

# **BIM Implementation in Malaysia: A Case Study in Department of Survey and Mapping Malaysia**

**Mohd Noor ISA, Siti Nurbaiduri MOHD YUSOF and Sarah SHAHARUDDIN, Malaysia**

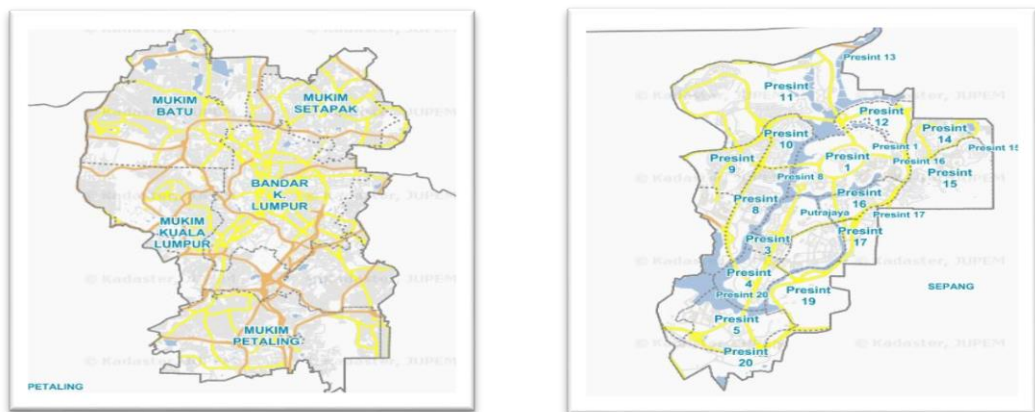
**Key words:** DSMM, BIM, SmartKADASTER

## **SUMMARY**

The Department of Survey and Mapping Malaysia (DSMM) is the sole government organisation responsible for providing high quality survey and mapping products and services to the government, business, public and individual for the purpose of national development. The advent of technology has changed the landscape of how DSMM running its' businesses. Modernisation took place and better services are anticipated through the implementation of automation. On that note, JUPEM has incorporated Building Information Modelling (BIM) in one of its digital delivery system known as SmartKADASTER. BIM can be considered as one of the most intriguing opportunity for surveyors. According to US National Building Information Model Standard Project Committee, BIM is a digital representation of physical and functional characteristics of a facility. The BIM dimension offers in SmartKADASTER is 3D Model where users are capable of experiencing walk through, visualisation, virtual modelling and prefabrication. This paper provides an insight on how DSMM has gone further afield with the fulfilment of BIM and thorough explanation on the method, software and interface used to accomplish it.

## 1. INTRODUCTION

As the key agency in conducting Survey and Mapping, it seems inevitable for DSMM for not to adapt to the emergence of technology. The evolution of technology has played a significant role in changing the way DSMM running its survey activities. DSMM has embarked in implementing Building Information Modelling (BIM) through one of its project called SmartKADASTER. The project was successfully developed under the Malaysia's 10<sup>th</sup> Development Plan (RMKe-10) for Federal Territory (FT) of Kuala Lumpur and Putrajaya (see **Figure 1**).



**Figure 1:** FT of Kuala Lumpur and Putrajaya

Both FT Kuala Lumpur and Putrajaya were chosen due to the fact that it acts as the capital and commercial heart of Malaysia and central hub for many economic activities while the latter is referred as a federal Government administrative centre. The fundamental purpose of SmartKADASTER is to establish a spatial analysis platform using multi-purpose cadastral information as the foundation.

The BIM element in this project was conducted using laser scanning method. It employed Scan to BIM method by turning point clouds into detailed modelling. The Terrestrial Laser Scanning (TLS) approach is used as it has strong ties to spatial information and it can assist in detail out or visualise building in 2D and 3D perspective. **Figure 2** shows the TLS workflow involved in this project.

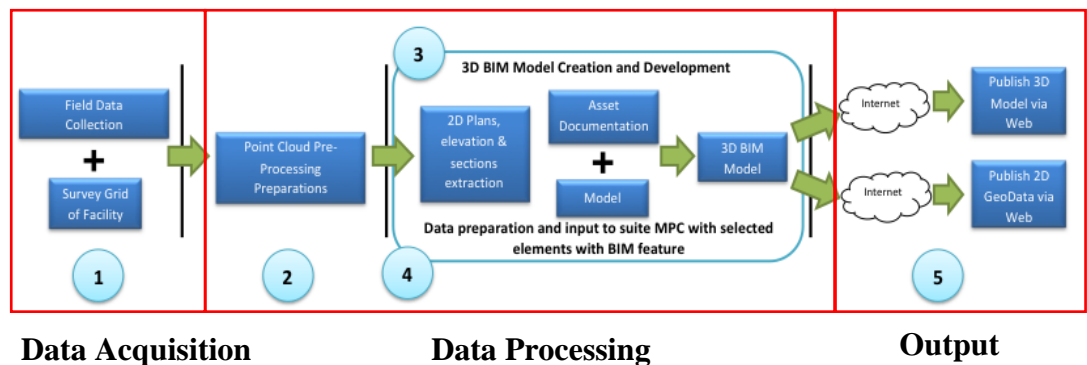


Figure 2: TLS workflow

## 2. BIM

As stated by US National Building Information Model Standard Project Committee, BIM is a digital representation of physical and functional characteristics of a facility. The cycle starts with planning and design phase, followed by modelling and subsequently building the model and eventually the maintenance phase. It is called a rich model because all objects in it have properties and relationships and this information can be used to develop simulations.

The perception and use of BIM varies with the needs of each project's stakeholders. DSMM has decided to venture into BIM as part of SmartKADASTER to fulfil 3D-Model and 7D-Facility Management Applications in BIM Dimensions. Apart from that, the information of the building can be easily shared, value added and reused.

