Integration of BIM and Archibus for Facility Management (FM) in FKAAS, UTHM Building

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Abstract. Building Information Modelling (BIM) can play a great role in improving the operation and maintenance (O&M) of building and facility management (FM) through the use of construction technology. BIM can be implemented in design, construction and facility management which provide a digital database of information management that can be easily shared between stakeholders. However, the use of BIM in O&M for FM is still limited in Malaysian construction. The aim of this study is to explore the integration of using BIM tools and FM software for space management as the primary key to facility management. FKAAS building located in UTHM has been used as the case study for this research. The main objective is to develop a 3D BIM model by using Revit Autodesk and integrate into ARCHIBUS software to manage spaces based on Sistem Kod Aset Tak Alih Kerajaan (SKATA). As a result, the data of the building can be used by the facility management to manage the building spaces in a more efficient way and enhance the building performance in future. This result can help the facility management of FKAAS building to manage spaces, space inventory and better performance and maintenance for FKAAS and other UTHM Buildings.

1. Introduction
Building Information Modelling (BIM) is the best collector for data and a great database for information management in Architecture, Engineering and Construction (AEC) as well as for operation stage (O) which can be used for maintenance (M) and facility management (FM) [1]. BIM helps the stakeholders to interchange the data and information of building construction throughout the building lifecycle [2], [3]. BIM has a strong benefit in O&M and better facility management [4], such as space management [5], energy efficiencies [6-7], security and safety management [8]. The potential of BIM is providing real value to the owner and facility manager by presenting a massive database to capture information from a virtual model for the facility management [9].

The FM industry is still having difficulty to adopt the new technology but BIM has proven the benefits to FM and the lifecycle of building [10]. Information and Data gathered by BIM user throughout the building lifecycle decreased the limitation of time and cost to build FM systems [11]. For example, space management could be modeled in digital format within a BIM model and transferred to FM systems without recreating the management data system [12]. There are not much cases of implementing BIM applications in FM [13]. This paper examines the integration of BIM in FM for space management.
using ARCHIBUS software and a real case study of one building in Universiti Tun Hussein Onn Malaysia (UTHM) in Batu Pahat main campus.

1.1. BIM for Space Management

Space management is leading the facility management with asset management for both private or public sectors [14]. The Malaysian government is conducting in house team to be a department which is has the responsibility to manage assets within the organization [15]. BIM has a great performance during facility management for spaces that have specific requirements related to maintainability and occupancy of spaces and this must be considered at an earlier stage of the project lifecycle [16]. A BIM-based FM system could be grateful for quest spaces since it can calculate the area of each space [17], the use of BIM for space management for example, could be used to check exchanging data such as measuring space area and room location also occupant information [18], which can help the Facility Manager to do the inventory space and get more efficient of building property once they refer to BIM model [19-20].

1.2. ARCHIBUS for Space Management

ARCHIBUS was designed to integrate workplace management for real estate, infrastructure and facilities management to define the needs of multiple functions and departments in an organization [21]. ARCHIBUS software uses a web central based application to address, check, monitor and simple access to the system using an internet browser [22]. ARCHIBUS Space Inventory provides an integrated Web central and mobile application in managing and viewing an organization’s different types of space (such as Rooms, Division boundaries, service areas, and common areas, etc.) to ensure identification of space with great efficiency. With ARCHIBUS software, facility managers obtain a plan for greater space efficiency by locating the building, division, zones, and departments to get opportunities for the organization [23]. ARCHIBUS application allows users to self-service report for effective space allocation, use more spaces efficiently and prepare a survey to adjust spaces location in real-time [24].

ARCHIBUS is one of the FM leading software packages that are able to link with Microsoft Office, AutoCAD and BIM tools such as Revit with its ability to link to ARCHIBUS for FM based on graphical information and model geometry [25]. The ARCHIBUS for Revit with small extension plugin loads into Revit and it will connect a Revit model immediately to the ARCHIBUS enterprise database whenever it uses Web Services [26]. The facility managers can easily access and manage facilities’ information and processes with Revit data and graphical components to improve space management posture as it is the aim of this study to use BIM tools with ARCHIBUS for space management.

2. Methodology

The research objective of this study is to use BIM tools and ARCHIBUS software for facility management and space management as the main aim to evaluate the integration of BIM and facility management. The value of BIM has been tested using FKAAS building as a case study with authoring BIM tools and FM software. FKAAS is a new building and the biggest building in UTHM which has many buildings nearby but there are still issues to manage the spaces in this university.

