Students' Preferences Using BIM Software in Design Studio Project in University of Malaya – An Exploratory Study

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Abstract

The government's demand on targeting 40% reduction of Green House Gas emissions by 2020 have challenged the building industry to come out with energy efficient and green building design guidelines. Building Information Modelling (BIM) has received enormous attention from the Architectural, Engineering and Construction (AEC) industry. In 2007, the director of public works department (PWD) of Malaysia introduced BIM as a new 'tool, system and process' to reduce construction cost as well as to avoid design problems. To ensure the success in the implementation, it is important for emerging graduates to be equipped with the operational skill of the software. This will require architecture schools in Malaysia to consider adjusting their curriculums, and syllabus in preparing their students for the demand of the industry. This research aims to explore and understand the architecture students' sensitivity towards the advantage of using BIM design tool in their design studio projects. A preliminary study has been conducted through a survey among 84 respondents in 3rd, 4th and 5th year of the architecture program in the University of Malaya (UM). The result indicates that both AutoCAD and SketchUp are the most commonly used software in both education and practice. BIM software – Autodesk Revit, however is found to be not preferred software to be used by the students.

Keywords: Architectural Education, BIM, 3D software, Design Studio

1.0 INTRODUCTION

Building construction contributes to one third of total worldwide greenhouse gas emissions. According to UNEP SBCI summary report on buildings and climate change in 2009, in forty years the world will have to drop 50% of its greenhouse gas emissions to avoid the worst-case scenario of climate change (Lu, 2009). The report also states that the building sector produces 30% of the greenhouse gas emissions and that both the developed and developing countries contributes to 40% of all the energy consumption (Sbci, 2009). This energy consumption rate will continue to take place in the building industry if no preventive action is taken. In order to counter the unnecessary energy usage from the building industry, proper design, planning and construction of a building is crucial. To construct a building is a multistage process starting from the conceptual design until the construction of the real building on site. According to Pollock et al. (2009), any decisions made at early stage of a building's design will have more significant and effective impact than changes made at the latter Part of the building process.

The building industry has increasingly transforming since the introduction of digital tools into the building sector, in Particular, the use of computer design softwares in drafting and managing design (Lu, 2009). As the progress of computer starts to kick-in in the early 1980's, architects begin to use Computer-Aided Design (CAD) to automate their orthographic drawings which before was expressed manually using T-squares and pencils (Levy, 2012). As the complexity of building forms, structure, and services becoming more complicated, a new set of technology has to be made available to cater for the more sophisticated practice of design and construction. Building Information Modelling (BIM) extends from other past drafting tools by using the 3D model as an interactive database that contains all the required information for a building (Waterhouse, 2013). According to Kivits & Furneaux, (2013), BIM has the momentum for sustainability to be practiced in all stages from planning to design to the construction stage of a building. BIM is a useful tool that could further add value on the architectural design product by enabling a building to be modelled and simulated in order to achieve optimum energy and cost effectiveness. Such process has even facilitated the architects and other construction industry players to ensure their building works in accordance to the sustainability agenda. In this current Information and Communication Technology (ICT) era, it has become crucial to include computer aided software courses in the curriculum of any architectural education pedagogy.

1.1 The study aim and objectives

Since BIM is becoming an essential tool in the building industry, the architectural education curriculum should respond to it accordingly. This study aims to explore and understand the architecture students' sensitivity and readiness towards the advantage of using BIM design tool for their design studio projects. The primary objective to this study is to investigate the students' usage preference and perception of two 3D architectural design softwares for their design studio project; Autodesk Revit (BIM) and SketchUp (non-BIM). This study also investigates the students' software usage by looking at their prior training, experience and education they had on each software. This study will provide a useful data to explore the students' perception on BIM and to develop strategies for BIM integration into the architectural curriculum in the Faculty of Built Environment, University of Malaya (UM).

The feedback gathered from this study could point out an initial indication that shows whether or not there is a gap with BIM implementation and the architectural education. According to the National Building Specification (NATSPEC) Australia 2013 report on BIM education, globally, majority of the available BIM education up until 2013 mainly focuses on training the usage of Particular BIM software packages (NATSPEC Australia, 2014). The result of this study would provide the educator with an initial understanding of students' perception and preference – Particularly in UM, on the use and application of 3D design software in general and BIM software in specific. This study could be then enabling an initial adjustment to be made to the current curriculum in order to cater the architecture student with the necessary levels of BIM knowledge.

1.2 Building Information Modelling (BIM)

According to Succar (2009), BIM is an interaction of processes, policies and technologies that generate a "methodology to manage the essential building design and

project data in digital format throughout the building's life-cycle". BIM is a new way of working with a set of new technology. While BIM is a term that has been a while in engineering and manufacturing industries, it is now starting to create an impact in the building industry in Malaysia.

