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Inhibiting Factors Analysis of BIM Implementation in Jambi City's Construction Companies

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ABSTRACT

The development of information and communication technology is increasing every year, contruction sector indeed. The rapid increase in technology in the construction sector has forced all AEC actors in Indonesia to follow these developments as an effort to increase work productivity. The breakthrough that can support infrastructure development to follow the digitalization era is the use of various technologies and applications of Building Information Modeling (BIM) which have many benefits. However, for the implementation of BIM in Jambi City itself still relatively low, from the maturity level of BIM based on the model (Succar, 2010) obtained a value of 0.719 at the non-existence level, which means that the use of BIM in construction companies in Jambi City has not yet been implemented. the discovery of the potential use of BIM, even seen from the optimism of the implementation of BIM in the company, not all informants have high optimism. Therefore, a study was conducted on the inhibiting factors that hindered the implementation of BIM in construction companies in Jambi City, using interview techniques to determine the actual obstacles. The 5 highest barriers factors were identified, that is Lack of understanding of BIM and its benefits, Lack of government support, Requires high hardware specifications, High investment costs for BIM official licenses, Lack of market demand (Clients). With this research, it is hoped that the application of BIM can be better and provide maximum benefits to construction companies in Jambi City.

Keywords: *Building Information Modeling; BIM Adoption; Supporting Factors; Inhibiting Factors.*

INTRODUCTION

The construction industry is one sector where information and communication technology development is accelerating annually. This development can be seen from modeling design tools which were initially just 2D to 3D modeling [1]. This rapid increase in technology in the construction sector means that all AEC companies in Indonesia must follow these developments as an effort to increase work productivity. The breakthrough that can support infrastructure development to follow the era of digitalization is the use of various technologies and Building Information Modeling (BIM) [2]

BIM (Building Information Modeling) itself is a set of technologies, processes and policies where all processes work collaboratively and integrated in a digital model [3]. BIM provides an integrity system for the entire design and construction and able to coordinate every process digitally from the pre-construction stage to the construction implementation stage [4].

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BIM changes the entire concept of planning by introducing a process for developing design and construction documentation. Construction documents such as drawings, procurement details, and other specifications can be easily interrelated [5]. Building Information Modeling (BIM) has emerged in recent years as a new solution to make the project life cycle more efficient by encouraging collaborative work of all stakeholders involved in a construction project, namely owners, consultants and contractors [6].

Based on previous research by [6] which explains the adoption of Building Information Modeling (BIM) in the Indonesian construction industry, it shows that even though it has been around for a long time in Indonesia, the use of BIM in Indonesia is still not optimal. This is due to the barriers to implementing BIM by construction service providers, such as providers that feel do not need BIM because existing technology is considered sufficient, investment costs that high, including training, there is no demand from clients, and BIM software is considered sophisticated to operate.

Compared with countries in Southeast Asia, the development of BIM in Indonesia is still very slow [7]. The level of BIM use in Indonesia tends to remain low and the level of BIM used is still limited to 3D. Despite all the obstacles, considering the huge potential benefits of BIM, the majority of them consist 75% want to implement BIM in the next 2-3 years, while the other 12% plan to implement it immediately within 1 year. Conducted a survey on several practitioner and academic respondents in AEC Sectors in several cities in Indonesia with results showing that the level of awareness of respondents is quite high, contained 70% of respondents know BIM, but the level of use of BIM is still low which 38% only. As for the implementation of BIM in Jambi City's construction companies, it is still very minimal, seen from 100% of the work packages that implement BIM in Jambi City are not carried out by local companies (Data: Jambi Regional Construction Services Selection Implementation Center).

Over time, BIM received more attention from construction actors and received support from the government who also wanted to advance the development of BIM, with the creation of PUPR Ministerial Regulation No. 22/PRT/M/2018 which reads "The use of BIM must be applied to State Buildings, not simply with the criteria of an area of more than 2000 m2 and more than 2 (two) floors". Apart from that, the 2018 release of the BIM Adoption Guide Module by the Ministry of Public Works and Public Housing (PUPR) is expected to be a supporting factor in the implementation of BIM in Indonesia. Several projects that have implemented BIM in Indonesia include: the Gelora Bung Karno Main Stadium renovation project in Jakarta, the construction of Pasar Atas Bukittinggi, the construction of Istora Bangkit Papua, and several other projects.

