Skill Requirement of Building Information Modelling (BIM) Professional

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ABSTRACT

Building Information Modelling (BIM) is a digital representation that is integrated with stakeholder collaboration to create a building based on several types of data. The development of BIM creates a new role for practitioners in the field of Architecture, Engineering, and Construction (AEC), namely BIM Professionals. This desire for Professional BIM goes hand in hand with the awareness of the availability of skills among professionals. Skill requirements that must be possessed are soft skills and hard skills. Meanwhile, for hard skills, such as software and technical skills. This study aims to identify what skill requirements must be possessed by BIM professionals in implementing the use of BIM. The methodology used in this research is a literature review based on publications from the conference journal and Scopus journals. The results of literature reviews from previous journals are that most of the scope of BIM Professionals' skill requirements are hard skills such as the use of software by BIM Professionals. This research is expected to contribute to BIM research regarding what skill requirements a BIM Professional must have.

Keywords: Building Information Modelling, BIM Professional, Literature Review, Skill Requirement.

1. INTRODUCTION

Technological developments produce an information management system into building modelling, namely Building Information Modelling (BIM). Different countries in the world have adopted BIM with different standards. The main functions of BIM are project visualization, comprehensive report documentation, digital construction models, and a collaboration platform for all project stakeholders [1].

In Indonesia itself in 2017, the government issued a roadmap regarding BIM which contains implementation plans for the next 5 years. However, until now this plan has not been fully implemented. Regulation of the Minister of Public Works and Public Housing Number 22 of 2018 has mandated the policy of implementing BIM in the construction of non-simple state buildings, by this indirectly requiring contractors to immediately adopt BIM.

The development of BIM professional needs creates requirements that will enhance the new professional BIM. Each required BIM specialist job position requires specific competencies. There are still very few BIM Professionals in Indonesia because the lack of formal training and education is an obstacle to the implementation of effective building information modelling in the construction industry because most people do not have BIM knowledge either from companies or from formal education [2].

While there are also technological barriers, inadequate human resources in the use of technology in the digital construction industry result in a shortage of BIM professionals skilled in digital construction practices and collaborative design [3].

Lastly, the lack of readiness to upgrade qualifications of building information modelling technology and the low level of awareness of the importance of introducing virtual environments into plans were another obstacle in implementing the software [4].

Previous research also found that the criteria that must be mastered to become a BIM Professional are BIM software application skills, knowledge of BIM concepts and standards, professional knowledge (construction and estimation), soft skills (creative thinking, expertise; independence, adaptability). and work behavior. (responsibility, credibility, discipline, and flexibility). Therefore, it includes all the competencies that BIM professionals really need [5].

2. CONCEPTUAL BACKGROUND

2.1. Building Information Modelling

Building Information Modelling (BIM) can be considered as a product, process, modelling method, or even a methodology, depending on what is being used when it is implemented. It's visible not only in the software, but also in the three-dimensional (3D) building design that organizes and visualizes all the building data before the actual construction is made. [6].

BIM is defined as a technology that enables different project stakeholders to generate, exchange information, and view other designers' project information that integrates data into a single database and is not limited to 3D models and links building productivity processes across the entire development cycle from construction planning to operation. buildings [7,8].

BIM is currently widely used around the world, with several countries indicating that it has a very good impact on projects and results in acceleration at various levels [9].

BIM is a smart approach in the construction sector, especially in the planning through construction phase and is used in many ways and at various levels by governments around the world. [10].

The use of BIM in the planning stage includes condition modelling, costing, stage planning, site analysis, and design review. The design phase includes planning, design/engineering analysis, and 3D coordination. For site plan preparation, 3D monitoring and planning, and documentation modelling, BIM is used during the construction phase. During the building operation stage, BIM software is used for maintenance, scheduling, and costing, as well as building system analysis [11].

BIM provides a platform for BIM professionals to collaborate enabling project-related collaborative work with different stakeholders by interoperating data using multiple BIM applications or software [12].

2.2. BIM Professional

A professional BIM is someone who has the skills and competence to implement BIM, and whose job is to compile, design, or assemble. A professional BIM is a person who translates a design concept into detailed drawings, complete with dimensions, layout, and features, and analyzes problems that occur during the BIM implementation process. A professional BIM is also assigned to assist in the execution of the development or production. Generally, the top five most sought BIM Professional roles are BIM modeler, BIM Analysis, BIM coordinator, BIM manager, and BIM Engineer [13,14].