The implementation processes of BIM is that it moves away from using conventional Computer Aided Design (CAD) into the use of common standards and product orientated representations. The emphasis of BIM is by making a centralised 3D digital model as a primary tool for production of a more increasing documentation requirement, such as schedules, plans and bills of quantities (Pittard, 2012). A BIM model will consist of digital representations of the actual Parts and pieces used to construct a building with accurate spatial relationships, geometry, count and quantities, analytical information and properties of building components. With BIM, the entire building lifecycle from construction through to the demolition could also possibly be simulated (Vanlande et. al., 2008). Because of its significant benefits, governments worldwide are currently pushing BIM into their building construction industry, including Malaysia.

1.3 The application of BIM in Malaysia

The acceptance of BIM within the context of Malaysian construction industry is still in its infancy. Although, the software was available since the year 2002, only by 2010 the momentum of BIM was beginning to grow (Ahmad Tarmizi et al., 2012). Since then, there were many efforts driven on the awareness program and several pilot projects on BIM was done such as the National Cancer Institute project - the first government project using BIM methodology in 2010 (Ahmad Tarmizi et al., 2012; CREAM, 2014)

BIM in Malaysia at large is still in the pre-BIM stage, where the focus is to instil awareness of the technology to the industry players and to develop the competency of 3D Object-Based-Modelling (3D OBM) as a better alternative to 2D Line-Based-Draughting (2D LBD) in the current CAD system. According to the BIM Performance Measurement developed by Succar (2009), this stage is called the BIM stage 1.

Construction Research Institute of Malaysia, (2014) stated that the government of Malaysia saw BIM as an important tool to manage their properties, hence the government is targeting for the implementation of BIM by the year 2016 (CREAM, 2014). In order to push forward the development of BIM in Malaysia, it is necessary for the industry to be well equipped personnel with appropriate skills and technical competencies of BIM tools.

1.4 Introduction to BIM in Department of Architecture at University of Malaya

As there are no available records with regard to BIM education in Malaysia, the focus is specifically targeted at BIM education in the University of Malaya (UM). The architecture program at UM was established in 1995 as a small unit in the Faculty of Engineering. In 2001, a new faculty by the name of the Faculty of Built Environment was established, comprises of four departments; Department of Architecture, Department of Building Surveying, Department of Quantity Surveying and Department of Estate Management. In 2012, the Faculty of Built Environment introduced another department called the Department of Urban Planning and a year later, the whole Faculty moved to a

new building with state of the art tools and technologies to support the teaching of these courses. In Architecture Program, the teaching of CAD is mainly taught during the second year level. The CAD course has two Parts; the first Part is mainly for 2D drafting and the second Part is mainly for 3D modelling and animation.

In 2007, Ar. Aniza Aziz, En Asrul Sani Razak and Ar. Gary Wong with several architectural students initiated a pilot study to compare the BIM software with architectural drawing production, namely ArchiCAD and Revit. At this time, there was not any specific or dedicated course or teaching subject pertaining BIM. In 2011, the study was continued with the formation of training courses conducted on BIM software, namely Autodesk Revit Architecture to 3rd year architecture students (graduating Part 1 students). The course was not Part of the curriculum syllabus of the department, but rather as Part of the government's initiative leading from the Ministry of Higher Education's (MoHE) program called 3P Industry-based Certification Program (Program Pentauliahan Professional).

The government's initiative program provided Industry-Based Certification Program for final year students of selected Faculties from UM, and it was also offered to faculty staff such as lecturers and technical staff. At the end of the training, the Participants would sit for an examination that would enable them to receive an Autodesk certification of competency with regards to a Particular software training that they had. However, after the government's initiative, the faculty did not have any further training on BIM or the BIM software.

1.5 Integrated Environmental Solutions (IES-VE)

When the Integrated Environmental Solutions was established back in 1994 by Dr. Don McLean, the main purpose was to create a virtual environment suite of an integrated building design and simulation tools. The now known as Integrated Environmental Solutions – Virtual Environment (IES-VE) software aims to overcome the barriers of building analysis simulation process and the building design process. (Please revise this sentence – unclear) IES-VE has a set of parameters that includes the building orientation, natural ventilation, construction, lights and daylights, thermal energy, and cost analysis. These analyses are based on weather data that has been stored in IES-VE. IES-VE mainly depends on the input of the users to yield the appropriate results. Thus, a few rating systems are included such as LEED, CIBSE and Green Star.

IES-VE has two types of software models; one is for engineers and the other is for the architects. The main focus of the architecture department is with the architect's model because of its relevance to studies linking to design processes. The IES-VE architects' package provides analysis tools starting from the early stage of design including conceptual design, schematic design up to the design development stage (Figure 1.0).