Because the level of BIM implementation in Indonesia, especially in Jambi City, is still relatively low and many contruction companies still use traditional work methods, it is necessary to carry out research to determine the inhibiting factors in implementing BIM in Jambi City which can increase the level of BIM implementation in the future. So that the construction industry in Jambi City can begin to change from conventional methods to Building Information Modeling methods, and the construction industry in Jambi City can adapt to the global level of construction technology.

MATERIALS AND METHODS

The method used in this research is a combination of qualitative and quantitative methods. Bim Maturity Matrix is used in this research as a tool used to identify BIM maturity in an

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organization [8]. The BIM maturity matrix is an adaptation of research entitled "Building Information Modeling Maturity Matrix". In this section the questions are arranged according to a simplified matrix in the research "Study of the Potential for Implementing Building Information Modeling in the Construction Industry in Indonesia" [9]. The matrix had 4 parameters, it is Non-Existence, Initial, Defined, Managed. Non-Existence, where the definition is that BIM has not been used at all by an organization.

Table 1: Bim Maturity Parameter

Scale	Level
0	Non-Existence
1	Initial
2	Defined
3	Managed

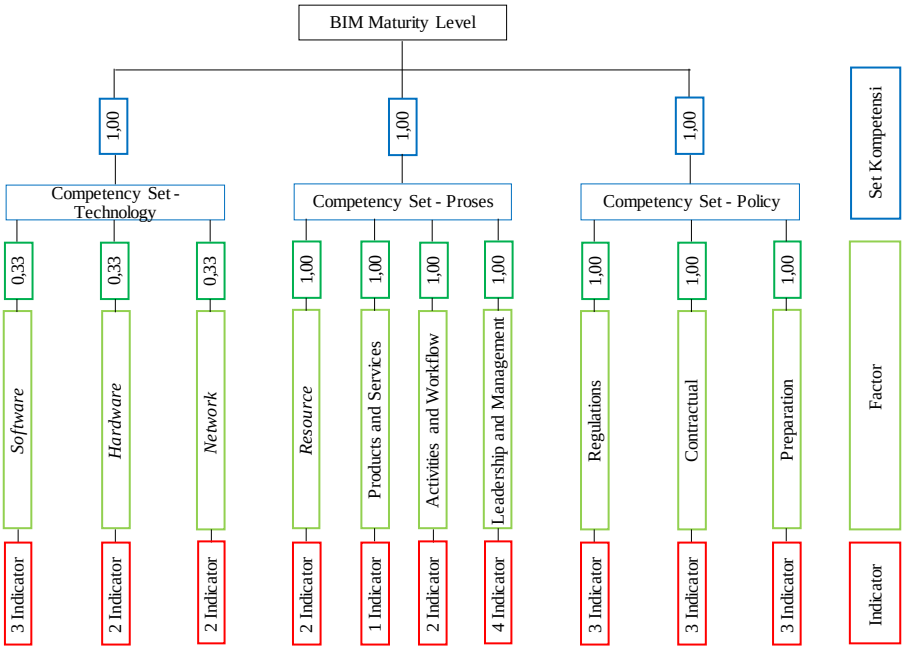

Figure 1: BIM Maturity Level Assessment Structure

Figure 1 is the BIM Maturity Level Assessment Structure for measuring BIM maturity level. The BIM maturity level will be carried out at each level starting from the BIM competency set first. Because the BIM competency set is an independent variable, each competency set will be given a weight of 1.00. Next, to determine the amount of weight at the factor level, the scored of the competency set will be divided according to the number of factors in each category with the assumption that these factors have the same influence. The following is an example of a calculation for a technology competency set:

$$Software\ factor\ index = \frac{Competency\ set\ index - Technology}{Amount\ of\ Factors\ in\ Technology - competency\ set}$$

Obtaining the average/mean value for the BIM maturity level for each indicator can be obtained through the following calculation:

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$$Mean_{Indicator\ 1-software} = \frac{\sum\ frequency\ of\ each\ class \times scores\ for\ each\ class}{Number\ of\ Samples}$$

$$Mean_{Indikator\ 1-software} = \frac{(4\ \times 0) + (4\ \times 1) + (0\ \times 2) + (0 \times 3)}{8} = 0.5$$

$$Skor_{Indikator\ 1-software} = 0{,}5 \times 0{,}111 = 0.056$$

The calculation of data acquisition of all the scores can represent BIM maturity level score for Jambi's Construction Companies

$$Total\ score\ in\ the\ technology\ competency\ area = \sum_{i=j}^{j} skor\ indikator\ i$$

$$Total\ skor\ pada\ area\ kompetensi\ teknologi$$
$$=0.056+0.153+0.056+0.063+0.146+0.208+0.125$$
$$=0.806$$