2.3. Skill Requirement of BIM Professional

2.3.1. Soft Skill

2.3.1.1. Leadership

Leadership is the ability to lead and direct others in achieving a common vision, mission, and goals. A good leader must be able to make the right decisions, motivate the team, and manage conflict.

Leadership is essential in all areas of human endeavor. Leadership is even more important for building process features and construction projects, technically demanding, and require large and diverse project teams. Effective leadership in construction can be a solution to poor project execution. Leadership and construction are very important to each other. In general, leadership is an important success factor in any activity that involves collaboration between the groups involved [15].

A good environment in the project also comes from the importance of the leader in creating it. As a result, the success or failure of project management largely depends on the leadership skills of the project leader in managing the team [15].

2.3.1.2. Communication

Communication is an important skill that every BIM professional should have. Every team of BIM professionals in every organization around the world must be good at communicating to ensure a smooth flow of progress.

The ability to communicate well is a characteristic of a good BIM specialist, as well as the most frequently cited skill required in a BIM project team. the importance of having good communication skills and interacting with all team members to motivate them and help them solve all problems. This is important because BIM projects require a collaborative process, and multiple departments are needed to ensure the project runs smoothly [15].

These skills develop mutual respect among all colleagues, and good communication creates a positive work environment. A comfortable environment for doing work increases the morale of project members, and this behavior increases the quality of work [15].

2.3.1.3. Collaborative

Collaboration is the process of working together to achieve a common goal. It involves individuals or groups sharing knowledge, skills, and resources to achieve a common goal. Collaboration can take many forms,

including virtual teamwork, co-authoring, and project management, and is critical to project success.

Collaborative Building Information Modelling (BIM) is a process that involves using 3D models to facilitate better communication and collaboration between various stakeholders involved in a construction project, including architects, engineers, contractors, and clients. [12].

Collaborative BIM can be used to provide benefits without engaging users in collaborative practices with other project participants.

BIM technology implementation is often considered to be synonymous with collaboration, without the process inspection of the human element. With BIM coordination and multidisciplinary collaboration, projects are completed very quickly and easily managed [12].

2.3.1.4. Problem Solving

Problem solving is a very important skill in construction. These skills can develop with experience and knowledge, making them essential for any project. One's ability to be able to solve problems during construction and find solutions to those problems which can result in a stronger team. A leader needs to have the ability to find the source of a problem, solve it, and make sure it won't happen again [16].

BIM helps detect conflicts where parts collide with each other. However, a leader needs to know the causes and be able to solve problems and make decisions for model design [16].

2.3.1.5. Decision Making

Decisions are the result of solving a problem that must be faced firmly and deliberatively. Decision-making is the process of thinking in choosing from several alternatives or possibilities that are most suitable with shared values or goals to get results or solutions regarding future predictions. Decision Making is defined as selecting a decision or policy based on certain criteria. This process includes two or more alternatives because if there is only one alternative, no decision is taken [17].

2.3.1.5. Experience

Experience is a process of learning and improvement to be able to develop and achieve the potential to behave in both formal and non-formal education or can be interpreted as a process that brings a person to a higher pattern of behavior. The wider a person's experience, the more skilled a person is in doing work and the more perfect the mindset and attitude in acting to achieve the goals that have been set [18].

2.3.2. Hard Skill

2.3.2.1. Software

Construction planning using BIM needs to be supported by qualified software to support construction work. Such software as Revit, Tekla, and Navisworks.

2.3.2.1.1. Revit

Autodesk Revit is a structural and architectural design application based on BIM (Building Information Modelling) with 3D models that makes it very easy for building designers to produce accurate and high-quality designs. This software is specifically designed to support planning, design, construction, and building management processes in an integrated and coordinated manner. At Revit, all building data and information are available in one complete 3D model, making it easy for building professionals to work efficiently and effectively. Autodesk Revit is available in various editions that have special features that maximize design requirements [19].

2.3.2.1.2. Tekla

Tekla is software that allows us to create highly constructible 3D structural designs or models regardless of material or structural complexity. Tekla models can be used to create an entire building from conceptual design to fabrication, erection, and construction management [20].

Tekla Structures is one of those products available in a variety of configurations and local environments that provide a specific set of functionalities suited to specific segments and cultures for the needs of the construction industry [20].

With Tekla Structures you can get analysis and calculation results, drawings, reports, or other outputs from a single structural model. Tekla Structures has a standard API (Application Programming Interface) interface for connecting software analysis and design [20].