BIM is also seen to be moving beyond the scene of traditional building construction. Majority of the stakeholders foresee the virtue in utilising BIM. The key benefit of implementing BIM are as follows:

- i. Better design – building information could be rigorously analysed, quickly and performance benchmarked, enabling improved and innovative solution;
- ii. Controlled whole life costs and environmental data – environmental performance is more predictable; lifecycle costs are understood;
- iii. Better production quality – documentation output is flexible and exploits automation;
- iv. Better customer service – understood through accurate visualisation
- v. Lifecycle data – requirements, design, construction and operational

information can be used for:

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- vi. Integration of planning and implementation process – government, industry and manufacturers have a common data protocol; and
- vii. More effective and competitive industry and long term sustainable regeneration projects.

### 3. THE METHODOLOGY

In this project, there. As highlighted earlier, this project conformed with the 3D-Model BIM Dimensions namely walk through, visualisation and virtual modelling. BIM was developed for five (5) DSMM official building comprises of *Wisma JUPEM*, *Bangunan Ukur*, *Bangunan Computer Aided Management System (CAMS)*, *Dewan Ukur* and DSMM’s Compound Area. In order to create the 3D BIM model effective from point cloud, a set of 3D BIM modelling guidelines, workflow, processes and procedures need to be structured and established. The process and workflow for the preparation of the data from point cloud to initiate the conversion of 3D BIM model development and the establishment of 3D BIM model was executed in the most expedient and efficient manner. The implementation of scan to 3D BIM development model encompasses of:

- i. Site reconnaissance and scanning (See **Figure 3**);



**Figure 3:** Site reconnaissance and scanning

- ii. Registration and texture mapping (See **Figure 4**);



**Figure 4:** Registration and texture mapping

- iii. Primitive modelling (See **Figure 5**);



**Figure 5:** Primitive modelling

- iv. Parametric modelling (See **Figure 6**); and



**Figure 6:** Parametric modelling

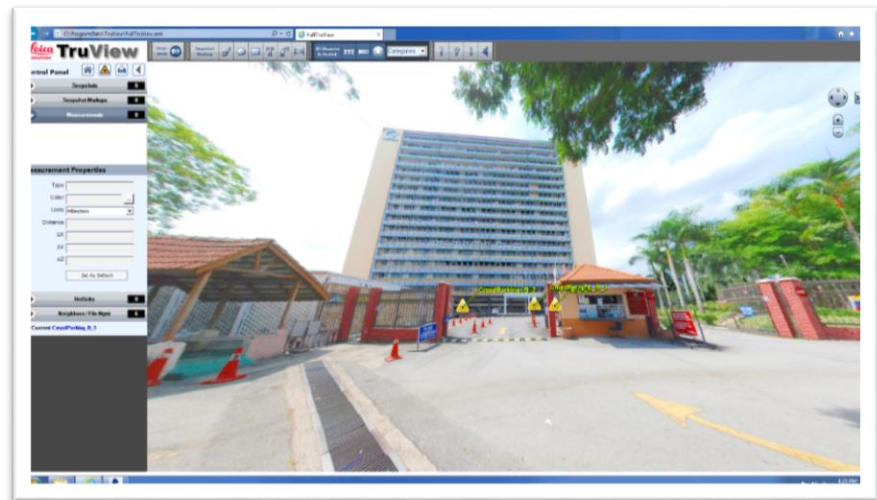
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- v. Publish on the web – SKiP Walkthrough (See **Figure 7**)

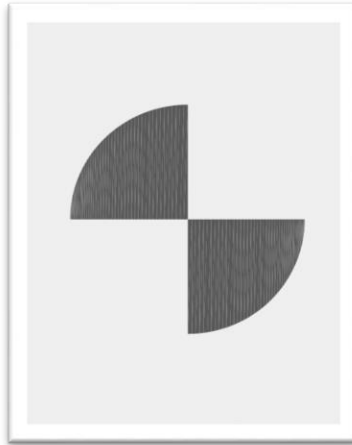


**Figure 7:** SKiP Walkthrough

### 3.1. Site Reconnaissance and Scanning

Site reconnaissance must be conducted prior to site scanning. During the site reconnaissance, there are some procedure must be taken into accounts which are:

- i. Site scanning works is estimated based on project requirement. A typical building scanning could be based on 5 x 5 or even 3 x 3 metre grid. The bigger the grid, lesser scan location being setup, likewise the smaller grid would require more scan position to be placed and position;
- ii. Observe the placement of A4 Black & White (B&W) target (See **Figure 8**). This B&W target shall be placed with a good line of sight to the scanner position whereby during the scanning process, the target would be captured as per scan location;



**Figure 8:** B&W target

- iii. These target will be recorded in each scan location and used to adjoin the neighbouring scan (See **Figure 9**). Therefore, the B&W targets were placed evenly to ensure good distribution when it came to registration of scan process;



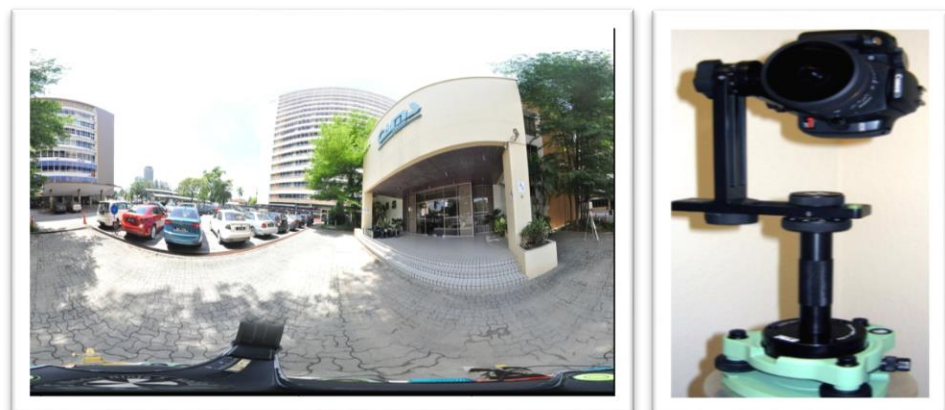
**Figure 9:** Scanner and clear line of sight to capture all target

- iv. To perform Scan to BIM procedure, Leica ScanStation C10 equipment was being used to scan five (5) buildings in DSMM (See **Figure 10**). Multiple scan locations will be placed appropriately at selected location to observe a complete building including interior and exterior of the buildings. Each scan station took approximately 3 to 6 minute to complete;