To find out the Inhibiting Factors for Implementing BIM in Jambi City's Construction Companies, a study of literature and previous research journals related to this problem was carried out. After obtaining the factors and variables, each factor and variable is grouped as shown in Table 2

Table 2: Inhibiting factors for implementing BIM

No	Sub Variable	Indicator
INDIVIDUAL FACTORS		
X1	Lack of BIM education and training	- Lack of BIM education at universities or schools - Lack of research by BIM experts - Lack of training by BIM experts
X2	Lack of understanding of BIM and its benefits	- BIM is considered less useful - Understanding of BIM is still lacking
X3	Lack of skill/ability development towards BIM	- Lack of expertise for BIM implementation at a high level - Weak engineering skills and difficulty learning BIM
ORGANIZATIONAL FACTORS		
X4	Lack of stakeholder awareness in BIM implementation	Lack ofcollaboration between project stakeholders or withother industries
X5	Lack of support from management	Lack of awareness of senior management (managers and owners) in motivating and supervising BIM implementation
X6	Reluctance to change/work transition	- Too comfortable with existing habits - Depends on software that is considered familiar
X7	Unclear BIM targets set by the company	Unclear BIM protocol standards (3D, 4D, 5D, 6D, 7D dimension target determination)
X8	Communication problems between divisions in the organization	- The workflow process is still not appropriate - Unclearness of the party responsible if information is damaged due to collaboration of information in one system
X9	Lack of Awareness of the benefits of BIM for	Lack of information about the benefits of BIM implementation

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No	Sub Variable	Indicator
	organizations	
X10	It is difficult to find competitors who can compete regarding BIM	The assumption is that BIM implementation is not yet mature as a whole
X11	Lack of effective collaborative cooperation	- Lack of collaboration between scientific disciplines - Minimal cooperation from other work partners
X12	Minimal government support	- Lack of government support - Lack of a supportive environment (Government policy and legislation)
TECHNOLOGICAL FACTORS		
X13	Software incompatibility for some types of projects	- Not all BIM software is suitable for a development project - Ability to interact with other systems, for example exchanging data, information, etc - Lack of single software solution
X14	BIM is not able to work optimally for fairly detailed image quality	The use of BIM technology is not optimal for fairly detailed image quality
X15	Existing technology is sufficient	Trust in current technology is considered sufficient so there is no need to use BIM
X16	Requires high hardware specifications	Requires high hardware specifications, such as a computer, internet connection, etc.
X17	Complex software usage process	Use of complex BIM software with minimal BIM specialists
X18	Data security issues	Information damage due to collaboration of information in one system
BUSINESS FACTORS		
X19	High costs of official BIM license investment	The official BIM license is relatively expensive
X20	High costs for BIM specialist training	Requires high costs for training required for BIM users
X21	Lack of market demand (Clients)	The owner did not request the use of BIM
X22	Lack of company financial capabilities	Companies have difficulty implementing BIM due to financial limitations
X23	There is no evidence of financial gain	Minimal evidence of financial benefits from using BIM
TECHNICAL FACTORS		
X24	Lack of BIM experts	Lack of qualified experts to provide BIM training
X25	There are no clear standards yet	Standards regarding BIM do not yet apply nationally
X26	Not using BIM because planners don't use BIM	Planning consultants do not yet use BIM, so project management does not use BIM
X27	Lack of real evidence	Lack of information regarding buildings built by implementing BIM
X28	It takes time to	- Time barrier due to time spent investing in and setting

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No	Sub Variable	Indicator
	implement BIM	up new software - time to learn how to use the software

The assessment of the variables in the inhibiting factors section is measured using a Likert scale with five levels that can be seen from Table 2, then Relative Important Index (RII), Mean Score and standard deviation are calculated on the factors inhibiting the implementation of BIM for Jambi's construction companies.

Table 2: Likert Scale

Score	Answer Description
5	Very influential
4	Influential
3	Neutral
2	No effect
1	Very Influential

RESULTS AND DISCUSSION

BIM Maturity Level

First, observations were made to find out whether there was an application of BIM in several construction companies in Jambi City, and after observing 3 companies in Jambi City, no companies were found that had implemented BIM in their projects but had understood the concept of BIM fundamentally through a brief discussion about the definition of BIM, BIM software, and the application of BIM to construction projects in Jambi City. The BIM maturity value for each company is in Table 3 which has been assessed using several indicators based on the model created by (Succar, 2010) and modified [9].

