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Research paper

BIM competency in personnel recruitment in Vietnam construction enterprises

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Abstract: The world has been implementing Building Information Modelling (BIM) successfully to construction projects from small to large scale. In Vietnam and many other countries, BIM is also widely applied in different fields of the construction industry. However, there are still many problems that need to be solved. One of those is to determine the necessary BIM competencies, thereby develop BIM personnel recruitment standards. The article identifies the competencies as well as evaluates their importance when supporting the recruitment of BIM personnel in construction enterprises in Vietnam. Through survey forms such as survey on online recruitment, expert interviews, and survey forms, the study is conducted with Likert scale, relative importance index (RII) for result analysis and ranking the importance of BIM competency for three distinct group of positions in Vietnam. With this result, the authors hope that the study will be an important reference, contributing to the development and concretization of the required competency criteria in the recruitment of BIM personnel in Vietnam and other similar countries.

Keywords: competency, building information modelling, personnel recruitment, BIM personnel, construction company, Vietnam

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1. Introduction

In recent years, with the explosion of the digital revolution in the construction industry, BIM becomes increasingly popular not only for design consultants but also for contractors and the owners. The development of computers and specialized software has led to the transformation of the design process from 2D drawings into 3D models [1], accompanied by the integration of information into the model. These new tools and solutions make design process faster as well as the management more intuitive and efficient [2]. The stakeholders of the construction project get the potential benefits when BIM (Building Information Modelling) is applied. Reducing clash/change, errors, and cost of changes in the construction process, enhancing the quality of drawings, for the convenience of data management and ease in resources planning and mobilization are remarkable benefits. Besides, BIM gives owners outstanding benefits such as 'maximizing project efficiency' and 'easy to select investment option' [3]. These benefits are potential and can only be obtained when project team members use model in day-to-day work.

In Vietnam, although it has been known and studied since 2000, the implementation of BIM to construction projects is still not popular and comprehensive [4]. Although the Government has issued supportive guidelines, the process of implementing BIM into the industry is still limited [5]. One of the main causes of this process is the shortage of personnel with high BIM skills [6]. This is partly due to the lack of awareness and assessment of BIM competencies in suitable with the needs of enterprises, which leads to orientations and training plans for universities and higher educational institution.

In order to solve the above problems, combined with the theoretical analysis of BIM competency, the article has conducted a survey of online recruitment, expert judgments and survey forms. Hence, analysing the results and ranking the importance of BIM competencies for three different groups of positions in Vietnam. The RII index analysis method is applied to rank and evaluate the competencies based on the results of the survey forms.

2. Literature review

2.1. BIM competencies

2.1.1. Definition of BIM competency

The term "competency" was first introduced in a study in 1959 by R.W. White [7]. In this study, competency was defined as the abilities that help individual to interact more effectively with their surroundings. For humans, this is considered as a factor affecting the motivation to promote work performance [7]. In terms of job competency, in essence, this term is defined as a combination of measurable or observable factors about the knowledge, skill, and personal attitude that individual can perform during work. The competency to implement BIM-related works (referred to as BIM competency for short) can be defined as the measurable or observable factors of the knowledge, skill, and attitude that an individual performs in their BIM-related works.

2.1.2. Classification of BIM competencies

Based on three main factors including knowledge, skill, and attitude, required competency in the BIM process has been classified in different methods in many domestic and international studies. In his research, M. Uhm [8] collected and analysed 242 online job postings in English, from the US, UK, and China. These job postings are then extracted into 35 job title categories and 5,998 job-related terms. Based on 5,998 extracted terms, the study has identified 43 competency factors, divided into 3 main groups including fundamental competencies, common competencies, and job specific competencies. Focusing on analysing individual BIM competencies, B. Succar [9] decentralizes competencies based on capabilities, measurable results, and activities of individuals as they perform BIM-related works. These levels include core competencies, domain competencies and execution competencies. In the process of studying the development of new job positions due to the emergence of BIM in construction industry, PM Bosch-Sijtsema [10] also classified BIM competencies into three main competency groups, including personal characteristics: attitude or behaviour, knowledge: concepts and theories and skills: manipulation and application. The above three groups of competencies are classified based on the characteristic of the new BIM-related position as well as on the basic characteristics when considering the competency of people at work.