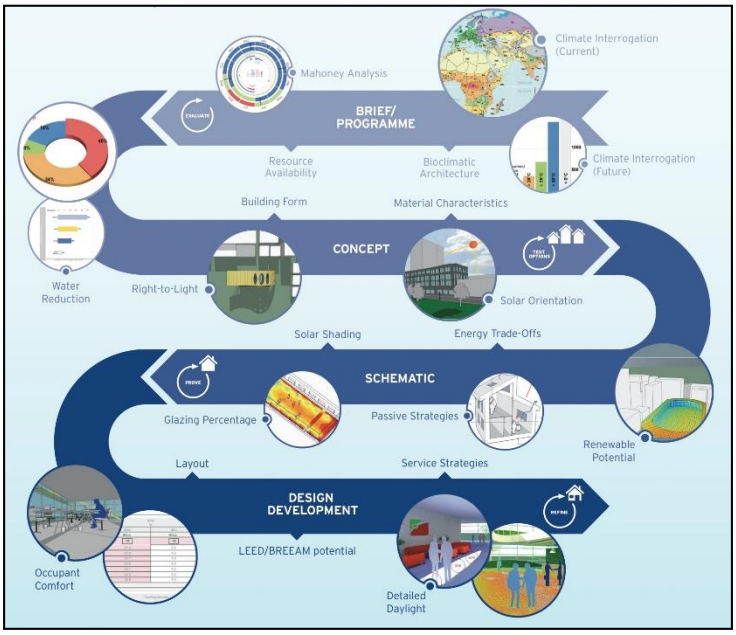

Figure 1.0: IES-VE performance workflow for architect's package. Source:(Limited, 2013)

Architects can use this functionality of IES-VE to improvise and enhance energy efficiency as well as to inform clients to achieve better sustainable design decisions. Furthermore, IES-VE does consider various building components as a whole, providing an integrated design environment (unclear meaning). There are three early stage analysis in IES-VE; modelling, schematic design, and occupancy and internal loads. Subsequently, a comparative analysis will take place that includes building orientation, building form, high building envelope option, glazing types and percentage, glazing location, and HVAC system types. IES-VE has penetrated the realm of architecture education and practice via the two softwares, namely the Autodesk Revit (BIM) and SketchUp.

1.6 SketchUp

SketchUp is 3D modelling software for architectural design, civil, and other 3D design purposes. SketchUp is easing the users to generate the required 3D models with its push/pull-patented technology (M. F. I. Mohd-Nor, 2014) and it has an online free model library. The software includes drawing layout, and it also supports third-Party "plug-in" as extensions to enhance the capability of the software for rendering and various aspects of modelling techniques. SketchUp provides users with ease of use, flexibility, accuracy, and versatility in 2D and 3D modelling environment. In addition, SketchUp also can classify geometry and assign schema tags to groups and components in digital models.

2.0 METHODOLOGY

The primary data for this study comes from a pilot survey study where a questionnaire survey was distributed to Part 1 and Part 2 architecture students at the University of Malaya. A total of 44 respondents responded to the survey. The survey contains questions on the students' software usage by looking at their past training, experience and education that they had on the software, whether in their university study or from their experience working with any architectural company. The survey also contains a series of questions regarding the architecture students' perception towards using BIM and non-BIM design software for their design studio project.

Basically the questionnaire is divided into three sections. The first section covers the respondents' profile including questions regarding the respondent's year of study, working experience and their most used software during their work. The second section covers the students' software usage for their design studio project and any former training or classes with regard to the software. The last section of the questionnaire covers the perception of students' on BIM and non-BIM software.

2.1 Population and sampling size

A total of 84 surveys were distributed to 55 students from 3rd year (Part 1), 11 students from 4th year (Part 2) and 18 students from 5th year (Part 2). Out of the 55 students from the 3rd year, a valid responds of 30 respondents were received which equals to 54.5% responds rate from the targeted Part 1 students. From the Part 2, out of the 11 students, 6 valid responds were received from 4th year and 8 valid responds out of the total 18 from 5th year students, which in total equals to 48.3% of responds rate from Part 2 students. The summary of the total population, sampling size and the response rate for this study are shown in table 1.0 and chart 1.0.

Part 1 / Part 2	Year of Study	Population (Person)	Valid Response received (Nos)	Responds Rate (%)
Part 1	3rd Year	55	30	54.5
Part 2	4th Year	11	6	48.3
	5th Year	18	8	

