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Factors, Challenges and Strategies of Trust in BIM-Based Construction Projects: A Case Study in Malaysia

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Abstract: Implementing building information modeling (BIM) in construction projects can provide team members with an effective collaboration process. Therefore, organizations are implementing BIM to acquire the benefits. However, project members still use traditional collaborative approaches due to the lack of trust. Therefore, this study aims to identify the factors, challenges, and strategies of trust in BIM-based construction projects. To achieve this aim, semi-structured interviews were conducted with twenty industry professionals, and thematic analysis was used to analyze the collected data. The results suggest that the factors affecting trust in BIM-based construction projects are knowledge, skills, awareness, behavior, policy, system, cost, and management. Moreover, the challenges to creating trust in BIM-based construction projects are policy, cost, cooperation, system, service, behavior, expertise, and knowledge. Finally, the strategies used to create trust in BIM-based construction projects are management, preparation, capability, cooperation, awareness, individuals, education, and government. In summary, this study provides insights that can help industry practitioners to improve construction projects by reducing unnecessary distrust among team members.

Keywords: building information modeling (BIM); construction projects; trust; factors; challenges; strategies

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1. Introduction

Building information modeling (BIM) revolutionizes how facilities are designed, constructed, and operated [1]. BIM has garnered rising interest from the construction industry as it provides many advantages and may be utilized to save resources throughout the design, planning, and construction processes [2]. BIM has many benefits for construction projects [3]. Some benefits include improved efficiency, as BIM allows for more accurate estimation, scheduling, and coordination among project team members [4]. Moreover, BIM provides a repository for all project information, improving communication and collaboration among team members and reducing the risk of misunderstandings and conflicts [5]. Moreover, BIM allows the creation of effective models and simulations, which can help to identify potential issues and solutions before construction [6]. Overall, BIM can help team members to improve the quality, efficiency, and profitability of construction projects. However, BIM implementation is limited to only visualization, and a few construction projects use advanced BIM elements [4].

There are many barriers and challenges facing BIM implementation [7,8]. A lack of understanding and knowledge about BIM among project team members is one of the barriers [9]. Some team members may not fully understand what BIM is or how it can be used in their project, resulting in a hesitancy to implement it. Moreover, without proper management support, it is challenging to secure the necessary resources and obtain

buy-in from other team members [10,11]. In addition, the cost of BIM implementation, including training and purchasing software, can be a barrier to BIM implementation [12]. Furthermore, a lack of standardization in BIM practices and processes can be a barrier to BIM implementation; without standardization, it can be challenging to ensure that all project team members are using the same software, data formats, and processes, which can lead to confusion and misunderstandings [12]. Finally, trust is one of the major barriers to BIM implementation, including a lack of trust among team members in data sharing, as well as coordination, collaboration, and project management processes.

Trust is one of the metrics used to identify the nature of inter-organizational interactions in construction projects [13]. Trust strongly affects the strength of inter-organizational relationships and, ultimately, project success [14–16]. Trust determines the relationship between team members, which the project flow relies on [13]. Trust affects the interactions between individuals within the project and each individual's performance [13]. In BIM-based construction projects, trust is an essential foundation for successful collaboration among team members. Trust enables team members to rely on each other's expertise, knowledge, and skills and to work effectively together towards a common goal. When team members trust each other and feel comfortable expressing their concerns and ideas, it can create a more positive and collaborative atmosphere.

Without trust, team members may be hesitant to share information or express their concerns, leading to misunderstandings and conflicts [14]. This situation can result in delays, increased costs, and a lack of project cohesion. On the contrary, when trust is present, team members are more likely to collaborate and share their knowledge and expertise, leading to more innovative and efficient solutions. Furthermore, trust fosters a positive work environment, increasing morale and productivity [15]. In other words, creating trust in BIM-based construction projects requires open communication, collaboration, honesty, reliability, and professionalism from all team members [16–18]. Therefore, it is essential to overcome distrust in BIM-based construction projects.

Hence, this study aimed to identify the factors, challenges, and strategies of BIM-based construction projects. To achieve the research aim, semi-structured interviews were conducted with twenty industry respondents, and thematic analysis was used to obtain the results of the interviews. The study results could help to build trust in BIM projects for better communication and collaboration among team members, leading to more efficient and effective project outcomes. In addition, enhancing trust would help to increase BIM implementation.

2. Literature Review

2.1. Building Information Modeling

Three-dimensional (3D) modeling has been addressing engineering and construction challenges in recent years, particularly in construction safety and facility management [19–21]. Specifically, BIM is a technical creation that is used in the geometric modeling of a facility's performance and the administration of construction projects [16]. BIM is also considered an alternate solution to replace the old drawing design method [17]. The usage of BIM helps to offer more meaningful information for a project to be planned effectively, designed, constructed, and managed by industry professionals [22–24]. BIM can reduce the expenses of construction projects, resulting in better project affordability [19]. BIM also improves the overall project by enhancing information quality and accuracy in cost estimation. Powerful visualization and higher-quality information when employing BIM result in early clash detection and lessen disputes among project team members [20].

Besides aiding in planning and construction processes to operate more efficiently, BIM allows project team members to preserve data for subsequent operations and maintenance tasks. In addition, it minimizes the time to discover relevant information as it is simpler to obtain softcopy data than conventional hardcopy. These advantages of BIM undoubtedly provide architects, engineers, and contractors with a strategy to handle the typical challenges in construction projects via efficient planning [20]. However, in the construction

industry, projects are managed in a collaborative setting spanning several disciplines and different team members, causing trust concerns and producing a lack of clarity about duties, responsibilities, and interoperability. Therefore, several items need to be addressed while working on a BIM-based construction project, where team involvement is crucial [10,11].

BIM requires a particular amount of trust to be successful. However, the engineering, procurement, and construction (EPC) strategy generally employs transaction law, pushing each party to preserve their legitimate interests. Consequently, EPC contracting parties work within their aims and processes, in which trust is not a core contractual strategy. In addition, distrust, usually seen as harmful to the relationship, should receive more consideration when assessing the favorable effects of the partnership. Contract research has arisen from concentrating on the protection of contract transactions and is presently shifting toward coordination and contingency adaptation [14]. This leads team members to distrust each other in BIM-based construction projects. Without trust, construction projects will likely fail to achieve the overall benefits of implementing BIM. Therefore, this study explores the factors, challenges, and strategies of trust in BIM-based construction projects to avoid distrust among team members.