In Vietnam, author Nguyen Nhu Trang [11] analysed development of competency to be able to perform BIM-related works more effectively, based on identifying the necessary competencies to meet system requirements. 41 necessary competencies are proposed by the author and classified into 3 groups as core competencies, functional competencies and management and leadership competencies. Besides, author Nguyen Tuan Anh [6] has also proposed a collection of necessary competencies for BIM-related public positions from general theoretical studies and surveying market demand through data collection from online job postings. Research has shown 8 highly demanded competencies with the rate of appearing over 60% of all positions in the postings.

Based on the stated research objectives and BIM competency concept, the authors classify BIM competencies into 6 groups, including knowledge competency, communication competency, implementation competency, management competency, thinking competency and attitude (Table 1).

Table 1. Classification of BIM competencies

Competencies' group	Competencies	Sources
Knowledge	Professional knowledge	[8, 9, 11]
	BIM-related knowledge	[4, 8, 9, 11]
	Practical experience	[8, 9, 11, 12]
Communication	Communication	[8, 9, 11]
	Foreign language	[8, 11]
	Instills Trust	[8, 11]
	Negotiation	[8, 11]

Continued on next page

Table 1 – *Continued from previous page*

Competencies' group	Competencies	Sources
Implementation	Using BIM software tools	[4, 8, 9, 11, 12]
	Teamwork	[8, 11]
	Self-study	[8, 9, 11]
	Planning	[8, 11]
	Making solving problem	[8, 11]
Management	Time and resource management	[8, 9, 11]
	Leadership	[8, 9, 11]
Thinking	Creative thinking	[8, 9, 11]
	Critical thinking	[8]
Attitude	Honesty, integrity	[8]
	Professional Behavior	[8, 9]

Source: Survey results of the study

2.2. Analysis of competencies

Professional knowledge

BIM is applied to solve the shortcomings and disadvantages in the construction industry. Therefore, to understand and apply BIM solutions in a full extent, it is required to understand the problems of various fields in the construction industry [13]. Professional knowledge is formed and developed through training at educational institutions or by self-study. This knowledge such as current standards and regulations on construction, design, and planning – architecture; as well as catching up the current and future trends is also required [8].

BIM-related Knowledge – related terminologies and policies

BIM is not a new term to the construction industry in Vietnam. The emergence and application of BIM has created many favourable conditions to implement construction investment projects faster, better, and more efficiently. BIM has been implemented in several projects in Vietnam, especially for large and complex projects. However, personnel working in BIM-related fields still have limitations in knowledge, concepts, and related policies.

Practical Experience

This competency requires the user to have experience and practice for a certain period with real jobs. These people are generally older, experienced individuals with difficulty accessing new technology. Meanwhile, younger employees, often with less competence in practical experience, often access new technologies more quickly than older employees. Therefore, combining two generations will be the key solution for executing the BIM plans effectively.

Communication

Communication is the way of transmitting messages from one person to another. Possessing good communication skills will help people easily achieve success in life and work. Especially in the construction industry, through the communication process,

employer can assess the views and opinions of candidates. Also, through communication skills, candidates might create their own spotlight, making themselves stand out from the others.

Foreign language

Although society is increasingly internationalizing as all fields: education, economy, politics... are heading to the international market. Moreover, Vietnam is constantly developing with many foreign investors selecting Vietnam as a destination. However, in the construction industry, the foreign language factor is still a huge obstacle for recruiters in the recruitment process.

Instills Trust

In every field and environment, building a trust between individuals and the entity is inescapable. This is the ability to interact with others in a way that allows them confidence in speaker's purpose and organization's goal. Building trust is the first step to create success in flexible workspace, where people can access more productive ways of working.

Negotiation

This is the ability to analyse and propose alternatives to reach agreement between all parties [10]. Negotiation requires a careful preparation and a little ingenuity, active listening, and emotional intelligence.

Using BIM software tools

In the construction industry nowadays, all the works from design to construction has been delivered with modern software, quick calculation, which helps stakeholders connect and interact conveniently. Especially with the cloud storage, the capacity for storage is extremely huge. Therefore, knowing how to use this software is a great advantage for the candidates.