Table 1.0: Population, sampling size and response rate for the study

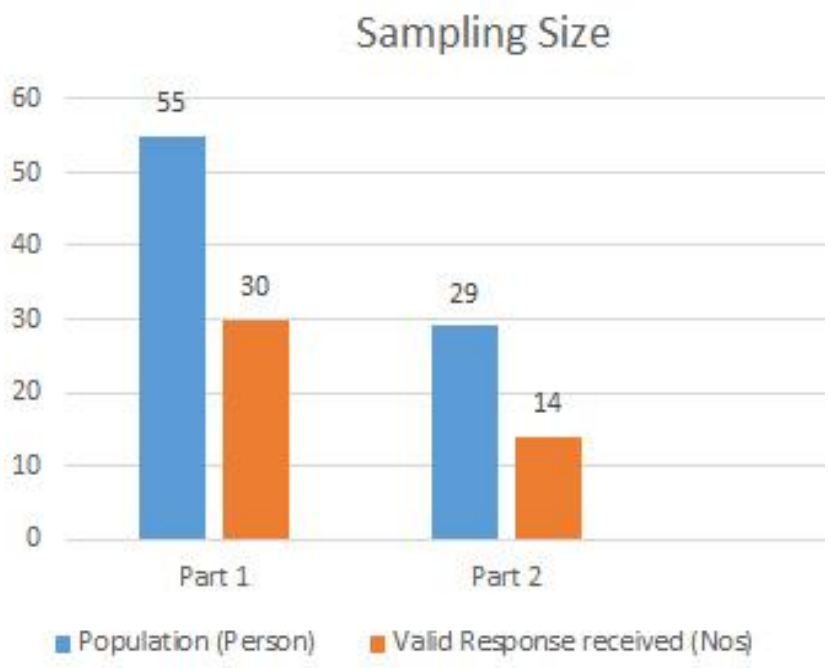

Chart 1.0: Sampling size in relation to the population of study

The survey only focuses on students from this three year of studies as only these students had the experience of using the 3D architectural design softwares for at least a year as the 3D design software courses in UM were taught in the 2nd year of study. A majority of them also had some working experience or at least had undergone practical training. Hence, they would have experience working with Particular architectural design software. Thus, 3rd year and 5th year survey data will provide a valuable input for this study as they are in their graduating years of their study. Their preferences data on the software could be used for further study either on the students' readiness to the industry with the appropriate software knowledge or a study that looks into the industry's demand on students' skills and knowledge.

3.0 FINDINGS AND DISCUSSION

A descriptive statistical analysis is conducted to explain the results from this study. The analysis will look into the results separately from the Part 1 students and the Part 2 students. This is to compare or look for any similarities on the results of both groups of students.

The primary data collected from the questionnaire underwent two levels of analysis. The first level looks into the students' knowledge about the design software. This includes data on the student's work experience, prior training on the software as well as the usage of the design software. The second level focuses on the students' understanding of using BIM and non-BIM software. In the questionnaire, the students were given Autodesk Revit as the BIM software and SketchUp as the non-BIM software for them to assess accordingly. The secondary data for this study were mainly from books and selections of peer-reviewed materials such as journal articles and conference paper.

3.1 Respondents' profile

Based on the received data, 30 students from Part 1 (3rd Year) and 14 students from Part 2 (4th year = 6; 5th year = 8) Participated in this study. Only 30% of the respondents from Part 1 have had their working experience with architecture companies with a time period from two months to one year. On the other hand, all respondents (100%) from Part 2 have had former working experience with a time period ranging from one month to two years.

The students then were asked about the design software that most frequently being used during their working time in their respective company. From the survey, it was found that all Part 1 students have used AutoCAD (100%) with a majority of them have also used SketchUp (88.9%) during their work in their respective company. Revit and 3DStudioMax were the least commonly used software within the working environment for the Part 1 students as shown in chart 2.0. Other software that has been identified by respondents to be complementary software were Adobe Photoshop and Adobe Illustrator.

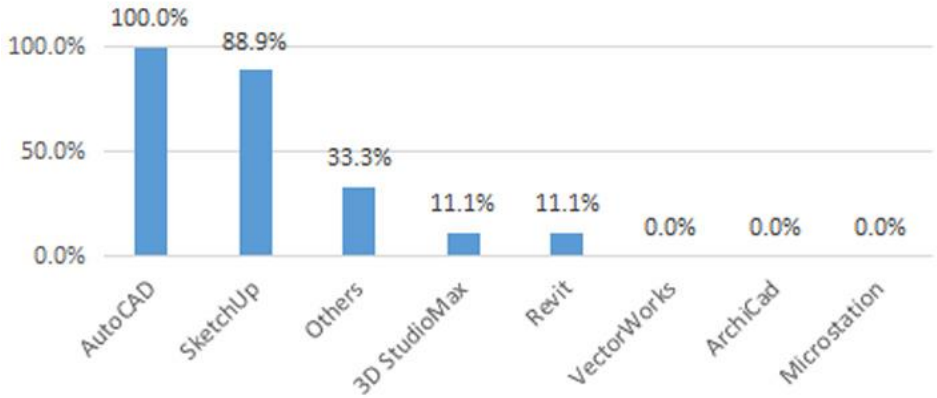

Chart 2.0: Percentage of mostly used software by Part 1 students from their work experience.

Nearly similar result to their Part 1 counterparts, for Part 2 students, AutoCAD was shown to be the most commonly used software throughout their previous working period with architecture firm (77.8%). It was followed by SketchUp with 66.7%. A few numbers of respondents from Part 2 have had experience using Revit software during their work with their respective company (27.8%). VectorWorks and 3DStudioMax were the least common software that were used by Part 2 respondents during their work, both with similar percentage of 11.1% as shown in chart 3.0.