2.2. BIM Benefits and Challenges

BIM is becoming increasingly common, resulting in savings in construction and facility management expenditure. BIM also provides data transmission for interoperability between varied computer programs for various applications and uses [2,23]. The information included in a BIM data structure may be used to design or analyze, via field measurements, a facility's compliance with acoustic classes or performance [23]. BIM uses digital models throughout a built facility's whole lifecycle, from early conceptual and detailed design to construction and long-term operation [24]. BIM improves information flow between project team members at all stages, resulting in greater efficiency by reducing the time-consuming and error-prone manual data entering that characterized previous paper-based workflows [10]. The most prevalent challenges in BIM-based design coordination include inconsistencies between designs, confusing designs, conflicts, and missing objects. In particular, 28% of design difficulties have not been handled adequately until the conclusion of the design coordination stage [25]. Conflicts are often caused by working alone, professional blunders, and insufficient design times. Other causes of conflicts include complicated designs, a lack of expertise and understanding of BIM-based design coordination, last-minute design changes, and using several file formats during design work [26]. A lack of awareness and knowledge during the design process can cause the failure of design rules. To avoid interference between the elements in the design, designers should know several specific volumetric layers of the facility, especially at a turning point [18]. The congested areas of projects nowadays are complicated and place pressure on project time delivery. Furthermore, computer systems cannot detect all dimensional errors or incorrect positioning of elements in a design [27]. Budgetary restrictions, a lack of BIM expertise, a poor understanding of BIM concepts, a lack of awareness of BIM benefits, a lack of legal enforcement, an aversion to change among project team members, inadequate organizational support and structures for BIM implementation, and a lack of BIM industry standards are the most significant challenges to BIM implementation.

2.3. BIM Implementation

BIM implementation is hindered by many problems, including a lack of investment and unwillingness to relinquish old tools and procedures [16]. Among the main obstacles to BIM implementation are a lack of understanding and support from managers to modify existing processes, a lack of realistic standards and guidelines, and insufficient attention from policymakers [8]. The role of policy in simplifying commercial motivations for complete lifecycle costing in procurement is encouraged to drive the change in management required to overcome the short-term attitudes of senior management and the broader fragmentation of the construction industry [7]. Prior work surveyed the level of BIM

implementation in construction projects, and the results suggested that 78% of survey participants never used BIM, 10% used BIM occasionally, and 12% used BIM always in their work [16]. These rates are a negative indicator of BIM implementation in the construction industry. Practical application is crucial to overcome the implementation obstacles and to comprehend when, where, and how to use BIM. Therefore, it is advised that organizations start the BIM implementation process and support their team continuously. As a result, the integration of BIM in the working environment becomes simpler [16]. BIM performance measures may be used to assess how BIM might be delivered successfully. However, the reasonable expectations established by trust and the confidence acquired from negative expectations of distrust are intangible, and it is impossible to assess their effects directly from BIM deliverables [16].

2.4. Trust in BIM-Based Construction Projects

Trust has been recognized and reported as a crucial element contributing to the success or failure of construction projects [16]. Trust is widely recognized as a "psychological state which comprises the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another" [28]. Three primary criteria that emerge as necessary are honest communication, reliance, and the delivery of results. When there are clear communications in a construction project, individuals effectively convey their expectations of one another [29]. On the contrary, unfulfilled individual expectations result in distrust. Trust is created during certain situations or several projects [30]. It may break down, certain factors can erode trust, and re-establishing it is not always simple [31]. Only trust can positively impact the transaction when fear and skepticism are reduced via distrust-related contract rules. Contract research has focused substantially on trust but disregarded the beneficial effect of addressing distrust in enhancing project efficiency [14]. Distrust originates from an incongruous viewpoint between an organization's values and those of its partner, which causes suspicion that a partner could behave opportunistically. Conceptualizing trust and distrust as two independent categories gives insights into how organizations encourage trust, as good intentions may be expected without considerable monitoring [14]. The majority of individuals trust the old system, with its inherent faults, and may even be deeply invested in mitigating them. The same or a greater level of trust must be demonstrated and maintained in any new system. The balance of certain degrees of trust and distrust during the initial stages of cooperation could benefit the later collaboration stage [32].

2.5. Research Gap

From the literature, BIM's benefits, challenges, and implementation are well discussed by researchers [16–32]. On the contrary, research on soft factors such as trust in BIM-based construction projects is limited. Trust is a human behavior that affects BIM implementation in construction projects, and having more trust would help to overcome the implementation challenges. Therefore, this study aims to identify the factors, challenges, and strategies of trust in BIM-based construction projects. Trust in BIM-based construction projects is essential for effective communication and collaboration, improving project quality, increasing efficiency and productivity, and achieving project success.

3. Methodology

3.1. Data Collection

In this study, semi-structured interviews were used as the data collection method. It is believed that the data obtained through this method are more reliable and applicable in supporting the study's aim. The study results are based on the respondent's behavior when answering the questions. This method has also been used in other works, such as to identify the impact of COVID-19 on construction projects in India [33]. The main interview questions were designed based on the study's aim as follows:

- What are the factors affecting trust in BIM-based construction projects?

- What are the challenges to creating trust in BIM-based construction projects?
- What are the strategies to create trust in BIM-based construction projects?

Follow-up questions were then asked to acquire more information from the respondents and to obtain sufficient data. Examples of the follow-up questions are shown in Table 1.

Table 1. Interview questions.

No.	Main Interview Questions	Examples of Follow-Up Questions
1	What are the factors affecting trust in BIM-based construction projects?	• Can you share some examples related to this factor? • Other than your experience, do you think there are other possible factors affecting trust in BIM-based construction projects?
2	What are the challenges to creating trust in BIM-based construction projects?	• How do these challenges affect BIM-based construction projects? • Normally these challenges occur among which project team member?
3	What are the strategies to create trust in BIM-based construction projects?	• Any other strategies to create trust in BIM-based construction projects?