Teamwork

Teamwork is the ability to work interactively with other members of a group or a project for a common goal [6]. The characteristic of BIM is the complexity and close relationship between a large amount of work performed by many individuals in different departments to develop a complete model. This shows the importance of coordination and cooperation between the parties in terms of project schedule, quality, and cost [15].

Self-study

The implementation of BIM at the initial stage is unavoidable with challenges and obstacles when transferring from the traditional model to the new model with many changes. Therefore, learning and exploring knowledge is indispensable for a successful transfer [11]. This competency includes being proactive as well as strategic in the learning process. Individuals need to be voluntary in learning, actively approach new skills, self-study and quickly update the latest software tools and then guide other members. In addition, improving knowledge as well as applying and sharing new skills in the most optimal way are also recommended [8].

Planning

This is the ability to define the purpose and goals for BIM implementation in the project or in the organization [11]. From there, determining the work to be performed, the time and resources required to achieve the goals set.

Embracing the work

Embracing the work is one of the essential tasks at work. It is needed to know what to do, how the result would be. This helps an individual be more confident and understand what is needed to do for the work [11].

Time and resource management

In a construction project, the criteria for schedule and resource allocation are always considered in the most careful way. Time management is an important thing to help businesses determine the order of work, whether the execution process is following the set goals or not. Meanwhile, resource management is the allocation and monitoring of the project's manpower, machinery, equipment, and capital. Meeting deadlines, continuously reviewing designs, and ensuring that construction is on schedule are necessary guarantees for effective time management. In terms of financial resources, financial managers must control the project budgets, be responsible for any changes in schedule, budget, information of models and identify and analyse financial-related risks. In terms of human resources, it is required to manage and guide the technician teams, balancing the number of workers in each item in accordance with the goals [8].

Leadership

Leadership competency is the administration of an organization or an enterprise. Administration includes the activities of developing an organization's strategy, coordinating employees to perform the tasks. This competency is required with a person who has a wide knowledge of management roles and skills, good awareness of the external environment and takes responsibility for their decisions, etc. . .

Creative thinking

Creativity is the key to breakthrough, innovation as well as the survival and development of a business. Creative thinking is reflected in the development of innovative initiatives, creativity when approaching and implementing work [8]. Creativity in implementation methods and ideas will lead to new solutions to replace and eliminate the old version, giving businesses a new direction for a continuing development. In the world with plenty of scientific development, businesses always need individuals with innovative thinking to optimize time and labour productivity.

Critical thinking

Critical thinking is the process of analysing and evaluating information, asking questions that challenge assumptions and assumptions, thereby clarifying the issue being discussed. This competency helps clarify goals, examine assumptions, assess underlying values, evaluate evidence, complete actions, and evaluate conclusions.

Honesty, integrity

This is the competency to demonstrate the basic and leading qualities as well as ethical standards of everyone in all fields and professions. Especially for the implementation of BIM model in the construction industry, the stakeholders are closely linked with each other in each stage. This leads to the needs for trust between stakeholders when performing the work to ensure the project schedule and quality. An individual's moral, integrity, and honesty affect the corporate culture, which has an impact on the reputation and stability of the organization.

Professional behavior

This competency is not only demonstrated through behaviours with stakeholders (the owner, consultants, etc.) but also in the way of working between departments within the enterprise. This is a premise to create a close and sustainable connection between individuals in the organization, contributing to the success of the organization and establishing a working environment of solidarity and high efficiency at work.

2.3. Recruitment of BIM personnel

Recruitment is considered as an important task for an organization, deciding the quality of the workforce, the productivity and efficiency of that organization's business in the future. According to Dinh Tuan Hai et al. [16], personnel recruitment is the process of candidates screening in many different aspects based on the position requirements, to get enough quantity and the most suitable candidates for the position to meet the requirements as well as the organization's personnel goals. Depending on the position and the characteristics of each organization in terms of scale, characteristics of business operations and financial potential, organizations develop detailing candidates screening. However, candidates who want to be recruited must meet the requirements of all steps. In addition, recruitment is also defined as the process of finding and selecting workforce to satisfy the current needs and necessary workforce for performance of the organization's goals [17].