**Figure 10:** Leica ScanStation C10

- v. After scan were completed, the same scan position will capture 360-degree panoramic image using Digital Single Lens Reflect (DSLR) camera where the camera will be mounted with a fish eye lens and a panoramic kit (See **Figure 11**). Next, all the scanned point cloud and panoramic images will be stored each in the Leica 10 and DSLR internal storage. Therefore, to ensure the point cloud and images can be mapped together the registration and texture mapping shall be carried out; and



**Figure 11:** Digital Single Lens Reflect (DSLR) camera were mounted with a fish eye lens and a panoramic kit



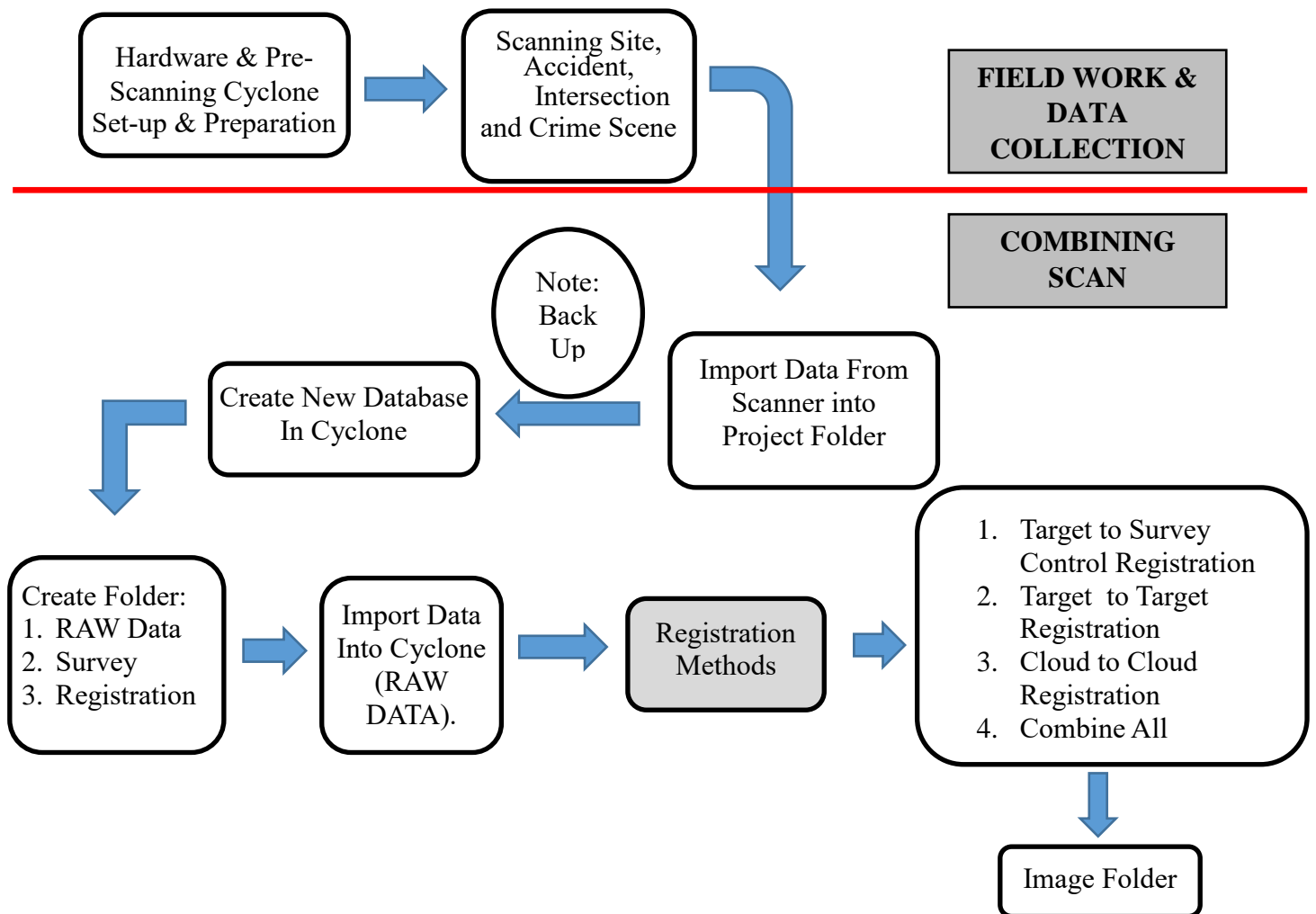
- vi. All scanned point cloud and images need to be tied up with known coordinate on the ground to certify so that the 3D Building Model will be in accurate position as per real world. Static Global Positioning System (GPS) observations was conducted referring to *Pekeliling Ketua Pengarah Ukur Dan Pemetaan Bil. 9/2005* (Chief Director General of Survey and Mapping No.9/2005 Circular) Three (3) reference GPS marks will be observed and Geocentric Datum of Malaysia 2000 Rectified Skew Orthomorphic (GDM2000 RSO) coordinate will be computed and transferred to each of the building. Static GPS observations must be performed next to the nearest building. Prior of using these sets coordinate for aligning the building coordinate, all GPS point need to perform traversing (tied up) to the nearest boundary stone. Having used two points that set as back station and occupied station, this will ensure the observed GPS point were in correct manner in compare to boundary stone.