This study's target respondents were chosen based on their professional histories and current job positions. Next, the researchers searched for positions on a professional networking website to identify the appropriate respondents and contacted these individuals. In addition, some respondents were identified through individual connections. Finally, some respondents were identified through targeted firms by contacting their human resources departments and requesting the contact information of appropriate industry professionals. The initial communication was structured as a cover letter to ensure that the relevant information was included and presented clearly and concisely. If the initial communication was not responded to, reminders were sent. Figure 1 shows the data collection process flow.

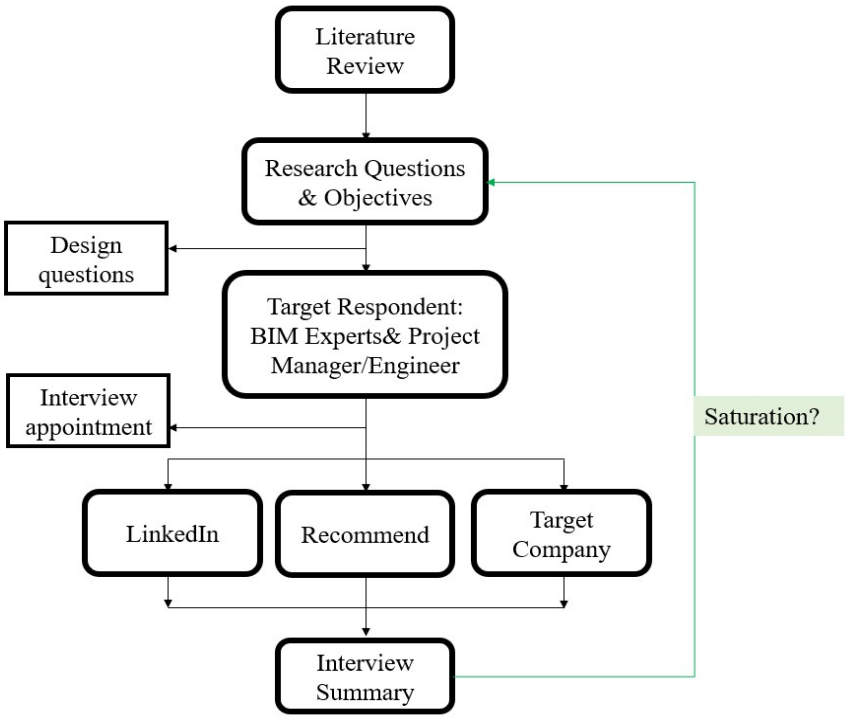

Figure 1. Data collection process flow.

The target population included BIM experts as well as project managers/project engineers related to BIM. BIM experts ranging from BIM Modelers to BIM Managers were selected as interviewees. While their job roles may vary due to different responsibilities, they all work in a BIM-based environment and have the opportunity to learn about the different aspects of BIM, including the modeling process, coordination process, and the role of BIM in estimation and clash detection. Additionally, they can participate in contract-based BIM work, including the specified completion time, design criteria, and legal agreements related to the project.

The rationale for selecting project managers and project engineers for interviews was that these professionals work closely with BIM experts throughout the construction project. For example, some organizations may hire BIM consultants mid-project, which requires strong communication and coordination between the construction and BIM teams. Additionally, some contractor firms may include the BIM department in their project team to carry out BIM work for quality and cost estimation, as well as visualization and conflict detection in the early stages of the project. A summarized list of the 20 interview respondents is shown in Table 2.

Table 2. Respondents' information.

Respondent	Gender	Designation	Work Experience (Year)
R1	Male	BIM Engineer	3
R2	Male	BIM Architect	3
R3	Female	BIM Coordinator	3
R4	Male	BIM Lead	3
R5	Male	BIM Modeler	3
R6	Male	BIM Coordinator	5
R7	Female	BIM Modeler	5
R8	Female	Senior BIM Executive	4
R9	Female	BIM Manager	6
R10	Male	BIM Engineer	5
R11	Male	Assistant BIM Manager	5
R12	Male	Senior BIM Engineer	3
R13	Male	BIM Architect	4
R14	Female	BIM Modeler	4
R15	Male	Head of BIM Department	12
R16	Male	BIM Modeler	6
R17	Male	BIM Modeler	5
R18	Male	BIM Modeler	3
R19	Female	Assistant BIM Manager	4
R20	Male	BIM Modeler	4

Accuracy and reliability are critical for ensuring high-quality data. Data validation is important in any research. It is a necessary process as it helps to produce the most reliable results possible. Ensuring the integrity of the data contributes to the authenticity of the results. In this study, the data were validated by summarizing the interview sessions with the respondents through email and phone calls. This approach was taken to ensure that the respondents had the opportunity to review and confirm the accuracy of the data.

3.2. Data Analysis

This study used the thematic analysis method to analyze the interview data [34]. This method is widely used in construction management research to analyze qualitative data [35,36]. The coded data were based on the factors, challenges, and strategies of trust in BIM-based construction projects. After receiving clearance from the respondents, the data were coded and analyzed. The coded data were then compared among respondents. Similar codes were grouped into a single topic for further analysis and to support the study aims. Additionally, although specific coded data may not be sufficient as primary supporting points, they can provide further context and insight into the main topic. These

data were classified as subthemes and were chosen based on their relevance and logical connection to the main theme [34]. Figure 2 depicts an overview of this research flow.

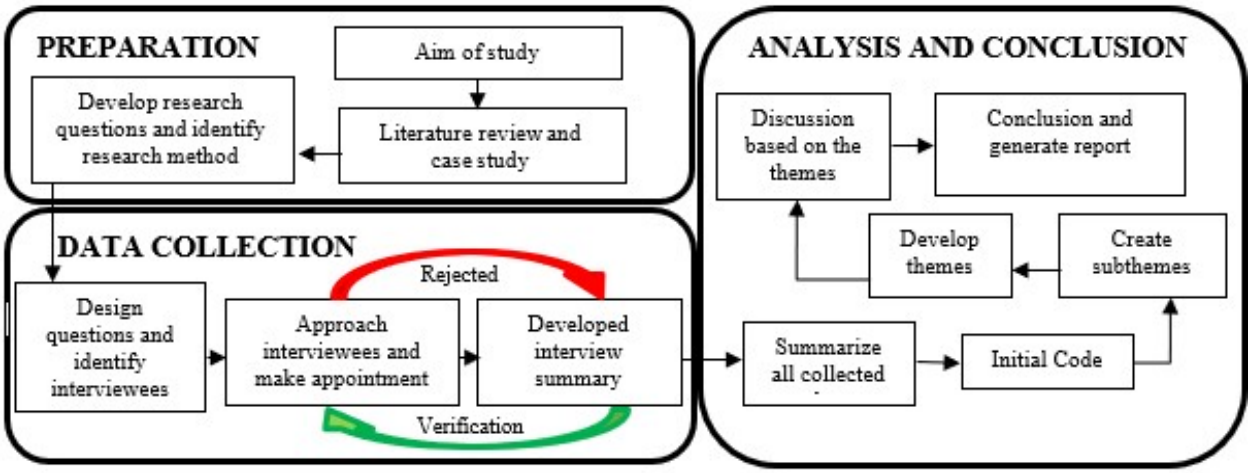

Figure 2. Overview of methodology.