There are many methods of classification BIM related job positions in different countries. In the study of Miyoung Uhm et al. [8] it is proposed total of 35 types of BIM job titles. They were then divided into eight groups, classified by analysing the relationship between job titles. Namely BIM project manager, BIM director, BIM coordinator, BIM senior architect, BIM manager, BIM designer, BIM MEP coordinator and BIM technician.

According to a study by Joseph [18] BIM positions are classified into 7 groups: BIM director, BIM modeler, BIM analyst, BIM application developer, BIM software developer, BIM modeler, BIM facilitator, BIM consultant, BIM researcher. In another aspect, according to Nguyen Nhu Trang [11], BIM-related jobs are classified into 4 main positions: Modeler (Modelling specialist), BIM Specialist (Technology expert), BIM Coordinator (Technology expert), and BIM Manager.

Within the scope of the study, the authors choose the form of classifying BIM-related jobs in construction enterprises in Vietnam according to 3 main groups according to [19], including: BIM modeler, BIM coordinator and BIM manager.

BIM modeler

BIM modeler can include different jobs such as drawing engineer, modeler, construction drawing engineer, BIM designer, etc. The main tasks of this position in Job postings include developing 3D models, developing design documents, and coordinating with stakeholders to get the tasks performed. It can be concluded that modelling is the primary responsibility of a BIM modeler. Besides, the implementation of design documents is also a common task of a BIM modeler.

BIM coordinator

The most common tasks required for this position include controlling models, clash detection and report, coordinating multidisciplinary models, developing, and updating

templates, standards, BIM guidelines, quality assurance of internal processes, development of 3D models, ensuring connection between stakeholders, updating project information.

BIM manager

A BIM manager is one of the key members of any organization that implements BIM building information modelling. They are responsible for implementing BIM, adopting, and developing the use of BIM for the organization's projects. The BIM Manager's duties also include ensuring communication between project stakeholders, providing internal human resource training, evaluating the BIM execution plan, leading meetings to identify and handle BIM-related issues, monitoring BIM-related budgets, updating new scientific and technological advances in BIM and offering long-term development strategies.

3. Research method

3.1. Research process

This research is conducted with the objective of determining competency requirements to develop BIM model in personnel recruitment of Vietnam construction corporates. The research method is synthesized from four main steps (Fig. 1).

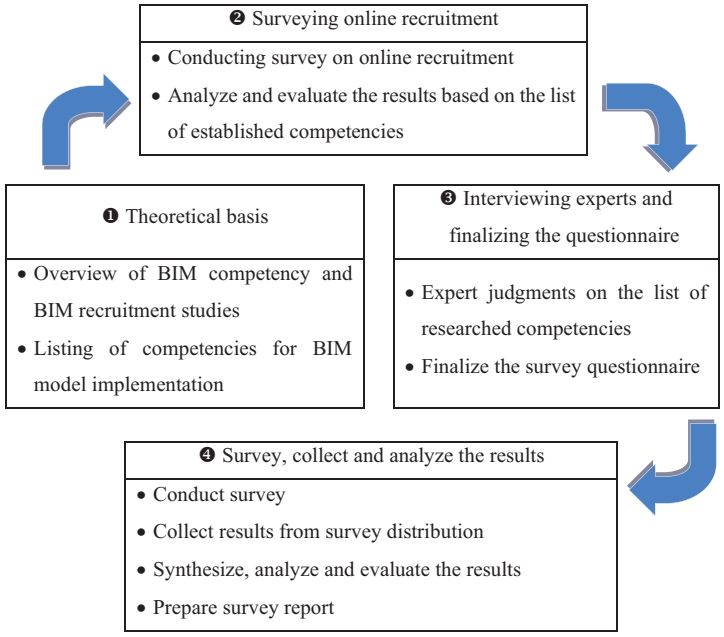


Fig. 1. Research conducting process (Source: research proposal)

The first step, select document sources, synthesize opinions, analyse, and evaluate objectively for establishment of theoretical basis.