The data process was prepared by obtaining the complete plan of FKAAS which was the first step from AutoCAD. This plan was obtained from Pejabat Pembangunan Hartabina (PPH) after the approval issued by the relevant party and this plan cannot be disseminated by other parties because it is apprehensive that it might be misused. The plan was in the .dwg format and can be opened via AutoCAD software.

Incorporation with Microcorp Sdn. Bhd., the FKAAS building was modelled by using BIM Autodesk (REVIT) software by developing a 3D model. The data space code to the model database used Excel file base on SKATA code that is used by the facility management in Malaysia. A system named MySPATA developed this code to assist the management in reporting, monitoring and controlling government buildings by an established system known as SKATA. It was introduced to achieve standardization coding to all government assets including Malaysian public universities [15]. Figure 1 showed the integration process for BIM and ARCHIBUS for space management in FKAAS building. The process is to develop the 3D BIM model from CAD drawing then update all the necessary and
required data for FM in the BIM model for space management. The required data for space management must be accurate and base on SKATA code which could be imported to the BIM model from an Excel file. The final process is to verify BIM model data by using smart client and also to edit and update any unsatisfied data for facility management in ARCHIBUS software for space management.

![Integration Process of BIM and ARCHIBUS for Space Management](image)

**Figure 1.** The Integration Process of BIM and ARCHIBUS for Space Management.

The integration of BIM tools and FM was using ARCHIBUS software for space management with CAD drawings by implementing ARCHIBUS Extension for Revit to FKAAS building which uses a web database based application that allows quick and simple access to the FKAAS spaces by using internet browser for facility management.

While ARCHIBUS Space management could applicant space performance base on SKATA code, it can also be integrated with other ARCHIBUS applications to perform better workplace service functions. The reason for using ARCHIBUS in this study was that it allows users to take advantage of purpose-built facilities management tools to deliver the results needed to support the organizational mission. With one click, users can connect an entire Revit model to space management data and manage BIM spaces immediately.

The Space code system (SKATA) can be explained by the code or label used to differentiate each existing space within each area in the building according to the level, position, type, category and function of the space. Document of *Kod Fungsi Mengikut Ruang* (Code of Space Function) was an additional reference document and should be used in juxtaposition with the Guidelines of Immovable Property and Data Collection (Data) when carrying out data collection activities of the Special Asset Register (Space) [27].

The document was used as a guide in determining the function of the space available in the building or outside the building. For the purpose of simplifying the classification of area, the structure and hierarchy of function space defined by Type of Space followed Category of Space and Function of Space. The Type of space (Level 1) describes the general characteristic (feature) space according to use and divided into 11 major types as shown in Table 1. Category of space (level 2) was a further breakdown of the type of space that explains the special features of that space and the Function of spaces (Level 3) refers to special functions defined on the space after selecting a room type and room category [27].
Table 1. Space Code System [27].

| LEVELS | LEVEL 1 | LEVEL 2 | LEVEL 3 |
|--------|---------|---------|---------|
| No     | Type of Space | Code | Category of Space | Function of Space |
| 1      | Cultural/Religious | A | A | Meeting |
| 2      | Circulation     | C | C | |
| 3      | Facility Service | F | F | |
| 4      | Care/Treatment  | H | H | |
| 5      | Protection/Prohibition | L | L | Meeting |
| 6      | Business        | N | N | |
| 7      | Interaction     | P | P | |
| 8      | Lounge/Accommodation | Q | Q | Lecture Room |
| 9      | Recreation      | R | R | Meeting Room |
| 10     | Storage         | S | S | Briefing Room |
| 11     | Special         | W | W | |

3. Development of BIM Model for FKAAS

FKAAS Building is located at UTHM in Batu Pahat, Johor, Malaysia. It is the Faculty of Civil and Environmental Engineering building and has two towers (North and South) with six and nine floors and mezzanine between MA, MB, and MC buildings with three floors each with a total area of over 30,755 m² and 840 spaces as showing in Figure 2.

![Figure 2. Room Revit Schedule for FKAAS.](image)
Developers have used floor plans in .dwg format to construct the building and space information in Excel databases to manage the building. As the case study classifies as an existing building so there were some challenges in the application of BIM for FM in modeling the building by BIM Tools such as Revit to integrate it with ARCHIBUS V24 software. Figure 3 shows the 3D model for FKAAS in Revit software version 2018.

![Figure 3. The 3D Model View in Revit for FKAAS.](image)

4. Result Discussion

In this study it links BIM model with ARCHIBUS because of its great function to manage a huge data of BIM data, the Smart Client Extension for Revit could easily link to many of the most popular ARCHIBUS applications which can be seen in Figure 4 showing FKAAS model in ARCHIBUS web with the same total area 30,755 m² and room number total 840 rooms.

