Review of BIM-Based Software in Architectural Design Graphisoft Archicad VS Autodesk Revit

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Article Info

ABSTRACT

Revolution Industry 4.0 impacts world development AEC (architect, engineering, and construction), especially in developing useful digital technology for acceleration development infrastructure, namely BIM (Building Information Modeling). BIM uses 3D software to support all potential and productivity in designing building construction. This article aims to review the advantages and limitations of the software Graphisoft Archicad and Autodesk Revit, especially in the field of BIM. The method used was a review paper of six journals and three expert opinions. The results of the study show that the Archicad software dominates the criteria for the field of work and 3D display. On the other hand, Revit dominates work criteria in terms of the number of features integrated by the developers of the Autodesk program. Archicad software is more compatible with users who want a more concise and easy-to-understand interface, while Revit software is more compatible with users with more complex project scales. Both of the softwares support the parametric design and Live Connection, but Archicad also has a Param-O parametric object library, and Revit has Dynamo for visual programming of parameter modeling. Therefore, users should know more about their needs before using BIM software.

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1. INTRODUCTION

In the Compfest Talk event: Empowering and Education Society through Technological Innovation, Creative Industry, and Professional Industry, on Sunday (04/10/2020), Johnny G. Plate, the Minister of Communication and Information of the Republic of Indonesia, stated that currently, Indonesia is entering The industrial revolution stage 4.0 is the phenomenon of digital disruption through the presence of technology and digital systems such as the internet of things and artificial intelligence as tools for daily activities [1]. In his book, "Shaping the Future of the Fourth Industrial Revolution," Nicholas Davis discussed that industrial revolution 4.0 radically affected the entire order of life, from lifestyle and communication to how humans produce goods [2]. The industrial revolution based on the internet system also impacted the development of AEC (architect, engineering, and construction), ranging from developing types of work and skills to work strategies for production [3]. He next described that in the era of revolution first and second, architects designed and visualized ideas using a manual method or freehand sketching on a piece of paper on a table. In the third industrial revolution, computers began as a tool for calculating and drawing. At this stage, the architect drawing method slowly shifted to CAD programs that can only be used to digitize the work so that

the user better understands it. Then in the fourth revolution, there were four criteria for the industrial revolution, two of which were cyber-physical systems and smart factories. The fourth revolution is very influential in the development of architectural design, where digital technology helps the design process to be more flexible and synchronized automatically by all design teams to make work more efficient [4].

Along with the pace of the millennium era, the development of the architecture world, especially in the construction sector, is dominated by device software that utilizes Building Information Modeling (BIM) technology. It is aligned with documentation needs, the embodiment of architecture design ideas, and the level of project complexity that is increasingly innovating. This condition also encourages users to compare the various available applications to find specification software that best suits their needs [5].

This paper compares two popular tools in the BIM world, namely Graphisoft Archicad and Autodesk Revit. The two software is a technology-based software BIM which is very useful in building construction [6]. Therefore, the scope of the discussion focuses on comparing the two software technology to identify each software's functions, potentials, and limitations to demonstrate the advantages and disadvantages of BIM-based software (Graphisoft Archicad and Autodesk Revit) in terms of use in design architecture.