The second step, evaluate the results after collecting the competency requirements to develop building information model (BIM) from online recruiters.

The third step, collect expert judgments in the field, the survey questionnaire is then formulated with adjustments to meet the recruitment criteria for BIM workforce at construction enterprise in Vietnam.

The fourth step, survey distribution and then analyse, evaluate responses from construction enterprises in the Northern, Central and Southern regions of Vietnam.

3.2. Preparing questionnaire and conducting survey

3.2.1. Surveying online recruitment information

The research is conducted and presented 18 competencies for BIM related jobs for further research. Based on the above list, a survey of online job postings was conducted. In this step, using online searching tools, the research team have accessed recruitment forums on Facebook and job posting website including linkedin.com, vietnamworks.com, jobstreet.com, jobstreet.vn, 123job.vn, applycv.com, cadjob.com, timviec365.net, careerbuilder.vn and some other websites. With the use of keywords "BIM", "Building Information Model", "Revit", "AutoCAD", "Tekla", "ArchiCAD" in the mentioned websites, within 2 months from August 2021 to October 2021, the research team collected 222 job postings from 126 construction companies in Vietnam. After analysing statistics on the frequency of appearance of 18 BIM competencies in online job postings, the team has listed a ranking for the presence of these competencies in the required description of 3 job positions, which are BIM modeler, BIM coordinator and BIM manager. The number of postings for BIM modeler is 159, BIM coordinator is 30 and BIM manager is 33.

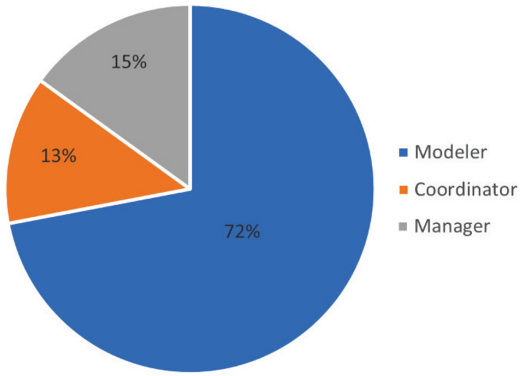


Fig. 2. Proportion of recruitment results for each job position
(Source: Analytical results of the study)

From the survey result, it is illustrated that the competencies "Embracing the work", "Instils Trust", "Negotiation" have very low frequencies at 7, 4 and 2 respectively. The list presenting the frequency of appearance of competencies are shown in Table 2. To ensure

that the offered competencies are oriented to the actual demands in the market, the above 3 competencies have been removed from the list. Other competencies are presented in Figure 3 based on frequency of appearance in BIM job recruitment.

Table 2. Frequency of appearance of BIM competencies in online recruitment postings of construction enterprises in Vietnam

No.	Competency	Frequency of appearance	Note
1	Using BIM software tools	208	
2	Practical experience	202	
3	Professional knowledge	199	
4	Foreign language	173	
5	Communication	142	
6	BIM-related knowledge	121	
7	Teamwork	106	
8	Professional behavior	88	
9	Honesty, integrity	58	
10	Creative thinking	53	
11	Self-study	48	
12	Time and resource management	47	
13	Leadership	34	
14	Planning	21	
15	Critical thinking	18	
16	Making solving problem	7	Removed
17	Instills Trust	4	Removed
18	Negotiation	2	Removed

Source: Analytical results of the study



Fig. 3. Frequency of appearance of competencies in BIM job recruitment
(Source: Analytical results of the study)

3.2.2. Consulting experts and setting up survey questionnaires

a. Consulting experts

In the next step, after removing 3 competencies, the research team made a list of the remaining 15 competencies for the survey questionnaire which was sent to 8 experts for judgments. there were 3 experts who are managers at Head of department level or higher in enterprises with the role of investors, 3 experts are managers at Head of department level or higher in enterprises with the role of contractors, 2 experts are recruiters with experience in recruiting BIM personnel for 3 years or more. After experts' judgments, besides removing the "planning", other competencies were agreed to be included in the next step.

b. Preparing survey questionnaires

After adjusting the competencies, the research team was prepared survey questionnaire to collects responses from construction enterprises in Vietnam about the importance of competencies for recruitment personnel at BIM-related positions. The targeted subjects are business managers, recruiters and employees working in BIM field. These subjects should have an understanding about the characteristics of certain BIM-related jobs or be able to evaluate the importance of the required competencies for the job position at a certain extent.