4. Results and Discussion

4.1. Factors Affecting Trust in BIM-Based Construction Projects

Figure 3 illustrates the factors that impact trust in BIM-based construction projects. Table 3 shows the total hits for each factor. The themes of these factors are people and processes. For people, the subthemes include knowledge, skills, awareness, and behavior. For processes, the subthemes are policy, system, cost, and management. The following sections discuss the details of each theme and subtheme.

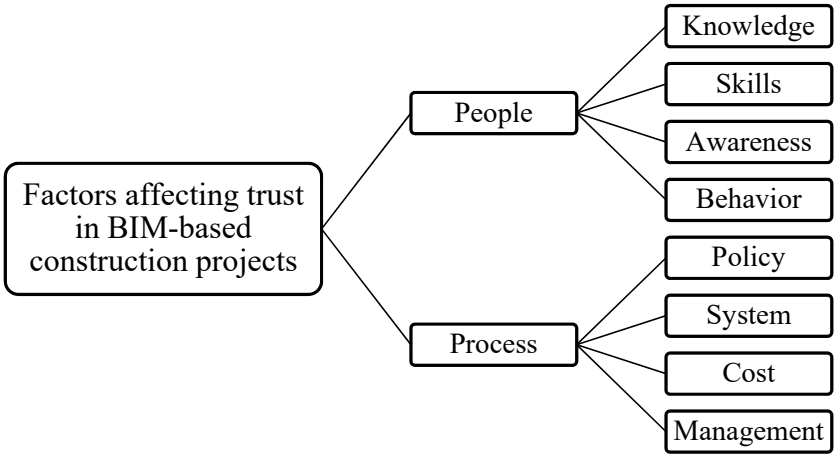

Figure 3. Summary of factors affecting trust in BIM-based construction projects.

Table 3. Factors affecting trust in BIM-based construction projects.

Respondent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum
Project																					
Policy	√									√						√					3
Cost	√		√		√			√	√		√	√		√		√	√	√	√	√	13
Cooperation			√					√													2
System						√					√	√						√			4
Services			√		√							√			√					√	5
Technical																					
Behavior		√		√	√	√			√		√			√	√		√	√	√		11
Expertise		√	√	√	√	√			√	√	√			√			√	√		√	12
Knowledge							√	√					√	√			√				5

4.1.1. People-Related Factors

Knowledge

Knowledge of BIM is essential [37]. However, BIM implementation can be challenging as it requires input from many project team members. Project team members that lack knowledge of BIM are more likely to make mistakes when completing tasks, which can lead to rework. In addition, rework can decrease productivity and increase distrust [38]. Therefore, knowledge of BIM can help to overcome distrust in BIM-based construction projects [39]. Examples of the related interview responses are as follows:

> *Knowledge of BIM is not only just for BIM consultants to realize how important BIM is. Contractors, clients, and other project team members should know how BIM works to smooth the project workflow. (Respondent 1)*

> *Most projects do not use BIM if not mandatory, and lack of knowledge of BIM influences the trust in BIM. (Respondent 6)*

Skills

Some workers lack the necessary skills for these projects [30]. Some project team members can work with BIM, but when they are on-site, they are unwilling to use it [40]. Despite the availability of 3D models mostly developed in Virtual Reality (VR) systems [41], some project team members still prefer traditional methods (i.e., relying more on 2D reports) to avoid design conflicts. All project team members must follow the new BIM requirements outlined in the standard operating procedure, rather than reverting to old methods. Distrust can arise when project team members cannot trust each other due to skill or capability issues. Examples of factors discussed by respondents include the following:

> *Skill preparation, such as contractors and consultants, must discover further about BIM as most people agree on AutoCAD rather than BIM, which affects few BIM positions available. (Respondent 11)*

> *Before the project begins, a discussion is conducted regarding the duration needed for each team to complete its tasks. A problem will occur if the team does not complete it within the allotted time. (Respondent 12)*

Awareness

Awareness involves being informed about and attentive to a particular situation or development. A low level of BIM implementation is often attributed to a lack of awareness [42]. Project team members need to have a high level of awareness of BIM-based construction projects, as technological advances are meaningless without user awareness. To avoid mistakes, the team should be fully aware of the detailing, deliverables, reports, drawings, and modeling [43]. Every project team member should know their tasks and research the project before beginning work. Failure to do so can lead to difficulties in communication among project team members. A relevant response from a respondent was as follows:

> *Apart from that, among the examples of miscommunication are those who must check the detail of the drawing/modeling, not doing their job properly, and not checking and responding well, which bothers many project team members later. (Respondent 4)*

Behavior

People's behavior in the industry is a factor that affects trust in BIM-based construction projects. Interoperability promotes collaboration, personal commitment, motivation, and individual behavior to spread BIM [44]. A high amount of rework can lead to a breakdown of trust. The BIM execution plan plays a role in how they plan in terms of tools, software, and work paths to save costs and avoid rework. One of the causes of rework is workers not completing the job properly, overlooking or changing drives that are inconvenient, or cluttered files [45]. BIM is a collaborative process, and civil design and mechanical

and electrical (M&E) must also modify the model when the architectural design changes. Disputes can occur between the main contractor and subcontractors when the architect is late in updating design changes in BIM. At the same time, work continues, causing the site construction and BIM to be out of sync. This can lead to disputes and distrust between project team members.