1.1   BIM

Building Information Modeling (BIM) is a set of technologies that use three-dimensional (3D) modeling to help architects work on a model without dividing it into several different models [7]. BIM contributes fully during stages of design and construction to support the retrieval process decision project such as (1) all related parties have a more precise understanding of the purpose and scope of the project, (2) it can visualize various alternative designs better to propose better analysis, (3) simulation can conduct fast and possible solutions, more excellent and innovative designs and (4) support project data transfer to other data management. Moreover, process management becomes more accessible and informative because it boils down to an information model that could work by collaboration to minimize conflict information between various parties involved in a project [8]. That statement is supported by results study from Stanford University Center for Integrated Facilities Engineering (CIFE) based on 32 majors projects using BIM shows benefits: (1) up to 40 % change that is not budgeted, (2) a curation estimation cost up to 3%, (3) reduction time up to 80% for produce estimation cost, (4) savings up to 10% of score contract through detection clashes, and (5) reduction time project up to 7%.
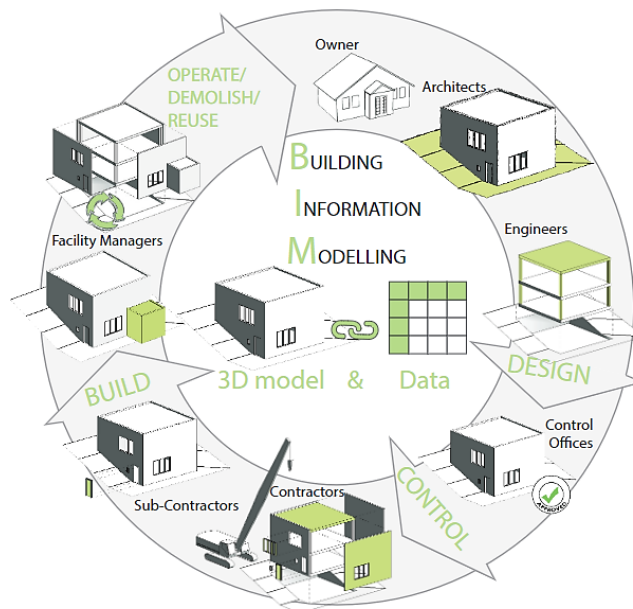

Figure 1. The Building's Lifecycle and Its Stakeholders [10]

BIM involves stakeholders, namely owners, architects, contractors, and engineers, working together to streamline, manage and share data and geometry information relevant to building construction,

fabrication, and embodiment [9]. Several discussions of BIM conclude that BIM is a software platform that allows for coordinating and combining the work of the different parties in one information model connected by one building to others [10]. BIM makes modeling in 3D shape with elements of length, width, and height based on object modeling parametric. The additional feature of time for scheduling makes BIM 4D. Furthermore, developing BIM to 5D by adding the cost element can do a budget estimation. Then BIM can analyze energy and environment impact, which is called 6D. Elements information contained in full BIM can be used by the facility management for maintenance and operation, called 7D [11] [12].

BIM can gather information from different applications as the model server becomes more general. For example, it can start with the initial building space program from one application, continue with addition element architecture in the second app, build elements in the third app, and so on [13]. BIM technology originates from modeling parametric-oriented objects [14]. The term "parametric" describes a process where modification of components and adjacent objects (e.g., the door attached to the wall) is by automatic customization for maintaining a relationship that has been intertwined previously [15]. BIM gives a potential for virtual information in a single model that offers visualization, impact detection, construction phase, and materials, as well as model testing for handed over from team design (architect, surveyors, engineers consultation, etc.) to contractors and sub-contractors and then to the owner [11]. BIM is a technological revolution, and the process has fast changed the view of understanding planning, building, implementation, and operation.

1.2   ArchiCAD

In Building Information Modeling (BIM), ArchiCAD is beneficial for realizing ideas quickly and accurately. It is because the software ability of 2D images simultaneously shapes 3D images in the form of virtual buildings or buildings in the virtual world. For example, virtual building technology merges the three types of fieldwork: a floor plan, section/elevation, and 3D. Then making an image of a floor plan will immediately form a picture showing sections and 3D visual images in the form of perspective and isometry from various views or Multi View [16].


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SGI Image (*.sgi)
Photoshop Image (*.psd)
Windows BMP Image (*.bmp)
JPEG Image (*.jpg)
PICT Image (*.pct)
PNG Image (*.png)
TIFF Image (*.tif)
Truevision TGA Image (*.tga)
JPEG 2000 Image (*.jp2)
QuickTime Image (*.qtif)
ArchiCAD Solo Project (*.pln)
ArchiCAD Project Template (*.tpl)
ArchiCAD 9 Project (*.pln)
ArchiCAD Archive Project (*.pla)
DXF File (*.dxf)
DWG File (*.dwg)
Wavefront File (*.obj)
3DStudio File (*.3ds)
Piranesi file (*.epx)
ElectricImage File (*.fact)
VRML File (*.wrl)
Lightscape File (*.lp)
U3D File (*.u3d)
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Figure 2. Various Types of File Formats Offered by ArchiCAD[18]

ArchiCAD is a program that offers a Parametric Object Library where a user can arrange Settings to construct an object library by interacting during the current design of manufacturing processes. Elements of library construction and objects can determine Settings parameters in the settings dialog box, and if any error occurs, it can conduct editing through the 3D work field. Editing is performed by selecting the object and clicking double type device image on **ToolBox** or clicking once on the **Settings Dialog** until going out of the dialog box. Users can keep the original object from the **Object Default Settings** dialog box with necessary parameters [17]. The ArchiCAD program also provides convenience for publication or various picture designs to software such as AutoCAD and 3DS Max exported to DXF and DWG formats. For software-based pictures like Photoshop and CorelDRAW can save in (*.psd), (*.bmp) as well as (*.jpg), and (*.png) formats (Figure 2).