As the random convenience sampling method are selected, the use of Google Forms platform to create and send questionnaires was chosen because of its popularity and convenience for both surveyors and respondents. In terms of content, apart from demographics questions, the survey also collects opinions of respondents about the importance in recruitment requirements of 14 mentioned BIM competencies respectively for each position in 3 job groups including BIM modeler, BIM coordinator and BIM manager. The Likert scale with levels from 1 to 5 is used to assess the importance of each competency, in which: 1 – Not important or necessary; 2 – Not really important or necessary; 3 – Important, necessary; 4 – Very important, very necessary; 5 – Extremely important, compulsory.

c. Questionnaire distribution and collecting data

For time-saving and suitable amount of time allocated for the entire process of the fourth step, the implementation of the survey questionnaire was taken place entirely by online transition. The research team created the survey questionnaires on the Google Forms platform. Based on this platform, the questionnaire could be answered simply and quickly with just a Internet-connected device. After receiving responses from survey participants, the total number of forms received was 198, of which 164 were valid. The regional distribution of respondents converted to percentages is 56.7% of the forms collected in the Northern, 20.1% in the Central, 23.2% from the Southern of Vietnam. The number of respondents' years of experience in the construction industry is widely distributed, with 54.3% of those with 10 years of experience or more. Details is shown in Table 3.

Table 3. Information of survey respondents

Content	Range	Number of responses	Percentage
Years of experience in construction industry	Less than 5 years	37	22.6%
	From 5 years up to under 10 years	38	23.2%
	From 10 years up to 15 years	38	23.2%
	More than 15 years	51	31.1%
Years of experience in BIM-related job positions	None	5	3.05%
	Less than 1 years	73	44.51%
	From 1 year up to under 3 years	39	23.78%
	From 3 years up to 5 years	22	13.41%
	More than 5 years	25	15.24%
Position	Enterprise leader	25	15.2%
	Head of department	42	25.6%
	Recruiter	30	18.3%
	Technical staff, researcher, specialist, . . .	62	37.8%
	Others	5	3.0%
Regional	Northern Vietnam	93	56.7%
	Central Vietnam	33	20.1%
	Southern Vietnam	38	23.2%
Role in industry	The Owner	33	20.1%
	Construction contractor	83	50.6%
	Design consultant contractor	23	14%
	Others	25	15.3%

Source: Survey results of the study

4. Data analysis

4.1. Rank competencies with RII

Relative Importance Index (RII) is the average value of a factor with a proportion between 1 and A while A is the highest value of the scale. In this study, the value of A is 5.

RII is applied to describe the importance of that factor in combination with Likert scale. *RII* is determined following this equation:

$$RII = \frac{\sum W}{A \cdot N} \tag{4.1}$$

where: W – weight based on Likert scale for each response, in range from 1 to 5; A – highest value of the scale (5 in this study); N – total of respondents.

Following this equation, the results of *RII* indexes for each competency in each of 3 positions is presented in Table 4.

Table 4. Ranking competencies with *RII*

Competencies	BIM Modeler		BIM Coordinator		BIM Manager		Total	
Knowledge								
Professional knowledge	0.7313	8	0.7585	4	0.7756	11	0.7552	8
BIM-related Knowledge	0.6927	12	0.7366	11	0.7744	12	0.7346	12
Practical experience	0.7146	10	0.7463	8	0.7927	6	0.7512	9
Communication								
Communication	0.6756	14	0.7451	10	0.7805	9	0.7325	13
Foreign language	0.6817	13	0.7159	14	0.7634	13	0.7203	14
Implementation								
Using BIM sofware tools	0.7598	3	0.7305	12	0.7415	14	0.7439	10
Teamwork	0.7573	4	0.7646	3	0.7915	7	0.7711	3
Self-study	0.7561	5	0.7549	5	0.7805	9	0.7638	4
Management								
Time and resourse management	0.7220	9	0.7524	6	0.7951	4	0.7565	6
Leadership	0.7012	11	0.7220	13	0.8012	3	0.7415	11
Thinking								
Creative thinking	0.7354	6	0.7451	9	0.7854	8	0.7553	7
Critical thinking	0.7329	7	0.7500	7	0.7939	5	0.7589	5
Attitude								
Honesty, integrity	0.7878	1	0.7805	2	0.8122	1	0.7953	1
Professional Behavior	0.7744	2	0.7854	1	0.8085	2	0.7894	2