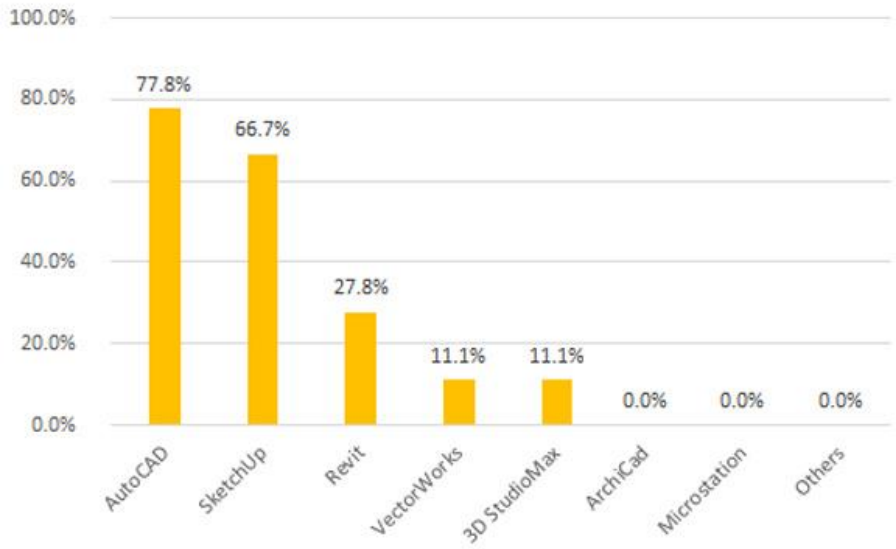

Chart 3.0: Percentage of mostly used software by Part 2 students from their work experience.

Based on the above, AutoCAD was obviously the most commonly used software in architectural practice. According to Burcu Şenyapılı and Burcu Gökçen Bozdağ (2012), the main reason why architecture professionals keen to use AutoCAD is due to its 'flexibility and sufficiency in 2D drawing' as well as '2D graphical presentation ability'. In addition, the architecture professionals have become more familiar with AutoCAD interface and its properties for more than three decades in the market. In 2009, a survey was done on Malaysian architecture companies and it was found that all respondents used AutoCAD for their architectural drawing work (M. F. I. Mohd-Nor, 2014).

Conversely, only 27.8% of former working students from Part 2 and 3.3% from Part 1 have had experience working with Revit (BIM software). In the existing Malaysian context with BIM, there is a confusion over the implementation of BIM as the national BIM implementation guideline was unavailable (Zahrizan et al., 2013) (this sentence and meaning is unclear). This unavailability of a national BIM implementation guideline was also one of the reason that the usage of BIM software within the architecture companies were low as only 20% of the architecture companies in Malaysia admitted to be using BIM technology (M. F. I. Mohd-Nor, 2014).

In February 2014, the Department of Architecture through Urban Conservation and Tropical Architecture (UCTA) research centre introduced Integrated Environment Solutions (IES-VE) software as a part of the preliminary adaptation of sustainability knowledge in the existing curriculum within the design studio projects. Third, fourth, and fifth year students were invited to attend a five-day IES-VE workshop. Prior to this training to these students, lecturers and postgraduate were asked to attend the 'train the trainer' session conducted by (the person's name) few weeks beforehand.

This workshop was expected to accommodate more than 40 students from Part 1 and 2. However, this did not happen. Only ten students joined the workshop as other students were still unaware and unsure about the capability and the benefit of the software to their studio design and sustainable knowledge.

In this questionnaire, the authors included a question on the respondent's former training or courses about IES-VE. The purpose of the question was to identify the awareness level among the students. The result showed that only 13 students have had their training on the IES-VE software.

3.2 Students' preferences

The second section discussed about the students' commonly used design software for their design studio project. Based on the result, AutoCAD and SketchUp were the most commonly used software by the Part 1 students with percentage of 96.7% and 93.3% respectively (Chart 4.0). Similarly, for Part 2 students, AutoCAD and SketchUp were ranked as the most commonly used software for their design studio project with a slightly lower percentage than Part 1 counterparts with a percentage of 72% for both softwares (Chart 5.0).

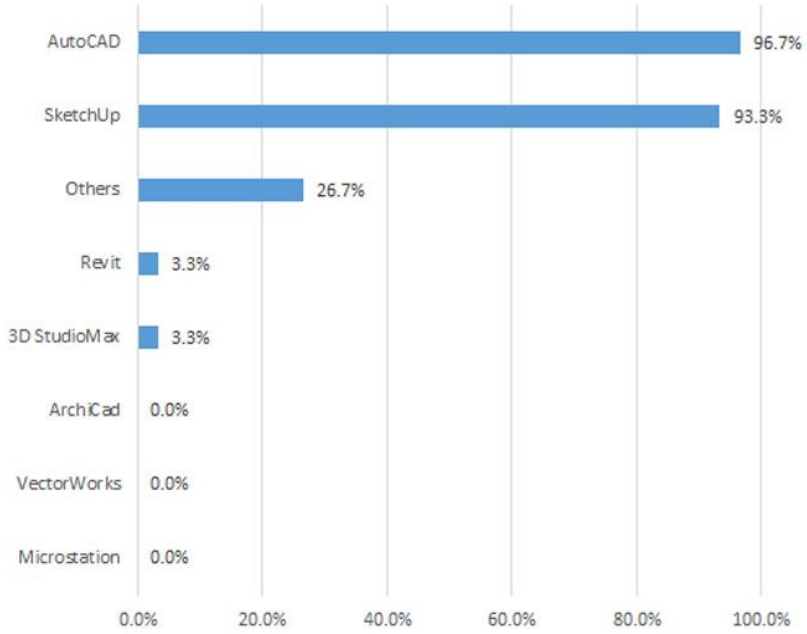

Chart 4.0: Percentage of most used software for design studio project by Part 1 students