> *Effective communication between all team members is important during the project. If there is any miscommunication, it will be tough for many project team members. Project team members will eventually disagree when there is a question while modeling when establishing your specifications without proper communication. Then, many changes must be made. (Respondent 4)*

4.1.2. Process-Related Factors

Policy

To promote BIM, policymakers have mandated the use of BIM in several construction projects. However, some organizations use BIM in their projects to facilitate work, while others use it only as required [46]. Additionally, BIM is used on one server, and all information is shared. Therefore, after completion, there may be distrust regarding data ownership between project team members, as most members have access to the cloud and can take data and information.

> *BIM is mandatory. There is no answer to identifying the factors affecting trust as policymakers have set BIM as a mandatory application for high-cost projects. (Respondent 9)*

System

The system of BIM during construction projects, such as internet connection dependency, means that reduced internet speeds can lead to decreased work productivity. There is also a risk of overreliance on systems that will only be as effective as the information placed into them. In terms of security and privacy, cloud providers host data, and there may be concerns about who has access. BIM experts are cautious as cloud technology is still developing [47]. Nevertheless, BIM is a reliable source of information for all team members in a project. In addition, BIM requires essential information for modeling and coordination with other trades. This can help to address any issues at an early stage.

> *It is essential to have a complete model with full coordination to avoid any discrepancy in real-time construction. We have already reduced the tendency of human error in construction by having a solid visual of the exact building we will build. (Respondent 2)*

Cost

The high cost of implementing BIM in construction projects is a factor that can affect trust [12]. It can be costly to train senior staff on BIM and to hire new staff with BIM skills. Changing the workflow and equipment, obtaining licenses, and training staff can be time-consuming and require a financial budget. It is not certain that investing in BIM will be worthwhile, as there is no guarantee of receiving BIM projects in the future. A relevant response from a respondent was as follows:

> *High-cost projects require many BIM modelers to handle a section. Each section is combined into one cloud file that all modelers can access. It becomes dangerous when the modeler opens or changes a part that is not part of his job and causes design errors. As a result, all project team members will be blamed. (Respondent 4)*

Management

BIM implementation involves many challenges, one of which is the management challenge [48]. The senior management's decisions regarding the transition to BIM are significantly influenced by their awareness of BIM implementation and its process in construction projects [39]. Therefore, before starting the project, it is important to brief project team members thoroughly. However, not all members are prepared to use BIM as

it requires the implementation of new changes. Therefore, it is important to assign team members to appropriate positions based on available resources. The participants' responses were as follows:

> *When a developer or client wants to approach a BIM consultant or aspect offering BIM, they usually want to check if the consultant can deliver BIM. There are many process workflows in BIM, and not everyone can do them properly. Unfortunately, there are too many BIM processes and workflows, and it is difficult to know which one to use. (Respondent 13)*

> *A BIM execution plan must be prepared and provides an overview of the entire project's content. The execution plan needs a complete deliverable, what it is going to get, what to manage, and what BIM content. This execution strategy should be presented to clients to help them understand and trust BIM. (Respondents 13 & 18)*

4.2. Challenges to Creating Trust in BIM-Based Construction Projects

It has been found that many organizations have yet to implement BIM, which means that professionals within these organizations cannot experience and interact with BIM. This will significantly impact the project team members' technical and management skills [39]. Figure 4 illustrates the challenges to creating trust in BIM-based construction projects. Table 4 shows the total hits to implement these strategies. The themes related to creating trust in BIM-based construction projects are project and technical aspects. The subthemes for the project include policy, cost, cooperation, system, and service. For the technical category, the subthemes are behavior, expertise, and knowledge.

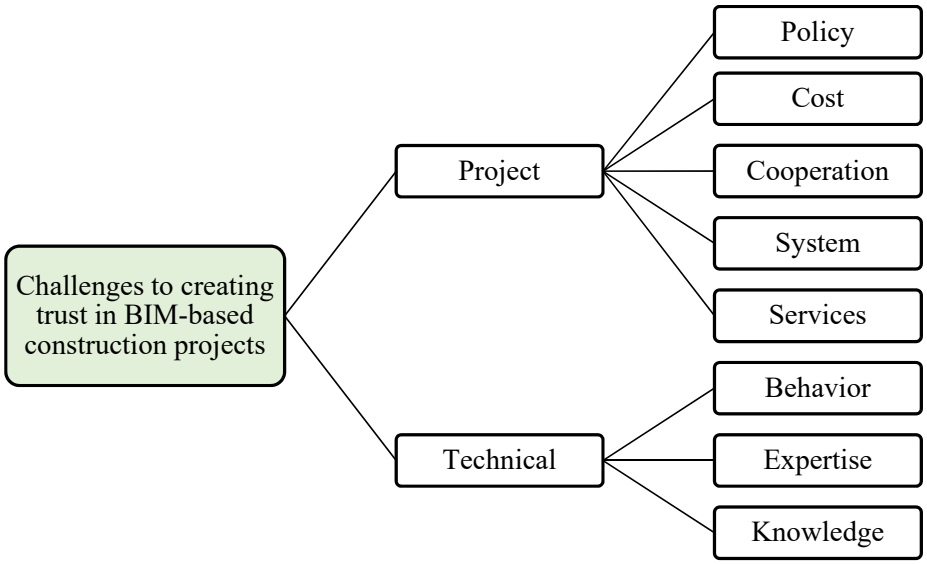

Figure 4. Summary of challenges to creating trust in BIM-based construction projects.

Table 4. Challenges to creating trust in BIM-based construction projects.

Respondent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum
Project																					
Policy	√									√						√					3
Cost	√		√		√			√	√		√	√		√		√	√	√	√	√	13
Cooperation			√					√													2
System						√					√	√						√			4
Services			√		√							√			√					√	5
Technical																					
Behavior		√		√	√	√			√		√			√	√		√	√	√		11
Expertise		√	√	√	√	√			√	√	√			√			√	√		√	12
Knowledge							√	√					√	√			√				5

4.2.1. Project-Related Challenges

The construction project is an organized construction, renovation, and refurbishing process. For BIM-based construction projects, there are many challenges to creating trust. Five subthemes are identified related to the project: policy, cost, cooperation, system, and service.