Source: Analytical results of the study

4.2. Ranking competency groups with RII

To determine and rank the contribution of each competency groups in the survey, RII is calculated for all of 6 groups. *RII* is the important factor for evaluation and ranking the importance of those. Table 5 illustrates the position of 6 groups based on RII. This classification is based on the listed competencies with impacts from external environment such as politics, socio-economic factors, environment, etc. Below are ranking of groups.

From the results above, the chart for comparison of average RII of each groups is presented in Fig. 4.

Table 5. Ranking competency groups with *RII*

Competency group	BIM modeler		BIM Coordinator		BIM Manager		Total	
	RII	Rank	*RII*	Rank	*RII*	Rank	*RII*	Rank
Attitude	0.7811	1	0.7829	1	0.8104	1	0.7915	1
Inplementation	0.7577	2	0.7500	2	0.7711	6	0.7596	2
Thinking	0.7341	3	0.7476	3	0.7896	3	0.7571	3
Management	0.7116	5	0.7372	5	0.7982	2	0.7490	4
Knowledge	0.7130	4	0.7472	4	0.7809	4	0.7470	5
Communication	0.6787	6	0.7287	6	0.7720	5	0.7264	6

Source: Analytical results of the study

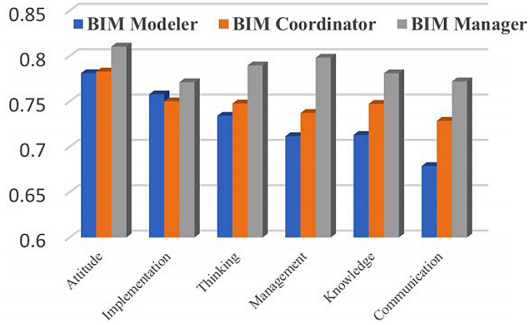


Fig. 4. Compare the average RII between the competency groups
(Source: Analytical results of the study)

4.3. Analyze and interpret the results

Attitude group

This is the most important group (*RII* = 0.7915) as clearly shown in Table 5 that employers aim for in all 3 positions. In all, the position of BIM manager rated this group the highest (*RII* = 0.8104), and the lowest at the BIM model position (*RII* = 0.7811). With all three positions having the same assessment, it is clearly shown the important influence of the "attitude" group in each position. The detailed analysis from Table 4 shows that the competency "Honesty, integrity" is rated as the highest (*RII* = 0.7953). "Professional behavior" competency is ranked second (*RII* = 0.7894).

Implementation group

This group is the 2nd most influential in importance (*RII* = 0.7596). In both BIM model and BIM coordinator, it is stated that this group is important only after the group "Attitude". Table 5 shows the competencies in the group ranking, the "Teamwork" competency is rated the highest (*RII* = 0.7711) at the third place while the "Self-study" competency ranks 4th (*RII* = 0.7638). The "Using BIM software tools" competency is not highly appreciated with overall ranking of 10th (*RII* = 0.7489).

Thinking group

All three positions have the same opinion that this group has the third most important influence on the job (*RII* = 0.7571). It is obvious to see that this group of competencies has an equal influence on all 3 positions. Analyzing the competencies in the group, Table 4 shows that the two competencies of this group are also ranked equally and in the middle of overall, with the competency "Critical thinking", ranking at 5th (*RII* = 0.7589) and closely behind at ranking 7th with creative thinking competency (*RII* = 0.7553).

Management group

This group is ranked 4th (*RII* = 0.7490) as shown in Table 5. In the position of BIM manager, this group is ranked higher than the remaining two (*RII* = 0.7809). Table 5 shows that the influence of these two competencies does not contribute as much role as other competencies with the two competencies "Time and resource management" ranked 6th (*RII* = 0.7565) and "Leadership" ranked 11th (*RII* = 0.7415).