### **3.2. Registration and Texture Mapping**

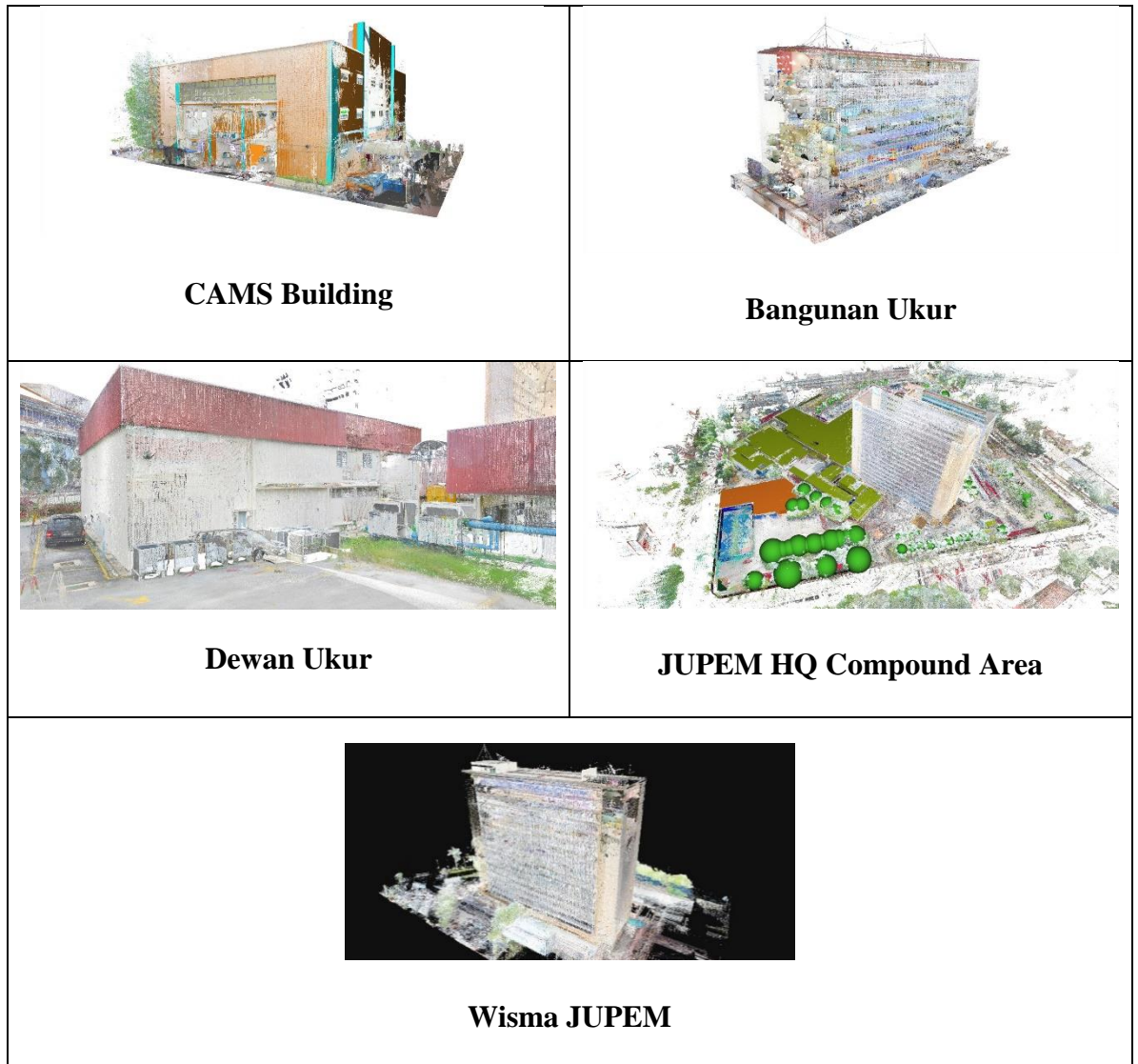
The scanned point cloud and images that being stored in the internal storage will be downloaded to the processing desktop computer for registration and texture mapping purposes. Raw files will be imported into point cloud pre-processing software known as Leica Cyclone REGISTER where one project file will be created to store all scan location. All scan location will be merge into a single working environment or database. This database is in \*.imp format. Common registration process will be performed using one or more of the following method which are:

- i. Survey + Target;
- ii. Target + Target;
- iii. Cloud to Cloud registration; and
- iv. Utilized Modelling registration.

Workflow of registration and texture mapping is illustrated as **Figure 12** and **Figure 13** portrays DSMM buildings that have been processed via registration and texture mapping procedure.