Table 3: BIM Maturity Level in Jambi's Construction Companies

Indicator	Contractor	Consultant	Average
Technology	0.625	0.986	0.806
Process	0.547	1.031	0.789
Policy	0.375	0.750	0.563

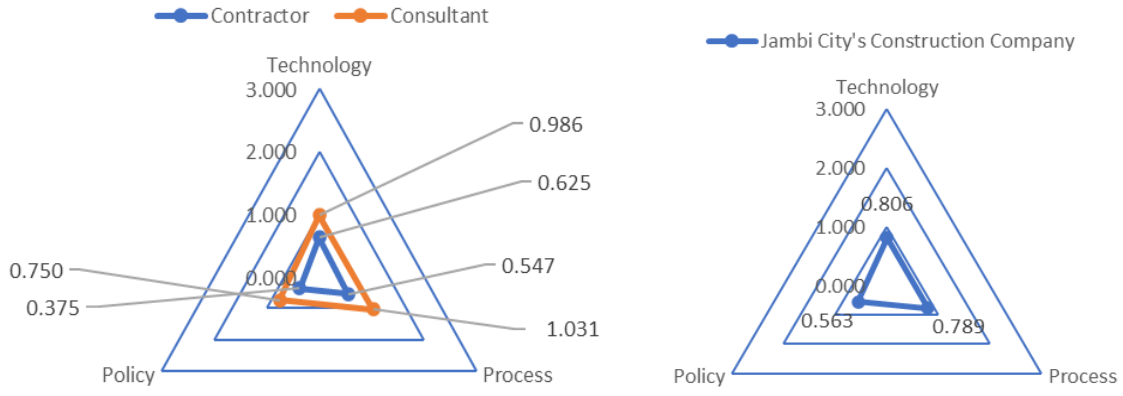

Figure 2: BIM Maturity Level Assessment Structure

From the results of this survey, it was found that BIM Maturity Value in Jambi City's

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Construction Companies is in range of 0.563-0.789. Figure 2 shows the level of BIM maturity in Jambi City's construction companies, where scores are obtained from the technology, process and policy competency areas with respective values of 0.806, 0.789, 0.563. Therefore, it can be concluded that Jambi City's construction companies are still at the non-existence level, with an overall average competency score of 0.539. The maturity level has not yet reached number 1, which means that there is still no use of BIM in Jambi City's construction companies, and the potential for using BIM has not been discovered, even judging from the optimism in implementing BIM in companies, not all informants have high optimism.

Because the implementation of BIM in construction companies in Jambi City is still at the non-existence stage, it is necessary to study the inhibiting factors that hinder the implementation of BIM in Jambi City's construction companies.

Inhibiting Factors for Implementing BIM

Data processing in this research was carried out by calculating the Relative Importance Index (RII), Mean Score (MS) and Standard Deviation. Then the informant had to rank 3 significant inhibiting factors. The inhibiting factors that have been ranked by each informant are as follows:

Table 3: BIM Maturity Level in the Pilot Survey

Variable's Code	Contractor			Comsultant			Resumes		
	RII	Mean Score	Standard Deviation	RII	Mean Score	Standard Deviation	RII	Mean Score	Standard Deviation
X1	0.95	4.75	0.433	0.85	4.25	0.433	0.900	4,500	0.500
X2	1	5	0,000	0.95	4.75	0.433	0.975	4,875	0.331
X3	0.9	4.5	0.500	0.85	4.25	0.829	0.875	4,375	0.696
X4	0.95	4.75	0.433	0.8	4	0.707	0.875	4,375	0.696
X5	0.9	4.5	0.866	0.8	4	1,225	0.850	4,250	1,090
X6	0.75	3.75	0.829	0.7	3.5	1,500	0.725	3,625	1,218
X7	0.8	4	0,000	0.65	3.25	0.829	0.725	3,625	0.696
X8	0.75	3.75	0.829	0.8	4	0,000	0.775	3,875	0.599
X9	0.85	4.25	0.829	0.85	4.25	0.433	0.850	4,250	0.661
X10	0.9	4.5	0.500	0.85	4.25	0.829	0.875	4,375	0.696
X11	0.9	4.5	0.866	0.85	4.25	0.433	0.875	4,375	0.696
X12	0.95	4.75	0.433	0.9	4.5	0.866	0.925	4,625	0.696