Knowledge group

This group is ranked at 5th place with the same evaluation by 3 positions (*RII* = 0.7470). Table 5 shows that in this group, competencies are not highly appreciated with similar opinions. Overall, the competency "Professional knowledge" is ranked 8th (*RII* = 0.7553) followed by competency "Practical Experience" ranking 9th (*RII* = 0.7512). Finally, "BIM-related knowledge" competency was not ranked as an high-demanded competency with the ranking of 12th (*RII* = 0.7346).

Communication group

This is the group of competencies that all three positions consider to be the last priority when ranking at the bottom of Table 5 (*RII* = 0.7264). Table 4 also clearly shows that the preference for positions for competencies in this group is the least when both are ranked last. Communication competency ranked 13th (*RII* = 0.7325) and ranked last is "Foreign Language" competency at the position of 14th (*RII* = 0.7203)

Analyzing, judging based on rankings result

After collecting survey results and conducting analysis, comparing, and assessing the importance of competencies through the RII, it can be seen that "Integrity, honesty" and "Professional behaviour" is highly demanded in any position, whether as a modeler, coordinator, or manager. Comparing that to the frequency off appearance of online job postings (professional behaviour is 88 and Integrity, honesty is 58 of total 222 results), it is a clear difference when these 2 competencies are only ranked at an average level (8 and 9 respectively compared to 14 competencies).

In other aspect, although there is a very high frequency of appearance in job postings with 208 compared to a total of 222, the competency "Using BIM software tools" experiences a clear difference when ranking level of importance through the RII. For BIM modeler, this competency is ranked third after only 2 competencies in the attitude group, but for BIM coordinator and BIM manager, this competency is only ranked 12th and 14th respectively. The same analysis goes for the competencies of "Practical Experience" and "Professional Knowledge".

For group of communication competency, in general and for BIM modeler, two of four competencies have the lowest RII values. For jobs related to coordination and management,

competency "Communication" is rated higher, but only at an average level when compared to other competencies. For "Foreign language", this is the competency with ranking last or near the bottom for each position according to the RII. Meanwhile, ranking off the frequency of appearance "Foreign Language" (173/222) and "Communication" (142/222) is 4th and 5th respectively. This once again shows the difference between frequency of appearance on online job postings and importance of using RII.

Another problem that can be detected through the comparison of competency groups using the RII is that regardless of the competency group, BIM management related jobs always have a higher RII value compared to BIM modeler and coordinator. This appears in all 6 competency groups when performing calculations and comparisons. This may partly reflect a higher level of demand for management positions compared to other jobs in the BIM field.

5. Conclusion

The research has collected a synthesis of domestic and foreign research documents related to BIM and presented 14 required competencies, which are classified into 6 groups for job positions in the BIM field. In addition, the study also conducted a survey of recruitment information on BIM personnel in an online form on online forums and websites. After receiving expert judgment, an assessment survey on the importance of competencies for recruitment personnel for BIM-related jobs was conducted through an online form. After collecting, processing, and analysing data, the research team compared the competencies based on three job positions: BIM Modeler, BIM Coordinator and BIM Manager.

By comparison, although "*Using BIM software tools*" and "*Practical experience*" are the competencies that are highly requested in the recruitment announcements, the group of competencies with attitude with "*Integrity, Honesty*" and "*Professional behaviour*" are considered importantly for recruitment of BIM Modelers, Coordinators and Managers. Although the requirements in terms of experience, technique and use of technology are necessary for BIM-related jobs, competency in attitude, specifically here is the issue of ethics, integrity, honesty, and professional behaviour greatly influence the recruitment of BIM personnel in construction companies in Vietnam.

In terms of limitations, the study still faces many difficulties in collecting data compared to the number of enterprises that have implemented BIM in Vietnam. With the use of random convenient sampling method when the population size is unknown, the number of surveys questionnaire is 164, which is only enough to meet the survey scale at preliminary level, more surveys are needed to guarantee the representativeness of the results.

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