![Figure 4. The 3D View in ARCHIBUS for FKAAS.](image)

The application of Smart Client Extension can use the data and results from Revit without delay, translation or rework the entry in any of those applications. So the users can achieve immediate results with:
i. Space inventory and performance: providing a merged inventory, with different space across the buildings and lines of business, important indicators, and an accurate view of building and occupancy

ii. Personnel and occupancy: tracking vacancies, pursuing professional planning, tracking trends and performance

iii. Management of movements: managing individual and group movements using a systematic workflow.

The Building Performance process by ARCHIBUS in FKAAS building is the starting point of space inventory. The floor plan drawings and outline of the areas on floor plans that are not available for occupancy or general use; that is to say, the vertical penetration areas (elevator shafts, stairs, pipe shafts) and the service areas (restrooms, lobbies, mechanical rooms) can be seen in this process. Once these areas are defined, the areas of the floor can be occupied by rooms, departments and staffs are known.

This method uses the plug-in for syncing two systems and could automatically update the ARCHIBUS area which can easily define the room category and types base on SKATA code in 2D and 3D view as shown in Figure 5 and 6.

ARCHIBUS can show FKAAS building in 2D View and 3D view by 3D Navigator which will help the facility manager to see a better view of building for rooms and spaces and they can also filter the building for 1 room base on floor code and room code. This study could navigate the FKAAS building in 3D view and see all the floors and room by room types and categories as shown in Figure 6. This figure shows the Ground Level (GL) of FKAAS that has different room types in different colours.
After the 3D model of FKAAS building was completed, information and data that can identify the code of the space according to its type, category, and function for all the spaces in FKAAS building could be key-in in ARCHIBUS system for each floor. The key-in information and data could also define the different colours for each room type and categories as shown in Figure 7 which shows the colour for room types in 3D view for FKAAS building.

In addition, ARCHIBUS could also present the information on how rooms are assigned to departments and-how space on a floor is used: does it personnel, laboratory, stairs, mechanical closets, circulation area, restrooms, lobby, or other areas. In ARCHIBUS, room categories indicate how the room is used. For example, a room might be assigned in a category of Circulation Area, Mechanical Closet, or Personnel as shown in Figure 7. So that it can further classify how a room is used and room categories can be divided into room types. For example, the Circulation Area room category can be classified into room types of Lobby, Egress, and Primary Circulation.

The ARCHIBUS space planning management could be used by FKAAS facility manager to create space inventory report on each floor’s vertical penetration areas (stairways and elevator shafts), service areas (bathrooms, hallways, and closets), departmental boundaries, rooms, and the common areas used by multiple departments (cafeterias, libraries, and conference rooms). It also can be used to graphically represent furniture, equipment, or maintenance of work locations.
As a conclusion, ARCHIBUS can clearly help to manage all the spaces in FKAAS building with a list of each room category and type in FKAAS building with total rooms and areas of each room type and category. ARCHIBUS system could also define the total of usable area, remaining area, service area and gross area with efficiency rate for the whole area in FKAAS building.

5. Conclusion
In conclusion, the integration of BIM and ARCHIBUS helps the facility manager to increase the efficiency of spaces by using BIM tools and web databases for FKAAS, UTHM, where the aim of this study that was to manage spaces by using SKATA code. The data code of this space was used to deliver information on the management of facilities regarding the types, categories, and functions of the space within the FKAAS building.

ARCHIBUS application and the user can obtain space efficiency by arranging departments and identifying opportunities with the organization. The development of BIM Model for FKAAS gives basic underlying facility information in the web environment and then BIM specialists can use the ARCHIBUS solution to develop floor plan and layout for each floor's gross areas, service areas, vertical penetration areas and departmental areas (at various levels of detail). With this information developed in the floor plan drawings and written to the database, web users can-update the-necessary data and fill in other details. It also can access a variety of reports and analyze the reports including the floor plan drawings to assess how space is used at the site.

From this study, space managers can take advantage of the workspace transaction features to document how space usage changes over time, analyze building performance and efficiency, identify major cost-saving opportunities and recover unused space. It also provides users with access to self-service and releases of space, individual moves, and group moves, ensures that space is allocated according to established policy and corporate strategy, which is enforced by a Web-based workflow and control and manage space allocation requests. This application of ARCHIBUS in FKAAS building gives a great plan for future needs and supports constantly changing demands for space.

6. References

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