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Variable's Code	Contractor			Comsultant			Resumes		
	RII	Mean Score	Standard Deviation	RII	Mean Score	Standard Deviation	RII	Mean Score	Standard Deviation
X13	0.4	2	0.707	0.45	2.25	1,090	0.425	2,125	0.927
X14	0.45	2.25	0.433	0.6	3	0.707	0.525	2,625	0.696
X15	0.85	4.25	0.829	0.7	3.5	0.866	0.775	3,875	0.927
X16	1	5	0,000	0.85	4.25	1,299	0.925	4,625	0.992
X17	0.8	4	1,225	0.75	3.75	0.433	0.775	3,875	0.927
X18	0.35	1.75	0.829	0.7	3.5	0.866	0.525	2,625	1,218
X19	1	5	0,000	0.8	4	1,000	0.900	4,500	0.866
X20	0.75	3.75	0.433	0.7	3.5	0.500	0.725	3,625	0.484
X21	1	5	0,000	0.95	4.75	0.433	0.975	4,875	0.331
X22	0.7	3.5	0.866	0.5	2.5	1,118	0.600	3,000	1,118
X23	0.9	4.5	0.866	0.55	2.75	0.829	0.725	3,625	1,218
X24	0.9	4.5	0.866	0.65	3.25	1,299	0.775	3,875	1,269
X25	0.95	4.75	0.433	0.75	3.75	0.829	0.850	4,250	0.829
X26	0.85	4.25	0.829	0.7	3.5	0.866	0.775	3,875	0.927
X27	0.9	4.5	0.866	0.6	3	0.707	0.750	3,750	1,090
X28	0.9	4.5	0.500	0.8	4	0.707	0.850	4,250	0.661

Where:
X2 :Lack of understanding of BIM and its benefits
X12 :Minimal government support
X16 :Requires high hardware specifications
X19 :High costs of official BIM license investment
X21 :Lack of market demand (Clients)

This research focuses on 5 (five) inhibiting variables with the hope that the treatment analysis of these significant inhibiting variables can be discussed more sharply even with limited

research time. The research results can be seen in Table 3. The priority ranking is arranged based on the RII value and mean score. The variable that has the highest RII value and the smallest standard deviation has the highest agreement value. If the RII and standard deviation values have the same value, then the mean value will determine the ranking, namely the variable with the higher mean. The following are 5 (Five) significant inhibiting variables with the same and highest agreement values.

Discussion

The results obtained in research conducted on construction companies in Jambi according to several variables that appear most frequently in 18 related journals, all variables are included in the top 11. Where X2 is in 5th place, X12 is in 5th place, X16 is in 10th place, X19 is in 2nd place.

This is streng then by expert validation carried out on 3 experts consisting of 2 academics and 1 practitioner. Validation is carried out by interview via Zoom Meeting. In this interview, validation was carried out again with the Expert regarding the 5 (Five) significant inhibiting variables, as well as brainstorming with the Expert regarding treatment/recommendations for the five inhibiting variables. Based on interviews with 3 experts, they agreed that the inhibiting factors in Jambi City are also factors inhibiting the implementation of BIM in Indonesia, especially the lack of market (client) demand. 2 experts agree that client demand is the most significant factor.

This is in line with research conducted by (GUSTAF, 2018), where it was identified that barriers from software and training costs were 67.80%, there were no guidelines for implementing BIM at 45.76%, there was no demand/need for BIM in the amount percentage of 38.98%

CONCLUSION

Based on the results of the analysis and discussions that have been carried out in research analyzing factors inhibiting the application of BIM in Jambi City's Construction Companies, it was concluded that the application of BIM in construction companies in Jambi City is still very minimal, seen from the use of BIM which does not yet exist in existing contractor companies. in Jambi City, it is only limited to 2D manufacturing so the use of BIM software is still not optimal. Meanwhile, planning consultants have started using BIM software for 3D modeling of several work packages. The BIM maturity level in construction companies in Jambi City has a value of 0.719, which is at the Non-Existence stage, which means that at this level the organization has not used BIM and no potential for BIM has been found in an organization.

Overall, significant obstacles for construction companies in Jambi City include lack of market/client demand (X21) with an RII value of 0.975; Lack of understanding of BIM and its benefits (X2) with an RII value of 0.975; Minimal government support (X12) with an RII value of 0.925; Requires high hardware specifications (X16) with an RII value of 0.925; High investment costs for an official BIM license (X19) with an RII value of 0.900.

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