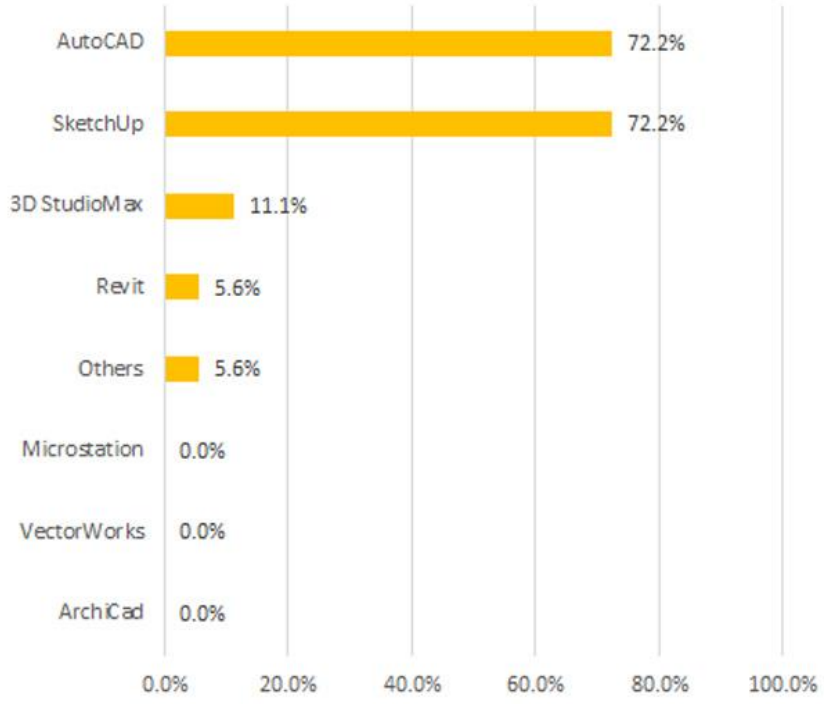

Chart 5.0: Percentage of most used software for design studio project by Part 2 students

This result of AutoCAD and SketchUp as the most used software by the students in education and during their work matched perfectly with the findings of M. F. I. Mohd-Nor, (2014). In his article entitled 'The Development of Digital Architecture Modeling in the Malaysian Architecture Industry', he carried out a survey to 140 architecture firms and found out that AutoCAD was the main software being used while SketchUp was the main secondary software being used by the architecture firms in Malaysia. (M. F. I. Mohd-Nor, 2014)

SketchUp could be considered as a powerful tool to produce 3D models and 2D drawings. According to M. F. I. Mohd-Nor (2014), comparing the years of AutoCAD in architecture education with SketchUp, he forsees within the next few years, SketchUp would be able to close in with AutoCAD as the most commonly used software amongst architecture students. This is probably due to the fact that the patented *Push/Pull* Technology in SketchUp has made the software the easiest 3D software to be used existing in the market. (M. F. I. Mohd-Nor, 2014)

Traditionally, AutoCAD, SketchUp and 3DStudioMax were introduced in the architecture program in the early stage of study, from the first semester of the second year to the first semester of the third year of the study. However, student preferences in using both AutoCAD and SketchUp came from the ease of use and the degree of freedom in modeling and rendering that the software provided.

3.3 Students' perception on BIM/non-BIM software

In this section of the survey, a preference comparison was carried out between the Autodesk Revit (BIM) and SketchUp (non-BIM) software. The result was separated into two groups for each software – Part/section 1 showing the preference result from the

Part 1 students and Part/section 2 shows the preference result from the Part 2 students in this study.

3.3.1 Students' perception on Autodesk Revit software (BIM software)

From the result for Part 1 students, generally they were unsure as to whether the Revit software could benefit them with their design process exploration or not. As shown in chart 6.0 – Part 1, most of the students neither agree nor disagree (grey colour) with the software's simplicity, the software's ability to enhance the student's creativity and its image rendering quality. They were also unsure about several aspects of the said software; data compatibility between IES-VE and Revit, its ability to give construction information, the use of the software by the students in the design studio project and whether or not there are market demand for this software.

However, the Part 1 students agreed (light green colour) that the software could save time, and is able to ease with the production of 2D drawings and detail drawings production. They also agreed that the architecture students should have knowledge on this particular software. In general, Part 1 students tend to have a high percentage of uncertainty to this software but with a considerable percentage of agreement to the statements given about this software. This shows that although Part 1 students did not have any particular training with Revit software, they still have a positive outlook towards this software.

On the other hand, the preference result of Revit software from the Part 2 students generally was more diverse in terms of their agreement to the statements regarding the software (Chart 6.0 – Part 2). Majority of the Part 2 students agreed (light green colour) that the said software is simple and basic 2D drawings and detail drawings could be easily produced using this software. They also agreed that the software gives construction information to the user. Therefore, architecture students should have knowledge on this software. On top of that, they strongly agreed (dark green colour) that there is market demand for utilising this BIM tools as part of the design process and design thinking.

