significant amount of time was needed to design it into digital drawing.

Another issue is some of the buildings, such as the LC block, had been modified for new construction such as the addition of toilets for disable people and the reduction in the number of male restrooms. These changes were made without referred to the original blueprint. Therefore, an estimation of wall heights and toilet space dimensions could only be measured by using a measuring tape.

FEEDBACK FROM THE CIVIL ENGINEER OF THE BUILDING AND INFRASTRUCTURE UNIT (BIU)

Presentation to the stakeholder were done twice for collecting the feedbacks on digitization DCE and AJH blueprints at the office of Building and Infrastructure Unit (BIU) as shown in Figure 12.

(a) (b)

Figure 12: (a) shows the progress presentation of the plans that have been digitized, while (b) shows the presentation of all the blueprints that have been fully digitized.

The comments gained for this project where it will assist the BIU in planning maintenance schedule without the necessity of recurrent site visits, since the building design is now more unambiguous, as presented by the researcher team. It was also assisting them in enhancing the current case of the building, including the painting of walls and the establishment of new building environment. Furthermore, the storage of printed blueprints can be reduced by adopted these digital documents.

This project might also benefit from the inclusion of a roof area in the digital architectural drawings. This is due to the fact that the roof area generated might be can assist the Building and Infrastructure Unit (BIU) in ascertaining the real roof area of the buildings. The Assistant Engineer of the Department of Civil Engineering (DCE) has also recommended that the structure's attractiveness and appropriateness for the educational institution building category can be restored by simulating the original building colours in Autodesk Twin Motion software. This recommendation can be submitted to PSA's executive leadership to elevate the aesthetic appeal of the existing building structure.

CONCLUSIONS

In conclusion, this project successfully achieved the main objective, with all building blueprints for JKA and DAJ had successfully digitized in 2D and 3D drawings. All the digital blueprints have been compiled and stored in a single portable document format (PDF) file on a flash drive. The digital blueprints for DCE and AJH also can be accessible throughout QR codes to facilitate user access.

ACKNOWLEDGEMENT

An acknowledge is extended to all those involved in this project, namely Muhammad Alif Ismail, Muhammad Azim Mohd Amizul, Muhamad Hafizam Mazlan, Muhamad Azhad Haikal Badrol Akmam as an assistant researhers, Mr. Kasyfi Yahya, and Mr Mohamad Khirudin Amdan as a representive from Building and Infrastructure Unit (BIU), Politeknik Sultan Salahuddin Abdul Aziz Shah.

REFERENCE

Abanda, F. H., Mzyece, D., Oti, A. H. and Manjia, M. B., (2018), "A Study of the potential of cloud/mobile BIM for the management of construction projects", Applied System Innovation, Vol. 1, No. 2.

Azhar, S. (2011), Building Information Modelling (BIM): Trends, Benefits, Risks and Challenges for the AEC Industry, Leadership and Management in Engineering, Vol. 11, pp. 241–252.

Haron, N. A., Raja Soh, R. P. Z. A., & Harun, A. N. (2017). Implementation of Building Information Modelling (BIM) in Malaysia: A Review. *Pertanika Journal of Science & Technology*, *25*(3).

Kasim, N., Abidin, N. Z., Zainal, R., Sarpin, N., Abd Rahim, M. H. I., & Saikah, M. (2017). Best practices of Building Information Modelling (BIM) implementation in design phase for construction project. In *IOP Conference Series: Materials Science and Engineering* (Vol. 271, No. 1, p. 012038). IOP Publishing.

Latiffi, A. A., Mohd, S., Kasim, N., & Fathi, M. S. (2013). Building information modeling (BIM) application in Malaysian construction industry. *International Journal of Construction Engineering and Management*, *2*(4A), 1-6.

Lorek, S. A. R. A. H. (2018). What is BIM? (Building Information odeling). *Constructible: Construction Industry Resources*.

Malaysia, C. I. D. B. (2015). Construction Industry Transformation Programme 2016-2020. *CIDB: Kuala Lumpur, Malaysia*.

Davtalaba, O. and Delgadob, J. L., Benefits of 6D BIM for Facilities Management Departments for Construction Projects–A Case Study Approach, presented at the ISARC 2014, 2014.

Sacks, R., Koskela, L., Dave, B. A. and Owen, R. (2010). Interaction of lean and Building Information Modeling in construction, Journal of Construction Engineering and

Management, Vol. 136 No.9, pp. 968–980.

Sacks, R., Eastman, C., Lee, G., & Teicholz, P. (2018). *BIM Handbook: A Guide to Building Information Modelling for Owners, Designers, Engineers, Contractors, and Facility Managers*. John Wiley & Sons.

Wang, C. C., & Chien, O. (2014). *The Use of BIM In Project Planning and Scheduling in The Australian Construction Industry*. In *ICCREM 2014: Smart Construction and Management in the Context of New Technology* (pp. 126-133).