Policy

One of the challenges faced in construction projects is that only public projects require BIM. BIM implementation involves many challenges, including legal risks [21]. Small organizations may not participate in open tenders and do not want to use BIM, leading to less exposure to BIM. Additionally, when senior management in an organization does not establish policies regarding BIM, distrust can arise. Therefore, organizational management needs to review documentation and create a new standard operating procedure for workers to understand and follow.

> *It is mandatory to apply BIM for projects that are more than 100 million, so is a probability of getting good contractors or bad contractors, such as in projects it should have 20 staff use BIM, but the contractor uses four staff. (Respondent 6)*

Cost

BIM implementation involves various challenges, including financial ones. Many individuals and organizations are still hesitant to use BIM, and one of the reasons is that it can be expensive. BIM software can be costly, which makes small organizations hesitant to use it. However, large organizations have already implemented BIM in their project workflows. Therefore, the cost of BIM remains a challenge for small and medium organizations.

> *As it is now mandatory to use BIM in high-cost projects, underprepared organizations will have to spend a high cost as the training and tools needed for BIM is high. (Respondent 9)*

> *Nominating subcontractors, installing software, and hiring personnel with BIM skills are expensive. (Respondent 11)*

> *The high cost of BIM-based construction projects always makes clients doubting with the price offered by an organization. However, the client would understand and agree with the cost provided after presenting the work done and the results. (Respondent 12)*

> *Using BIM in projects is a high cost. The license and expertise are costly. Small organizations are not worth it, so they cannot use BIM. They do not want to put their trust in them as there is no guarantee of acquiring construction projects with BIM implementation in the future. (Respondent 14)*

Cooperation

There are several challenges to creating trust in BIM-based construction projects, including issues with collaboration and cooperation. BIM requires high levels of collaboration from all project team members, and the larger the project, the larger the challenge [49]. Conflicts can arise due to a lack of cooperation between members. This can happen when some members do not fully commit to the project, resulting in tasks not being completed on time and delays in the entire project. Other issues affecting cooperation in BIM-based construction projects include not being involved in the coordination process, not coming to the site, or not participating in discussions. It is important for all members to actively collaborate and cooperate to create trust and ensure project success. One participant's response was as follows:

> *Any mistakes in drawing should be under the consultant's responsibility to resolve. The time taken for the project to be done will be a drag if the consultant only relies on the contractor. Many processes will be needed for the contractor to inform the consultant regarding the mistakes found. (Respondent 8)*

System

BIM offers much automation, but there is still room for improvement. Currently, only a few software developers are providing solutions to the market [16]. While BIM implementation is increasing, it is still challenging as not enough organizations are involved in developing new software. In addition, creating a detailed drawing using BIM can be time-consuming, as it can be difficult to ensure detail in the BIM model. A lack of client data is also challenging (for example, insufficient data to create a model). When this happens, the person responsible for the project may be unable to visualize the model due to missing data.

> *High-cost projects require many BIM modelers to handle a section. Each section is combined into one cloud file that all modelers can access. It becomes dangerous when the modeler opens or changes a part that is not part of his job and causes design errors. As a result, all project team members will be blamed. (Respondent 4)*

Service

Many organizations still do not provide specialized BIM services outside of major cities, and the industry is not fully attuned to modern construction practices [7]. Additionally, some organizations prefer traditional methods over BIM. Some individuals resist using BIM as they do not believe in its effectiveness [16]. This can lead to conflicts among project team members. Many organizations are not proficient in using BIM, but they promote its effectiveness. They are still adjusting to the new BIM environment in construction projects and continue to use traditional construction management methods.

4.2.2. Technical-Related Challenges

BIM implementation includes a variety of challenges, one of which is the technical challenge [21]. Three subthemes are identified from the interviews related to technical aspects: behavior, expertise, and knowledge. The details of the subthemes are discussed in the subsequent subsections.

Behavior

People who have not been trained in BIM may find it difficult to use, especially if they have been using traditional methods for a long time. This is especially true for those involved in the design, as many experienced consultants have been comfortable using traditional methods throughout their careers [7]. It can be challenging to shift to BIM for the older generation, as engineers who have worked for a long time before the invention of BIM may be more accustomed to using AutoCAD and alternative 3D VR environments and modeling software [50]. AutoCAD is still widely used in Malaysia as it provides more detailed drawings than BIM.

> *Most people are still not used to the new environment of BIM, causing unseen effectiveness. (Respondent 18)*

> *They tend to deny the effectiveness of using BIM in construction. This situation might reduce productivity and performance due to coordination issues with other consultants, waste material due to overbuying, and budget issues. (Respondent 2)*

Expertise

The lack of personnel with expertise in BIM means that many projects continue to use BIM in traditional ways [12]. This leads to inefficiency and profit loss, contrary to the goals of using BIM. In addition, those with more experience in BIM are generally more trusted than those with less experience. Therefore, organizations need to provide good training and exposure to BIM.

> *The individuals involved lack the readiness to use BIM in terms of skills and perspectives. (Respondent 9)*

The skill of a modeler or coordinator who is not very good causes them to take time to complete a task. This happens because they cannot imagine the drawing or do not follow the concept site due to a lack of knowledge. (Respondent 5)

Knowledge

There is exposure to BIM in the construction industry. However, it is not widespread as not all employees have expertise. People do not fully understand the capabilities of BIM due to a lack of information and expertise [12]. This lack of knowledge from team members can become a barrier in a project. There are also varying levels of understanding within each discipline. For example, the project manager may allow the use of a 3D model without fully understanding it. Problems cannot be resolved if higher positions do not give support and believe in BIM. The proportion of public and private sector professionals who understand BIM applications and processes is still lower than it should be [16].

It is not easy to practice BIM as a whole, as there are still many who do not understand how BIM works among the project team members. All members involved in the project should have a clear knowledge of BIM. (Respondent 16)

4.3. Strategies to Create Trust in BIM-Based Construction Projects

Figure 5 illustrates the strategies used to create trust in BIM-based construction projects. Table 5 shows the total number of hits for these strategies. The themes for these strategies are organization and society. Within the organization theme, the subthemes include management, preparation, capability, cooperation, and awareness. The society theme has the following subthemes: individual, education, and government.