However, Part 2 students were uncertain (grey colour) if the software could enhance the student's creativity and the software's quality of the rendered images. Compatibility of the software with IES-VE building performance analysis software was also one of the thing that Part 2 students was unsure of. One thing that they disagree (orange colour) was on the usage frequency of the software by the students for their design studio project.

The only exposure that the students may have on Revit software was from working with firms or a companies that adopts BIM software in their architectural projects. This might explain the uncertainty of the students on the software's capability to enhance the student's creativity and the question of the quality of the rendered images as the students also did not acquire any training on the usage of this software in their university education

Chart 6.0: Students' perceptions on Revit software

3.3.2 Students' perception on SketchUp software (non-BIM software)

From the result for Part 1 students' perception on SketchUp software, most of them agreed (light green colour) with almost all of the statements about the software in the survey except for 3 statements that they were unsure of (Chart 7.0 – Part 1). The students were uncertain (grey colour) of the quality of the rendered image from the software, detail drawings production capability of the software and the compatibility of SketchUp with the IES-VE building performance analysis software. On the other hand, the students agreed on the software's simplicity, the ability of the software to enhance their creativity and the software's 2D drawings productions capability. Part 1 students also agreed that the software saves time and provides construction information to their building design. Therefore, they think that architecture students should have knowledge on this software.

Mainly, Part 1 students were in favour of the SketchUp software usage as this software was one of the software that was taught as a course in their syllabus. Moreover, the interface of SketchUp with handy toolbar made it a huge time saver for those students who seek speed in their design process. SketchUp only requires a low specification computer to run on, and any normal Personal Computer (PC) or laptop would be able to get the job done.

Similar with the preference on Revit software, the preference result of the Part 2 students on SketchUp software were more diverse compared to their Part 1 counterpart (Chart 7.0 – Part 2). Generally, they strongly agreed (dark green colour) or agreed (light green colour) with 8 out of the 11 statements in the survey with regards to SketchUp. They agreed on the software's simplicity, the ability of the software to enhance the student's creativity and the quality of image renderings from the software. They also agreed on the software's capability to save time and that architecture student should have knowledge on this software.

There were 3 statements that the Part 2 students were indecisive of (grey colour) which were the capability of the software to produce basic 2D drawings, the construction information that could be provided by the software and detail drawings production by the software. An equal number of Part 2 students also strongly disagreed (red colour) with this last statement.

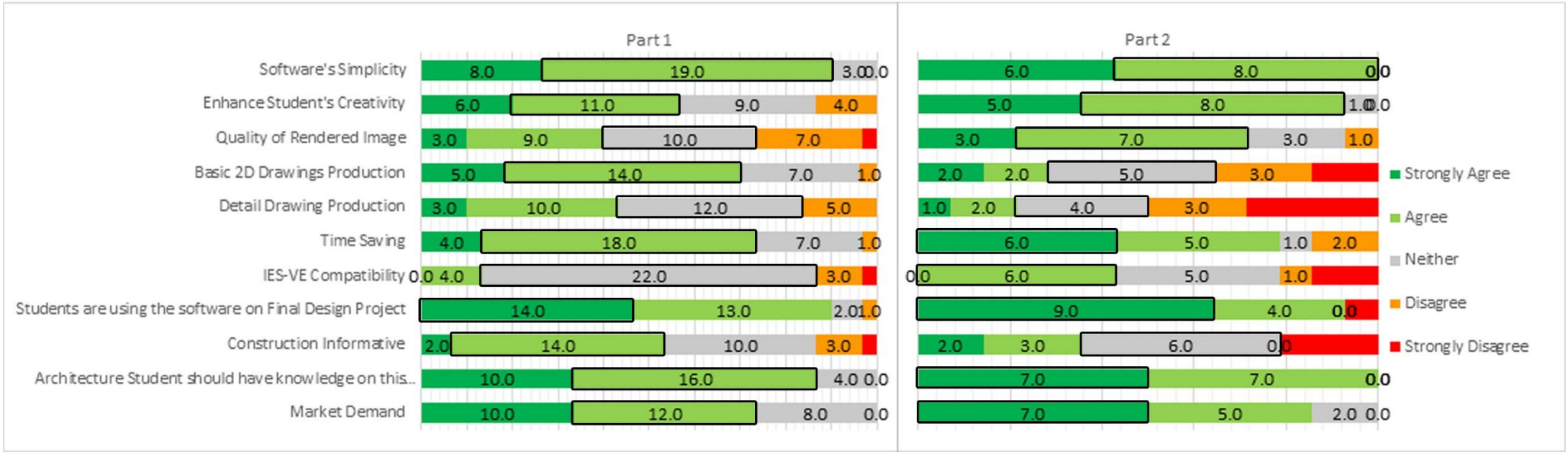

Chart 7.0: Students' perceptions on SketchUp software

The result basically showed that the Part 2 students were more conscious of the capability of this software compared to the Part 1 students. An example to this was that the Part 2 students knew that SketchUp software was not an appropriate software to be used to produce basic 2D and detail drawings. This contradicts the Part 1 students' knowledge on this software.