1.3 Revit

Revit is a software released by the company Autodesk, Inc in Mill Valley, California, specializing in the field industry software, media & entertainment, manufacturing, and industry as well as bioscience. This company popularized CAD (Computer-aided design) through the software AutoCAD. The Autodesk company created Revit's first formal edition in 2002, while the subsequent series edition aimed to increase digital representation and simulation building efficiency. In addition, Autodesk upgraded Revit's control interface and program layout similar to AutoCAD software, which was very popular in architecture. Revit is a BIM application that uses a single, parametric, 3D model to produce plans, sections, elevations, perspectives, details, and schedules [19]. By abbreviated name from Revise-Instantly, it reflects the software function that is not only to change component individuals but change models and documents of the whole building.

2. METHOD

Pieces of information were collected from scientific articles about using two BIM-based software, Graphisoft Archicad and Autodesk Revit, for architectural 3D modeling. It was obtained from Google Scholar via Publish or Perish software. At stage this, it contains six prominent journals that will be reviewed and three published expert opinions from 2018 to 2022. The review method compares the advantages and disadvantages of Graphisoft Archicad and Autodesk Revit compatible with the comparison criteria from the references. The following is a visualization of the Vosviewer analysis results.
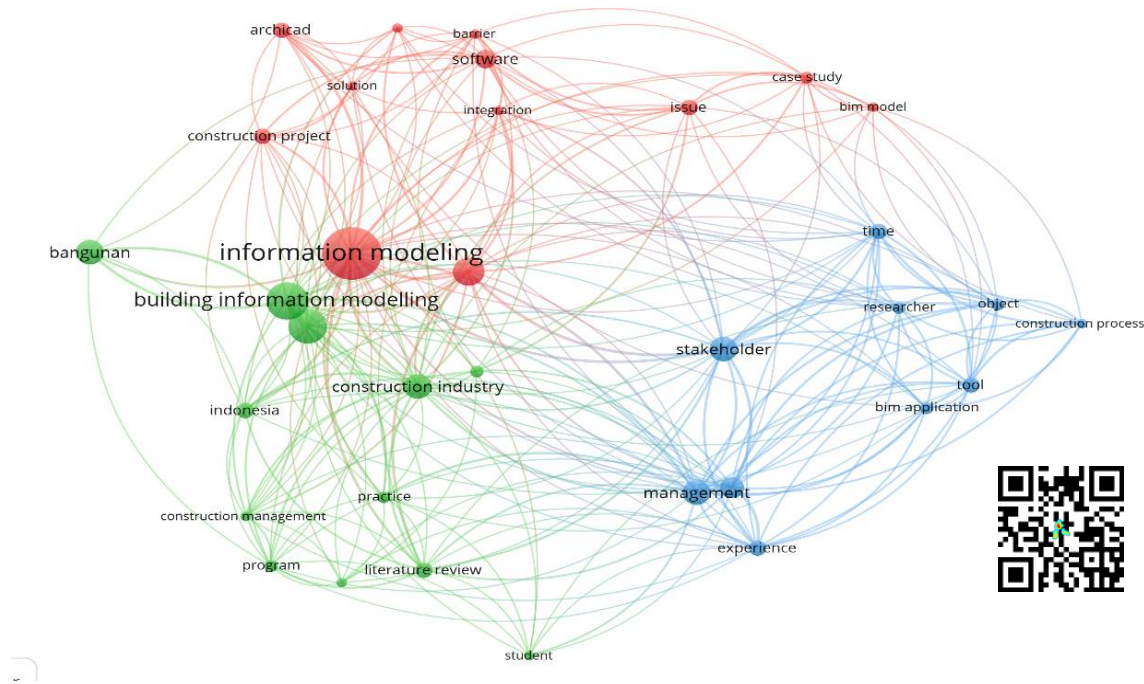

Figure 3 . BIM *Tools* Comparison Average Quotes in Architecture

Figure 3 shows the average citation comparison of BIM tools in architecture. The most frequently cited keywords related to BIM with the most networks are implementation, model, building, management, construction industry, and stakeholders.