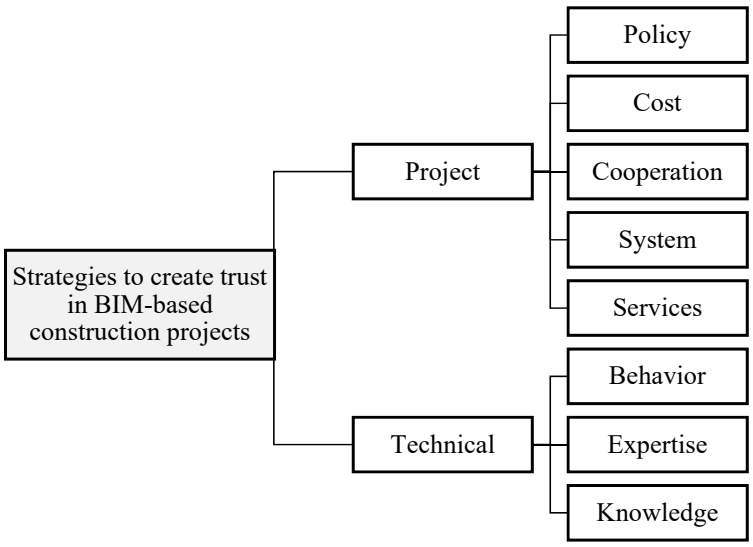

Figure 5. Summary of strategies to create trust in BIM-based construction projects.

Table 5. Strategies to create trust in BIM-based construction projects.

Respondent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum
Organization																					
Management				√	√		√			√					√		√				6
Preparation	√		√		√	√			√	√	√		√		√	√	√		√	√	13
Capability		√			√			√		√				√			√				5
Cooperation			√			√		√		√								√			5
Awareness				√								√								√	3
Society																					
Individual				√				√		√	√	√	√		√						7
Education	√										√			√	√	√		√			6
Government														√							1

4.3.1. Organization-Related Strategies

Trust in BIM-based construction projects can be created through the organization that is involved in these projects. However, the complexity of construction projects requires the collaboration and integration of many professionals from different organizations to carry out the tasks defined within the project scope and objectives [51]. According to the interview summary, the subthemes contributing to this include management, preparation, capability, cooperation, and awareness within the organization.

Management

Trust in BIM-based construction projects can be enhanced through effective management. BIM enables high performance in the construction industry through various management processes and analyses [51]. Senior management decisions about transitioning to BIM are greatly influenced by their awareness of BIM implementation and its use in construction projects [16]. Trust among workers can be fostered by clearly communicating standard operating procedures to all departments involved in the project regarding the implementation of BIM. The procedure should include agreements and timelines for both internal and external parties. Additionally, a BIM expert from another organization can be hired to fill a project role that requires a specialized source and establish BIM positions. Before starting the project, a demonstration can be provided to all project team members involved to ensure that they understand and know how to operate BIM. Simulations of BIM can also be shown to the client, although some clients may not wish to see this simulation, even if it can be helpful in providing a better understanding of BIM. The participants' responses were as follows:

> *Make sure all the workflows are clear during the construction project and put a suitable position based on their skills. (Respondent 4)*

> *Introduce a hybrid approach in BIM. Able to keep the best out of the traditional method and introduce something that would help accelerate many more factors. (Respondent 15)*

> *We can present the status and expectations of the project from our coordination across disciplines. Showing them accurate reports can enable a collaborative environment and ease decision-making within multidisciplinary groups. (Respondent 7)*

Preparation

Proper preparation by the involved organizations can help to establish trust in BIM-based construction projects. This includes training project team members such as architects, engineers, clients, and quantity surveyors [52]. When they are educated on BIM, they will better understand it and trust in its capabilities. Adequate BIM exposure should also be provided to industry players. In addition, a solution that includes input from all project team members and solid evidence, such as documentation and references from organizations that have successfully implemented BIM, should be prepared and presented. By taking these steps, BIM implementation is more likely to be seen as safe and successful, as many other organizations have already implemented it.

> *Create one module for a contractor and explain briefly in the module how BIM will help the project. Therefore, the contractor has a better view of BIM. (Respondent 1)*

> *Training in BIM use should be provided to gain knowledge of BIM management, submission methods, and many other actions needed if using BIM. (Respondent 20)*

> *Provide a solution that would involve everyone. To do anything in this industry nowadays, you will have to involve every single person. You cannot introduce a new system that takes over everything, as you will be wasting many years of experience. (Respondent 15)*

Capability

Improving the capability of BIM involves encouraging site supervisors to be proficient in using BIM software. One way to achieve this is by understanding the full BIM model [53].

This will allow them to identify discrepancies when relying on CAD or 2D drawings and facilitate coordination with all relevant disciplines. In addition, all project team members in the industry need to understand the benefits and advantages of using BIM and how it can benefit projects in the long term. Finally, senior management should also seek to continually learn and improve their knowledge and skills in advanced technologies in construction. This is especially important as BIM has been present for a considerable amount of time and is constantly evolving.

Cooperation

Minimizing conflict in projects can help to create trust. When project team members work together effectively, conflicts can be avoided. A project's complexity increases as the project becomes larger [49]. Therefore, the site team, technical team, consultants, project manager, and all other responsible members should work together cooperatively. All members involved should also try to understand the drawings to identify clashes. Additionally, organizations that have successfully used and excelled in BIM should provide proof of their past successes to convince other organizations to use it.

> *Cooperation from knowledgeable people. Experts should educate newbies, and the younger generation may teach the older age about BIM. (Respondent 6)*

> *The viewers of the software are from all departments, not just the BIM department. All departments in construction should also monitor the BIM parts so that there are not many complaints about errors in the model. (Respondent 10)*

Awareness

High awareness is important for creating trust. Increasing awareness can help to overcome challenges in implementing BIM, allowing more people to benefit from BIM [54–57]. High awareness within an organization can be fostered by submitting BIM-related projects ahead of schedule, which can help to create trust with the client due to the efficient working environment. It is also important to promptly and accurately deliver all relevant and new information to all departments. Many issues can be avoided when all project teams have strong communication skills.