**Figure 12:** Workflow of registration and texture mapping



**Figure 13:** Registered Point cloud

### **3.3. Primitive Modelling**

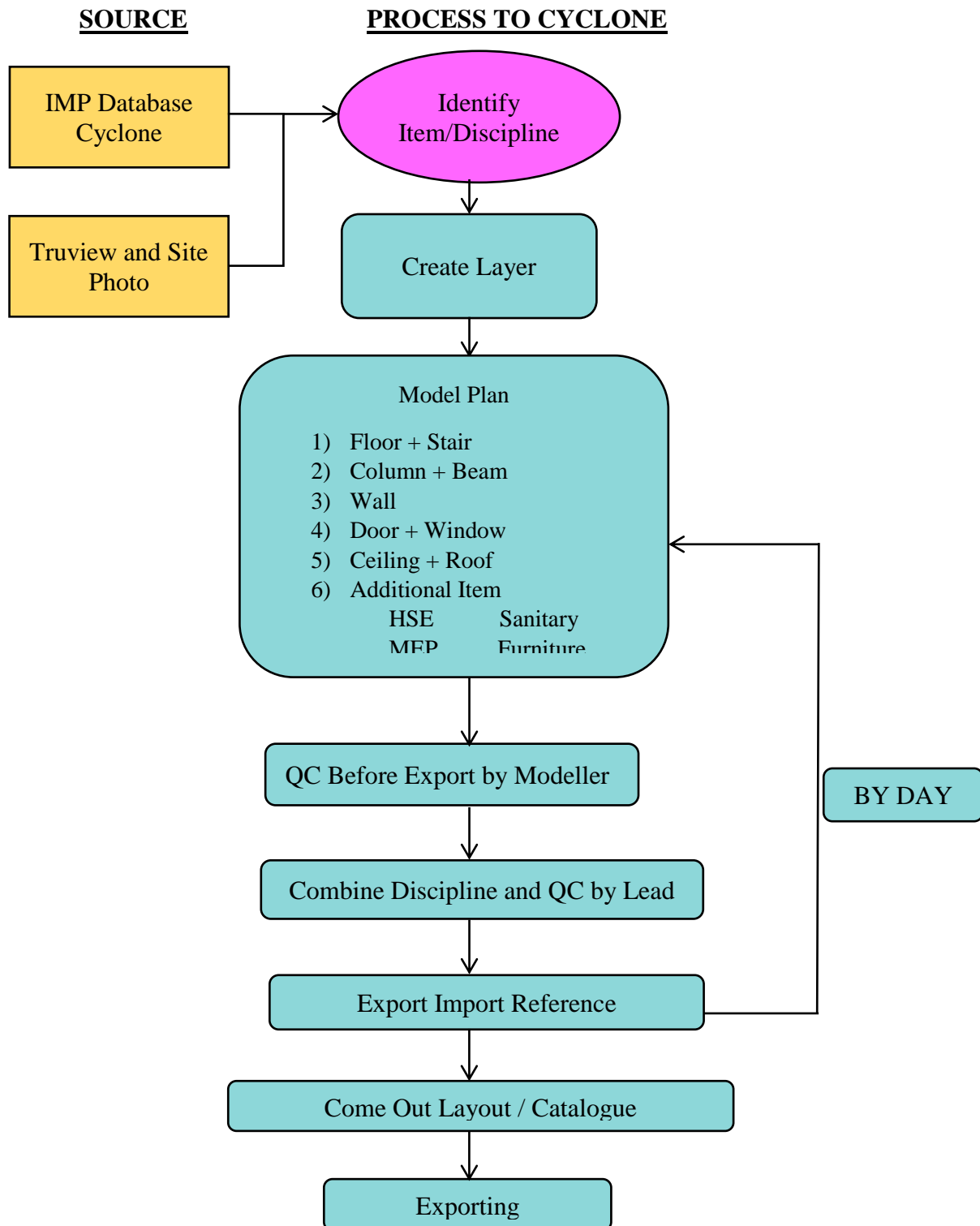
Primitive modelling is a process to develop 3D building model using registered data. This process was achieved using Leica Cyclone Model and it was used because of its stability and is capable of handling large point cloud data set as exhibit in Figure 14. Leica Cyclone Model possesses feature and function that utilised full point cloud information in modelling the real world. A basic shape such as square, rectangle, cylinder, patching with thickness was utilised to create the real world environment. Basic principle uses as follows:

- i. A full exterior and interior detail 3D model;
- ii. 3D Modelling for all floors and rooms, and

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- iii. Modelling shall discipline comprised of Architecture, Mechanical Electrical Plumbing (MEP) and Structure (where visible and not hidden over false ceiling).



**Figure 14:** Workflow of primitive modelling

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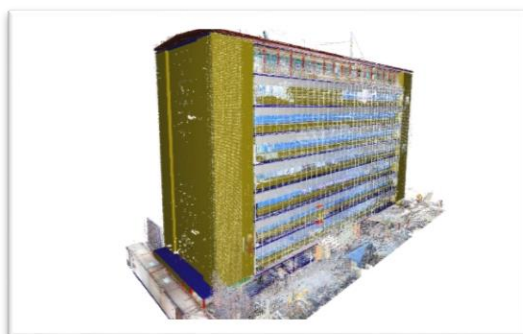
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The primitive modelling that have been classified into specific layer will be exported to CAD format (\*.dxf) which later will be used to develop 3D BIM parametric modelling. **Figure 15** shows an example of layers that will be exported to CAD.

Surf. Name	Color	Linetype	Lineweig...	Trans...
0	wh...	Continu...	Defa...	0
CAM_AIRCOND	254	Continu...	Defa...	0
CAM_AWAING	254	Continu...	Defa...	0
CAM_BEAM	172	Continu...	Defa...	0
CAM_BOWL	254	Continu...	Defa...	0
CAM_C_220X230	cyan	Continu...	Defa...	0
CAM_C_290X850	cyan	Continu...	Defa...	0
CAM_C_340X790	cyan	Continu...	Defa...	0
CAM_C_350X800	cyan	Continu...	Defa...	0
CAM_C_360X920	cyan	Continu...	Defa...	0
CAM_C_405X1316	cyan	Continu...	Defa...	0
CAM_C_410X385	cyan	Continu...	Defa...	0
CAM_C_450X740	cyan	Continu...	Defa...	0
CAM_C_455X700	cyan	Continu...	Defa...	0
CAM_C_490X520	cyan	Continu...	Defa...	0
CAM_C_520X530	cyan	Continu...	Defa...	0
CAM_C_520X590	cyan	Continu...	Defa...	0
CAM_C_520X930	cyan	Continu...	Defa...	0
CAM_C_525X430	cyan	Continu...	Defa...	0
CAM_C_525X525	cyan	Continu...	Defa...	0
CAM_C_530X520	cyan	Continu...	Defa...	0
CAM_C_550X340	cyan	Continu...	Defa...	0
CAM_C_610X680	cyan	Continu...	Defa...	0
CAM_C_615X730	cyan	Continu...	Defa...	0
CAM_C_625X865	cyan	Continu...	Defa...	0
CAM_C_630X635	cyan	Continu...	Defa...	0
CAM_C_645X870	cyan	Continu...	Defa...	0
CAM_C_705X640	cyan	Continu...	Defa...	0
CAM_C_720X740	cyan	Continu...	Defa...	0
CAM_C_730X780	cyan	Continu...	Defa...	0
CAM_C_1370X1060	cyan	Continu...	Defa...	0
CAM_CABINET	148	Continu...	Defa...	0
CAM_CCTV	red	Continu...	Defa...	0
CAM_CEILING	175	Continu...	Defa...	0
CAM_CHAIR	254	Continu...	Defa...	0
CAM_CLOCK	254	Continu...	Defa...	0
CAM_COMPRESSER	132	Continu...	Defa...	0
CAM_COMPUTER	yel...	Continu...	Defa...	0
CAM_CONDENSER	254	Continu...	Defa...	0
CAM_CROSS_VEBNTI	red	Continu...	Defa...	0
CAM_D1	248	Continu...	Defa...	0