3. RESULTS AND DISCUSSION

An extensive comparison between the Architectural Software of ArchiCAD® and Revit® shows that the choice of ArchiCAD® or Revit® as BIM Software dramatically affects the purpose and characteristics of projects [20]. The following is a table of the advantages and disadvantages of BIM software from the results of a review of six journals and three studies of expert opinions starting from review number six until nine.

Table 1 . Advantages and Disadvantages of BIM Software

No	Ref	Software	Superiority	Deficiency
1	[21]	Graphisoft Archicad	3D Modeling help when Step begins the creation of structural models; the available programs are realistic, easily understandable, and practical.	-
		Autodesk Revit	Excels are in the stage of making structural elements that can represent according to view analytics.	-
2	[22]	Graphisoft Archicad	• Easy to find errors in the drawing. • ArchiCAD is one of the device soft best 3-D modeling according to the opinion of many users, and they no once feel the need to switch to a device quite another.	To run ArchiCAD, especially during rendering, requires a large enough RAM capacity.
		Autodesk Revit	• Appropriate software if you want to form direct constructions in 3-D directly • Have realistic rendering power	Have a large file size
3	[23]	Autodesk Revit	• Intuitive workspace • Provides features for engineering architectural elements, utilities, and building structures. • With the help of RevitServer, project teams can work together on Revit models over a global network. • Automation of facade parts, specifications, nodes	• Weak features for working with steel structure details and wooden structural parts • Regeneration takes quite a long time.
4	[24]	Autodesk Revit	Revit is one of the best software for work utility because it is equipped with the MEP (Mechanical, Electrical, and Plumbing) program to perform building energy analysis.	-
5	[25] [7]	Graphisoft Archicad	• Building Energy Evaluation • Operation smooth app • Good coordination, interaction, and integration • It could use in making picture construction.	Not suitable for extensive project modeling
		Autodesk Revit	• More processes fast and more effective • Update information in real-time • Control cost and environmental data • Assembly Automatic • A high modeling accuracy	Limited capacity for complex modeling
6	[26]	Graphisoft Archicad	• Buy ArchiCAD license is sufficient one time • ArchiCAD has several plugins that help extend its strengths and capabilities in certain areas	-
		Autodesk Revit	Ability seamless file sharing compared to Archicad	• Revit no again have license permanent • Revit doesn't have many plugins
7	[27] [28]	Graphisoft Archicad	• Archicad view looks more concise • Camera exploration is so easy, and the camera view is so comfortable to look at	It is not a parametric architecture program, so it requires additional software, namely Grasshopper, that connects to Archicad.
		Autodesk Revit	• Parametric architecture, i.e., software based on thought easy algorithm user for specifying connection between various parameters in the design process. • Revit is the abbreviation from Revise Instantly, which means revise by instant so that no confiscate much time and energy. • Carrying drafts is very useful for sharing for large-scale projects so that changes or	• Revit looks much more complex • Using a default camera that seems axonometric with a narrow focal point and a wide camera that gives a distortion effect on large buildings. • It looks more complicated, and when you want to add assets such as doors and windows, the settings are pretty complex, and you are required to

No	Ref	Software	Superiority	Deficiency
			revisions made by one person will update the other units. • Sheets _ work or sheets generated in this software no sheets separated but sheets mutual work integrated.	download the Revit Family file. After downloading the file, requiring the user to open a new tab to continue the setting of adding assets.
8	[29]	Graphisoft Archicad	License permanent available in a one-time purchase	Documentation project, not enough support.
		Autodesk Revit	Many exploration designs because characters are more flexible and free to express design ideas	• Big file size hard to share. • Only available for PC and not MacOS • More complicated to study.

Table 2 explains Archicad and Revit applications with several criteria and software that outperforms them. Users who are experts in the BIM field are people with background experience using Archicad and Revit software.