2.3.2.1.3. Navisworks

Navisworks is a 3D model design review product from Autodesk. Used primarily in the digital construction industry to perform model checking. Navisworks allows users to open and combine 3D models, explore them in real-time, and review models using a suite of tools including commenting, redlining, viewing, and measuring. A selection of plug-ins enhances the package by adding interference detection, 4D time simulation, photorealistic rendering, and PDF-like publishing [21].

The main difference between Navisworks and Revit is that Navisworks is more of a shadow side of the project for professionals. Like Revit, it is also capable of working with MS Windows, and can also work in other Autodesk

3D to open and combine models, view, and navigate objects [21].

2.3.2.1. Technical

When planning a construction using BIM, technical planning is needed, such as planning, design, modelling, and maintenance.

2.3.2.2.1. Planning

Planning is a business process to achieve goals, for example by making strategies and developing work activities to achieve organizational goals. In the management process, planning is the most important thing, because, without planning, the monitoring and directing process will not work properly. Therefore, this is the most important part to formulate ways to achieve organizational goals [8].

The function of planning is determining what to do and how to do it. This involves making decisions about several options related to the construction process. Planning is determining the direction of action to achieve the desired results [16].

2.3.2.2.2. Design

In construction, there are Preliminary Design stages which include design criteria, design schemes, block plan diagram processes, site plans, sections, plans, spatial drawings or site plans, and estimated costs. after everything has been conceptualized in the Preliminary Design, the next step is the detailed engineering design (DED) stage, namely the development stage of designing a design in a more detailed form that allows builders to understand the building to be made and to estimate accurately the entire cost of building construction [22].

2.3.2.2.3. Modelling

Modelling in BIM construction is the process of making an object or model that you want to translate into a real visual form, in terms of shape, texture, and size of the object. Another definition is a technique in computer graphics to produce a digital representation of an object in three dimensions (both animate and inanimate). Modelling itself is forming an object or object. Create and design objects so that they look like they are alive [23].

2.3.2.2.4. Maintenance

Maintenance is a system consisting of several elements in the form of facilities (machines), replacement of components or spare parts (materials), maintenance costs (money), planning of maintenance activities (methods), and maintenance executors (man) [24].

Maintenance is a series of maintenance activities for facilities, infrastructure, and equipment that are always ready to use to carry out a job effectively and efficiently according to a predetermined schedule and based on standards (functional and quality) [24].

2.3.3. Scope of Skill Requirement of BIM Professional

Based on the explanation regarding the skill requirements of BIM Professionals above, the scope of this research can be seen in Figure 1.
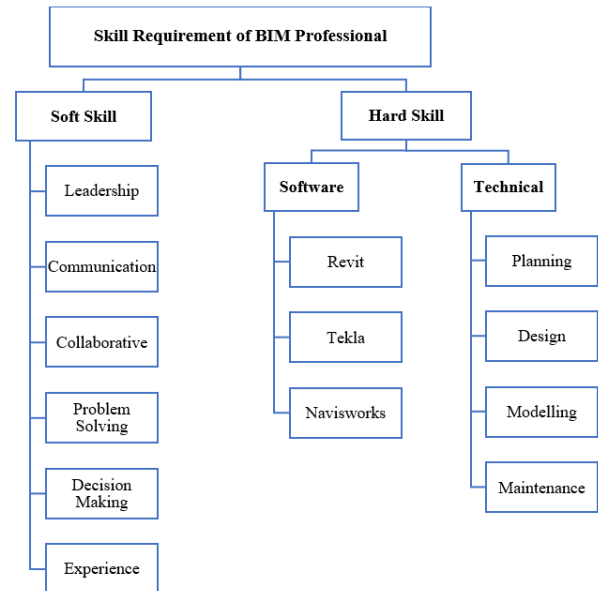
Figure 1 Scope of Skill Requirement of BIM Professional.

3. METHOD

This research method is a literature review based on previously published journals. These journals are based on covering conference proceedings and scientific publications such as Scopus. Selected journals based on the main theme of this paper, namely the skill requirement of BIM Professional. The criteria for selected journals can be seen in Table 1.

Table 1. Criteria of Selected Journals.

No	Criteria
1	The topic of the paper is BIM or skill requirements of BIM Professional
2	The main sources Conference Proceedings/ Scopus/Web of Science/Elsevier
3	Paper written in English language
4	Paper published within 2015 - 2023

Based on table 1, 10 papers have met the requirements for review. The papers were analyzed with literature mapping to identify important points in those papers.

Table 2. Previous Research.