**Figure 15:** Primitive Model in CAD layers

**Figure 16** shows conclude primitive modelling for *Bangunan Ukur* and *Dewan Ukur*.



**Bangunan Ukur**



**Dewan Ukur**

**Figure 16:** Primitive Modelling

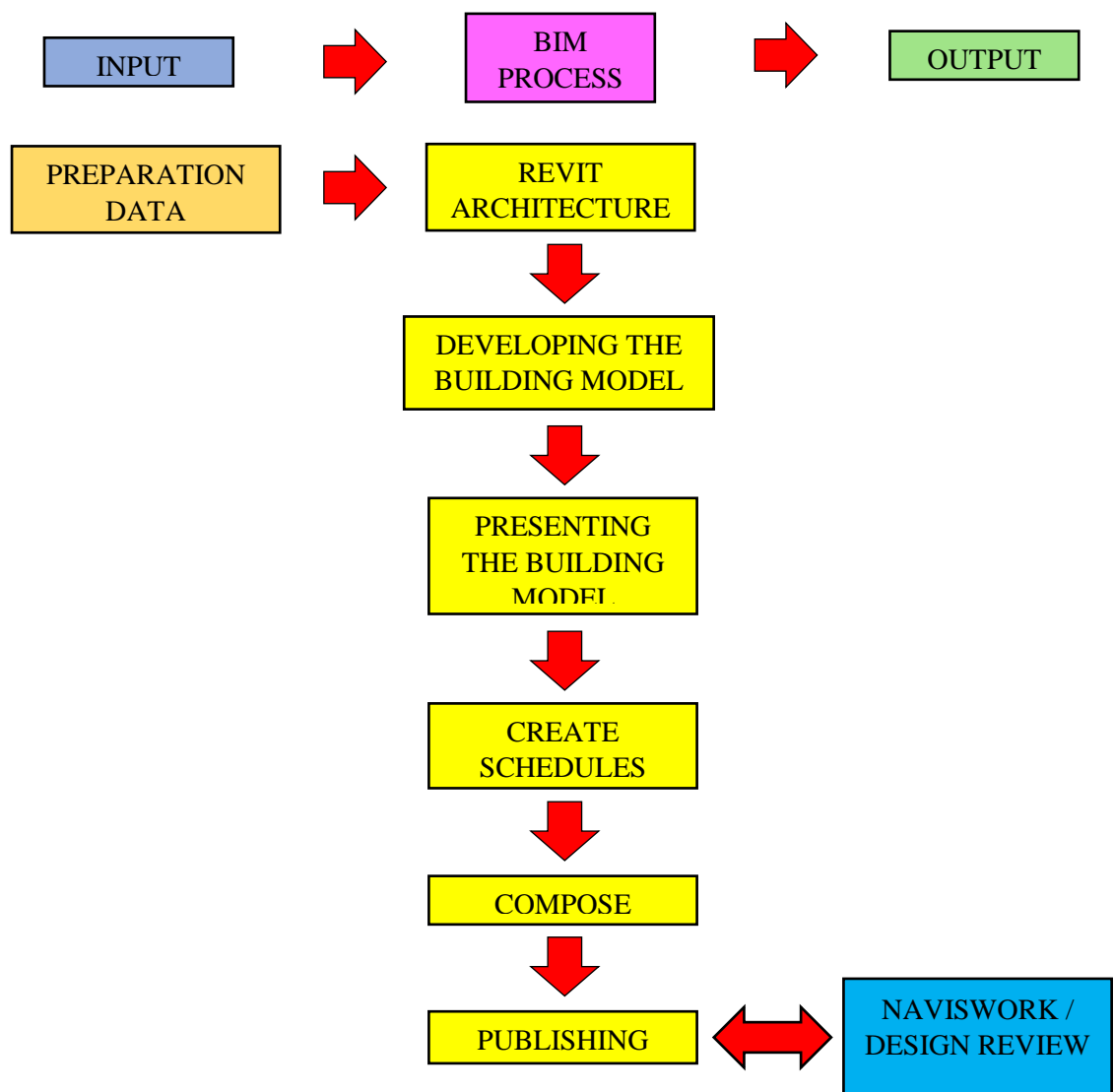
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### 3.4. Parametric Modelling

In preparing as built detail to Level of Detail (LOD) 4, the conversion of point cloud to 3D parametric model framework has been defined up to LOD 200 in BIM parametric context. Autodesk Revit was used to produce the 3D parametric modelling. The reference framework of coding structure was referring to **SPATA** that has been developed the BIM Facility Management Committee in Malaysia. This was the closest framework could be adopted until Malaysia very own BIM Guideline and Standard to be rolled out and finalised by Malaysian BIM Steering Committee which was established in 2013 by the Construction Industry Development Board of Malaysia (CIDB). Parametric modelling workflow in brief are prescribed in **Figure 17**.



**Figure 17: Workflow of parametric modelling**

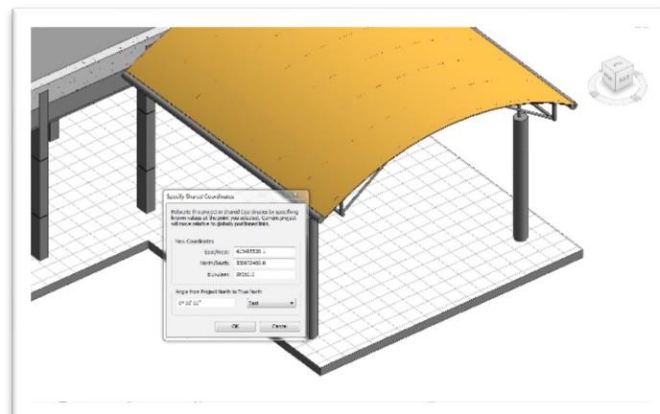
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In addition, 3D parametric modelling allows for supplementary or more information or data to be added such as furniture, electrical equipment and many more and these added elements contain relevant attributes. **SPATA** is again in line with the concept of BIM where a model that has been developed can be further enriched with more data or information that may be able to bring additional value for purposes or needs that may arise at a later or subsequent stage or time-frame. The final output of this process produced myriad of information as shown in **Figure 18**.