Table 2. Comparison of Archicad Software and Revit Software Based on Expert Opinion

No	Name And Profession	Criteria					Conclusion Winner
		User Interface / UX	3D visualization	Conceptual Design	*Workflow Between Programs*	Render	
1	TEJJY [30] "Service company architect and BIM".	Archicad	Revit	Archicad	Archicad	Archicad	Archicad
2	Chris Graham [26] "an interpreter of CAD (*Computer-Aided Design*) drawings, Architecture Landscaping & Civil Engineering"	Revit	Revit	Revit	Revit	Revit	Revit
3	Muhammad [31] "BIM consultant and 3D architect "	Archicad	Revit	Archicad	Archicad	Archicad & Revit	Archicad
							Archicad

3.1 Summary of Comparison Results Software ArchiCAD® and Revit®

The results of the scientific reviews and three expert opinions on the software operation could show comparison chart results of the two software by comparison criteria (UI/UX, 3D Display, Field of Work, and Plugins) in Figure 4.
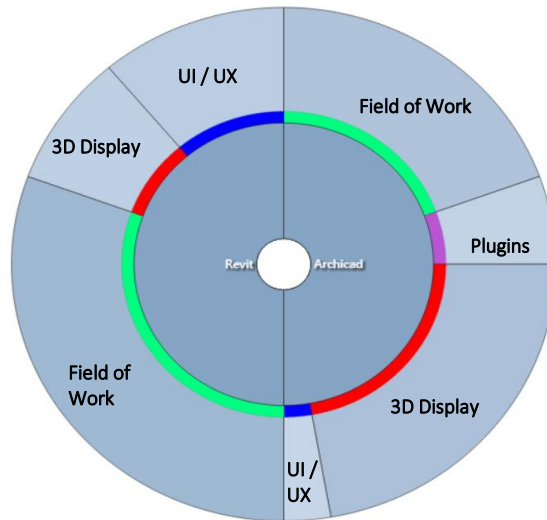
Figure 4 . Archicad Software Comparison Result Diagram and Revit Software

In a hierarchical manner from Figure 4, the diagram shows that the Revit software is superior in the field of work criteria. In contrast, the Archicad software is outstanding in the 3D display criteria. The result aligned with the study by G. Alfalah, et al. [20], who compared ArchiCAD and Revit software using 21 type criteria. Later, the author evaluated and reduced the comparison criteria into 13 measures based on score win-lose. Following the result criteria, research comparisons listed in Table 3 have been reviewed again based on articles and user opinions experts.

Table 3. P rating score between ArchiCAD® and Revit®

No.	Comparison Criteria	Revit®	ArchiCAD®	Ref
1	3D	0	1	[32] [33] [27] [18]
2	Libraries	0	1	[18]
3	Clashing	1	0	[34]
4	Detailing	1	0	[34]
5	Hardware Requirement	0	1	[29]
6	Support	1	0	[29]
7	Engine	1	0	[29]
8	Flexibility	1	1	[34] [27] [18]
9	Management Of Images	0	1	[33]
1 0	Functionality Of Image	0	1	[33]
1 1	Templates	1	1	[29]
12	File Formats	0	1	[29]
13	Market Share	1	1	[26] [29]
Score based on Win-Lose Comparison		7	9	

Description of assessment:
1: means that the software wins on specific criteria.
0: means that the software lost with on specific criteria.

4. CONCLUSION

Comparison based on main criteria usually used in architecture works shows Archicad software is superior in the more concise 3D viewing. Meanwhile, Revit software is more excel in the field of work criteria. It is because the Revit software has a lot of integrated supporting software from the Autodesk design program developer. The Revit license is renewed annually to get the latest software updates, but Archicad brings a permanent license on a one-time purchase but does not get the latest software updates. For beginners, these two software provide an educational license for one year.

Result comparison also shows that choosing one of the BIM software for work should be motivated by suitability aspects differentiated needs based on knowledge users and complexity of the projects. Archicad

software is more compatible for users who want a more concise and easy-to-understand interface, while Revit software is more compatible for users with more complex scale projects. Both of these software can use Rhinoceros-grasshopper software for Live Connection for parametric modeling. Archicad also has a Param-O parametric object library, and Revit has Dynamo for parametric visual programming. It shows that users should know more about their needs before using BIM software.

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