Although SketchUp was an easy-to-use software, this software is not the appropriate tools in producing the 2D and detail drawings or commonly known as CAD drawings. Based on a survey by M. F. I. Mohd-Nor, (2014) on Malaysian architecture firms, most companies preferred to use the AutoCAD software to produce the required CAD drawings. SketchUp would normally be used to produce the 3D visualization for the project or the conceptual 3D modelling for a project (M. F. I. Mohd-Nor, 2014). This contradiction was possibly due to the fact that Part 2 students had a much longer experience dealing with SketchUp software in the studio or in the working period as compared to their Part 1 counterpart.

4.0 CONCLUSION

From this study, the survey shows that both architecture students from Part 1 and 2 in UM that were selected for this study appreciates computer aided design software. AutoCAD is the most commonly used software in both education and practice. BIM software – Autodesk Revit, is not yet getting the momentum it required. Although 80% of Malaysian architectural companies are aware of BIM, extra motivation will be required to increase the current 20% usage of this technology in those companies (M. F. I. Mohd-Nor, 2014). If there was a proper BIM guideline being developed for Malaysia, education in BIM could probably be easily adjusted in accordance to the guideline.

The preference survey result shows that architecture students in UM have their own favourite design software to be used, mainly the one that is easy-to-use and that enables them to create a more creative and innovative form for the building which is the SketchUp software. The result also shows that the students do have a positive outlook on Revit software although they never had any particular training or courses on the software. This gives an indication that the students do have interest on this particular BIM software or BIM in general. If the software could be integrated into the curriculum, this will enable an introduction of BIM into the architecture education which also would later support the government's BIM implementation initiative.

Autodesk Revit and IES-VE software will be a good match for an architectural sustainable education tools if both softwares could be strategised and integrated in the department curriculum. By doing this, BIM and buildings performance software will raise a considerable amount of awareness to motivate architecture students with their design, construction, management and sustainability design idea.

This integration of BIM tools and software in the architecture curriculum will help to set a sustainable framework as sustainability is the key driver for the current global development. Construction companies and design firms are trying to cope with changes in the industry as the advancement of technology pushes the building industry professionals to create a more sustainable building design.

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APPENDIX: SAMPLE OF QUESTIONNAIRE

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Faculty of Built Environment, University of Malaya

A survey on Students' perception on using 3D modeling BIM and Non-BIM 3D modeling software.

A. Respondent's' Profile:

1. Year of study, ……
2. Do you have any working experience: ☐ Yes ☐ No
3. If Yes, please,
   - Name of the firm/s: ……..
   - Year/s of working:……..
   - Design software(s) MOSTLY used (you may select more than one):
     - ☐ AutoCad
     - ☐ Autodesk Revit
     - ☐ SketchUp
     - ☐ 3DStudioMax
     - ☐ ArchiCad
     - ☐ MicroStation - Bentley
     - ☐ Vectorworks
     - ☐ Others,……
4. Do you had any training/course on IES-VE software before?
   - ☐ Yes
   - ☐ No

B. Students' Preferences:

1. What is the software(s) that you MOSTLY used for your design studio project? (you may select more than one)
   - ☐ AutoCad
   - ☐ Autodesk Revit
   - ☐ SketchUp
   - ☐ 3DStudioMax
   - ☐ ArchiCad
   - ☐ MicroStation – Bentley
   - ☐ Vectorworks
   - ☐ Others,……..
2. Do you have any formal training/courses on the software you are using now? Where did get this training/courses ?
   ……
   ……

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C. Please rate your perception on the following statement on each software:

Type		Questions	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
BIM Software	**Autodesk Revit**	It is simple to model the buildings using this software.					
		This Software helps me to produce more creative & innovative designs.					
		I can produce high quality rendering images.					
		I am able to produce the basic drawings (plan, sections, elevations) easily using this software					
		I am able to generate details drawings.					
		It saves time					
		It is easy to use with IES-VE Software package.					
		Most of the students in my studio are using this software for their final design project.					
		I can understands the constructability of my building design using this software					
		Architecture students should have knowledge & skills on using this software					
		There is a market demand on graduates who have knowledge & skills on this software					
Non-BIM Software	**SketchUp**	It is simple to model the buildings using this software.					
		This Software helps me to produce more creative innovative designs.					
		I can produce high quality rendering images.					
		I am able to produce the basic drawings (plan, sections, elevations) easily using this software					
		I am able to generate details drawings.					
		It saves time					
		It is easy to use with IES-VE Software package.					

		Most of the students in my studio are using this software for their final design project.					
		I can understands the constructability of my building design using this software					
		Architecture students should have knowledge & skills on using this software					
		There is a market demand on graduates who have knowledge & skills on this software					

Thank You.

Please, return this survey to: Mr. Farizuda or Mr. Mohammed @ UCTA Center, Faculty of Built Environment, University of Malaya, Kuala Lumpur