**3D BIM Model**

**2D schematic floor plan**



**Georeferenced 3D BIM Model**

**Figure 18:** The output of 3D parametric modelling

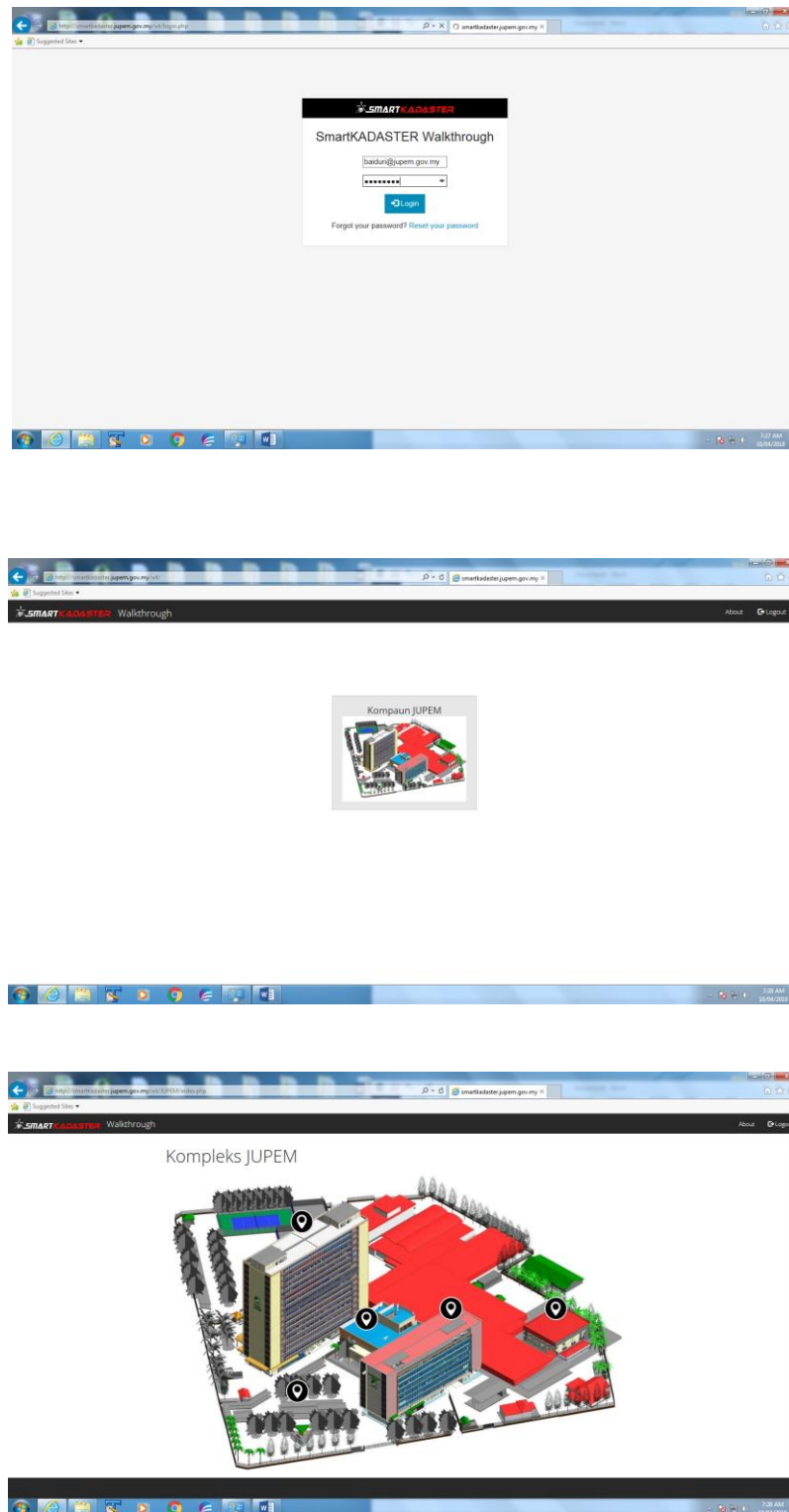
### 3.5. Publish On the Web

Subsequently, after the step and procedure to construct 3D BIM model has been fulfilled, the final production is displayed and published on the web for users to access. It is published on a portal and it allow users to see and move

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analysis such as measuring the length of the beam or determining a coordinate of a specific component can be achieved. **Figure 19** shows the interface of the web and **Figure 20 to 23** exhibit information that can be accessed by users.



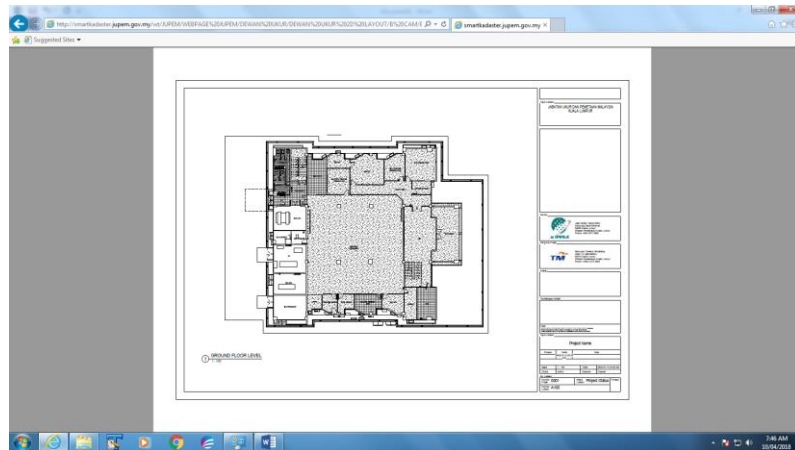
**Figure 19: 3D BIM model interface**

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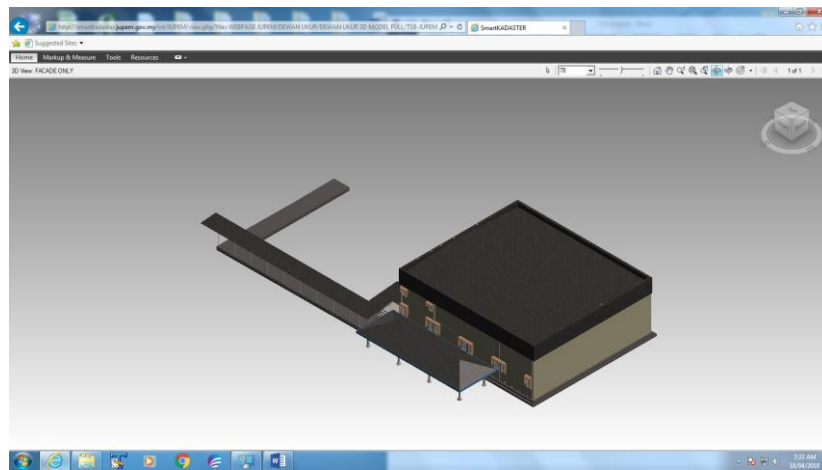
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**Figure 20: 2D Schematic Floor Plan**