No	Author	Purpose	Method	Scope		
				Soft Skill	Hard Skill	
					Software	Technical
1	Davies et al. [5]	Analyze the soft skills required for BIM Professional	Qualitative and interview	☐	☐	☐
2	Tai and Latiffi [6]	Identify the skills required for BIM Professional	Literature review	☐	☐	☐
3	Shah and Shrestha [20]	To find out the actual benefits from BIM-based 4D	Qualitative and interview	X	☐	X
4	Omer et al. [25]	To find out the constructive and destructive behaviors, skills, styles, and leadership traits in BIM-based construction projects	Qualitative and interview	☐	☐	☐
5	Adekunle and Aigbavboa [26]	To understand the role of BIM actors through the perspective of owners and actual BIM actors in the construction industry	Qualitative and survey	☐	X	X
6	Nguyen [27]	Identify BIM competencies that must be had by prospective workers in Vietnam	Qualitative and literature review	☐	☐	☐
7	Dakhil et al. [28]	Knowing what BIM competencies are needed by stakeholders	Case study and interview	☐	☐	☐
8	Udomdech et al. [29]	Knowing the inhibiting factors of BIM competence in Thailand	Qualitative and interview	X	☐	☐
9	Tanko and Mbugua [30]	Analyze the practice of using BIM, skills, and learning levels of BIM in Malaysian universities	Qualitative and literature review	☐	☐	X
10	Saka and Chan [31]	Defining the knowledge, skills and functionalities of BIM required by the quantity surveyor	Survey and delphi method	☐	☐	X

4. RESULT

Based on a literature review of selected journals, a literature mapping was carried out from these journals with the scope of research on the skill requirements of BIM Professional. An explanation of the literature mapping from previous research of 10 journals can be seen in Table 2.

Based on a literature review of selected journals, a literature mapping Based on Table 2, most of the scope of BIM Professionals' skill requirements are hard skills such as the use of software by BIM Professionals [5,6,20,25,27,28,29,30,31].

In BIM, all work is using integrated software such as Revit, Tekla, and Navisworks. This aims to support construction technical work processes, such as integrated planning, design, construction, and building management processes. Research methods that are often used in previous journals are qualitative and interviews [5,20,25,29]. Based on the analysis above, it can be described the positioning diagram mapping described in Figure 2.
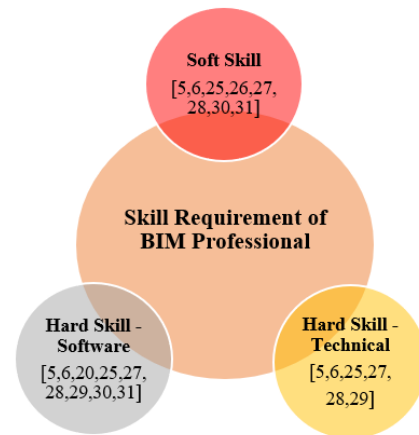
Figure 2 Mapping Positioning Diagram of Skill Requirement of BIM Professional.

5. DISCUSSION

In the world of digital construction, Building Information Modelling in Indonesia must apply the skill requirements for prospective BIM experts, skills in operating BIM-based software, and extensive knowledge of BIM. Because if someone does not have expertise in operation, it will be very difficult to coordinate between

project stakeholders and become an obstacle during the project development period. Therefore, in Indonesia, it is very important to apply the skill requirements for BIM Professional.

6. CONCLUSION

A BIM professional is someone who has the skills and competence to implement BIM, and whose job is to compile, design, or assemble. Generally, the top five most sought-after BIM Professional roles are BIM modeler, BIM Analysis, BIM coordinator, BIM manager, and BIM Engineer. Skill requirements that must be possessed are soft skills and hard skills. On soft skills such as Leadership, Communication, Collaborative, Problem Solving, Decision Making, and Experience. Meanwhile, for hard skills, such as software and technical skills. Mastery of software such as Revit, Tekla, and Navisworks. While the technical such as planning, design, modelling, and maintenance. The results of literature reviews from previous journals are that most of the scope of BIM Professionals' skill requirements are hard skills such as the use of software by BIM Professionals [5,6,20,25,27,28,29,30,31]. This research is expected to contribute to BIM research regarding what skill requirements a BIM Professional must have. In addition, it is hoped that there will be further analysis in this study.

AUTHORS' CONTRIBUTIONS

Writing—original draft, Rezi Berliana Yasinta; writing—review and editing, Adhi Purnomo, Ricky Johanes Saputra, and Intan Puspa Wangi.

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