**Figure 21: 3D Building Model**



**Figure 22: 3D Floor**

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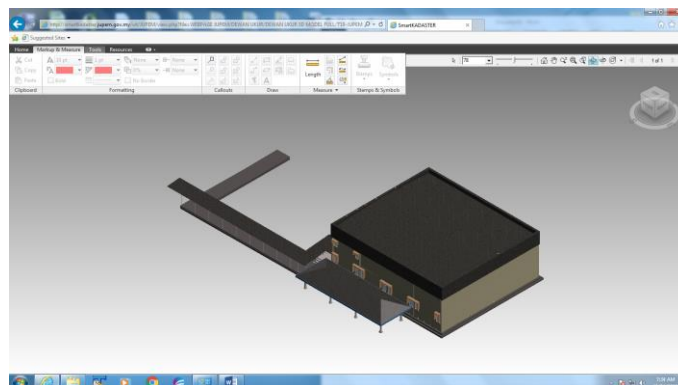
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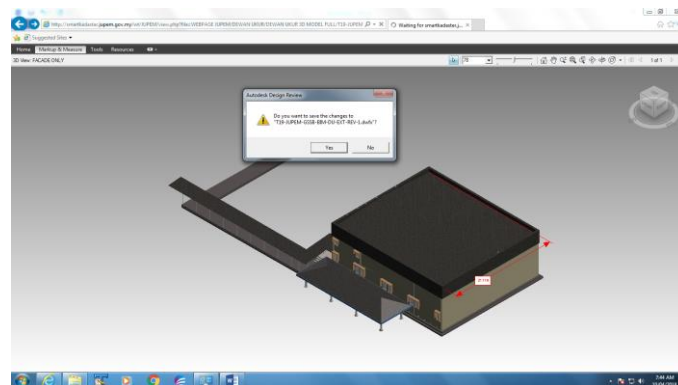


**Figure 23:** Cloud Walkthrough

As an extension for internal user, Autodesk Design Review Plugin can be installed to allow users to view, analyse, mark up, print, and track changes to 2D and 3D files (See **Figure 24**). It is absolutely helpful and resourceful as it permit users to access and save the information in variety of file formats, including \*.dwf, \*.dwt, \*.dwg, \*.dxf, \*.pdf as shown in **Figure 25** as well as image file types such as \*.bmp, \*.jpg, \*.gif, \*.pcx, \*.pct, \*.png, \*.rlc, \*.tga, \*.tif, \*.mil, \*.cal, and many more.



**Figure 24:** Example of tools in Autodesk Design Review



**Figure 25:** Save file into several of format

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#### **4. WAY FORWARD**

BIM is widely accepted and used worldwide and Malaysia is not excluded. It is indubitably a technology that is been getting a limelight by professionals such as architects, surveyors, civil and structure engineers as well as mechanical and electrical engineers. It goes beyond the planning and design phases as it extends throughout the building life cycle. DSMM is planning to embark on a new development project that incorporates BIM. The value of SmartKADASTER will be extended to urban areas and it is anticipated that local authorities will gained from this project. They can have their building blueprints in spatial and digital form so that rigorous and continuous monitoring can be exercises and assist in facility management.

Besides that, DSMM would like to strengthen, educate and prepare its workforce so that it is fully prepared for BIM. An extensive transfer of technology by appointed and certified BIM practitioner will be held to selected workforce to fully equipped them with data acquisition and data processing pertaining to BIM. This will allow DSMM to diversify its core business for not only cadastral and mapping but also BIM.

#### **5. CONCLUSION**

By gaining an understanding of the key concepts of BIM, DSMM always strive to effectively serve stakeholders needs. Flexibility is the prime traits as it is important to integrate accurate and efficient spatial data. In line with government vision of *Transformasi Nasional 50 (TN50)* that predicts potential future of technology utilising virtual and augmented reality for interactions. The emerging technology of BIM for mixed reality can help building models to be experienced as standalone models or overlaid into existing structure to show users how designed features will interact with existing conditions. This technology together with ample spatial information definitely can provide valuable services throughout a project's development, construction and operation stages.

## REFERENCES

Isa, M. N., Mohd Jazuli, A. R., Shaharuddin, S., Mohd Yusof, S. N. (2017). “Cadastral in Supporting Smart Cities in Malaysia”.

T19/2014, JUPEM – Cadastral Survey Information Web Services System (CSIWSS).

*Garis Panduan BIM JKR, Edisi 2014*

*SPATA, JKR: Sistem Pengurusan Aset Tak Alih.*

*International BIM Implementation Guide - 1<sup>st</sup> Edition 2014*

DSMM (2015): SmartKADASTER Interactive Portal (SKiP), [skip.jupem.gov.my/mapportal](http://skip.jupem.gov.my/mapportal).

DSMM (2015): SmartKADASTER Internal Homepage, [smartkadaster.jupem.gov.my/homepage](http://smartkadaster.jupem.gov.my/homepage)

<https://www.gim-international.com/content/article/bim-a-new-model-for-surveyors>

## BIOGRAPHICAL NOTES

Mohd Noor bin Isa is currently holding the position of Chief Director General of Survey and Mapping since August 2017. He is also a Fellow of the Royal Institution of Surveyors Malaysia (RISM), Chairman of Land Surveyors Board Malaysia (LSB) and a Registered Land Surveyor.

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