> *Apart from that, among the examples of miscommunication are those who must check the detail of the drawing/modeling, not doing their job properly, and not checking and responding well, which bothers many project team members later. (Respondent 4)*

> *Construction drawings should be clear to avoid taking a long time at the site. Any mistakes in the drawing will increase time and cost, especially when the structure drawing is not the same architectural drawing. (Respondent 8)*

4.3.2. Society-Related Strategies

Trust in BIM-based construction projects can be established not only within an organization but also within society. This can be achieved through early exposure to BIM, individual upgrades, and support from policymakers. The interview summary identified three subthemes related to society: individual, education, and government.

Individual

It is important for all individuals involved in BIM-based construction projects to continuously upgrade their behavior, awareness, skills, and knowledge. By constantly improving themselves, they can avoid problems in construction projects caused by individual actions [58–60]. Trust can be built when there are fewer problems. Attending construction events that include presentations on the success of BIM implementation can provide exposure to the public. There has been some debate about introducing BIM through contracts or legislation. However, BIM should be viewed more as a tool than as a completely distinct construction method. It is simply an instrument that can facilitate the process.

> *Discuss before deciding to avoid a clash, a clear workflow, and to avoid getting comments later that will result in a lot of time-consuming during the report and thus make the project time-consuming as well. Knowledge can be upgraded by going through individual training. (Respondent 4)*

> *As a BIM modeler, self-confidence should be strong. The modeler should know how to make the model and know for sure that the model should work just fine. By attending BIM training, the confidence of oneself regarding BIM can be developed and improved. (Respondent 8)*

> *Listen to the briefing. Everyone involved in the project should pay close attention to the briefing to be informed and alert about the method, platform, and software used. (Respondent 11)*

> *BIM skills should be improved day by day by keep practicing as this effort would produce a high-quality product and minimize the time used for the project. (Respondent 12)*

Education

Education is essential for establishing trust in BIM-based construction projects. Rather than focusing on promoting BIM to current industry professionals, it should be introduced at the educational level, starting in schools or colleges. This will allow future generations to grow up with an understanding of BIM and how to work with it from the beginning. The curriculum should include BIM, starting with the first year of study [61–63]. For example, in civil engineering programs at technical schools, in addition to learning the basics of construction, the Ministry of Education could include BIM. At the very least, students should be familiar with BIM in the industry. The curriculum should be updated in line with that of industrialized countries. This will allow us to produce professionals in our own country, rather than importing them from other countries.

> *Knowledge for future generations is important. BIM knowledge should be acknowledged as an undergrad student. (Respondent 16)*

> *Trust also be increased by the results compiled and provided by students doing their research for FYP or other research assignments. New information regarding BIM might be gained from many different resources, either articles or professional individuals. By providing and compiling the new information, trust in BIM applications for workers and contractors may be settled. (Respondent 6)*

> *Universities offer effective training. BIM should be taught at universities as a theoretical topic and a practical skill in real-world projects. Fresh grads will recognize a lot of real-world applications rather than just theories. (Respondent 11)*

Government

There are several ways in which policymakers can support BIM implementation and create trust among project team members. Providing free BIM training can help to increase the awareness and understanding of BIM among industry professionals and the public. This can be achieved through educational programs or workshops. Additionally, policymakers strongly influence the promotion of the successful implementation of BIM in the construction industry [64–67]. Policymakers can also provide financial incentives to organizations that implement BIM, including partially subsidizing implementation costs. This can help to make BIM implementation more attractive and viable for organizations, which can, in turn, contribute to the overall trust in BIM-based construction projects.

> *BIM is mandatory. There is no answer to identify the factors affecting trust as BIM has been set by policymakers as a mandatory to be applied for the high-cost project. (Respondent 9)*

4.4. Limitations and Future Work

When performing this study, the researchers encountered challenges in recruiting participants. Some responders could not attend the interview session due to their busy schedules. Because of this, the researchers had to identify other respondents whose schedules allowed their participation in the interviews. Moreover, many participants did not respond to the email, making it difficult to reach them. This issue could be resolved by contacting responders via a variety of channels. For instance, researchers might contact the organization directly to obtain the respondent's phone number, or they could attempt to approach respondents. Finally, researchers may directly contact respondents. In addition, the researchers had difficulty in obtaining accurate answers from the respondents. This is because some respondents did not answer the questions or provided irrelevant responses. As a result, respondents may not have comprehended the questions or were unsure of how to respond. Before asking the respondents the questions, the questions were explained briefly.

For future research, a different data collection method could be applied, which could help to gather more data responses, such as a questionnaire survey. This questionnaire survey can be distributed to more industry professionals. The researcher can obtain the exact values associated with the factors, challenges, and strategies involved in creating trust in BIM-based construction projects. The research can obtain statistics and identify the critical factors, key challenges, and the most recommended strategies through the data collected. After this, improvements can be made by widening the survey area. Therefore, it would be simple to gather data. Singapore likewise has an advanced degree of BIM maturity. Researchers may obtain diverse insights from industry professionals. Moreover, they may be able to compare data between the two nations and obtain more information about BIM-based construction projects.

5. Conclusions

This study aimed to identify the factors, challenges, and strategies of trust in BIM-based construction projects. The study aim was achieved by analyzing interview data with twenty industry professionals. Through thematic analysis, the results identified eight factors that affect trust in BIM-based construction projects, eight challenges to creating trust in BIM-based construction projects, and eight strategies for creating trust in BIM-based construction projects. Furthermore, the same subthemes appeared for various questions in the participants' responses, implying that the factors, challenges, and strategies for creating trust in BIM-based construction projects are interconnected. As a result, the best way to upgrade the level of maturity and gain trust in BIM-based construction projects is to upgrade them altogether.

The factors that affect trust in BIM-based construction projects are knowledge, skills, awareness, behavior, policy, system, cost, and management. These categories can be divided into two themes, which are people and processes. Based on the results, it is evident that behavior is the most significant factor that affects trust in BIM-based construction projects. When there is much rework in construction, it reduces trust. Rework can arise if employees do not complete a task properly, forget to complete a task, or their drives or files are too full. Next, this research shows that management is the second most important aspect that affects trust in BIM-based construction projects. Because so many new ideas, such as software, are being introduced, not all subcontractors are ready to use BIM. Therefore, every responsible person working on the project must have a role that aligns with their skills.

The challenges to creating trust in BIM-based construction projects are policy, cost, cooperation, system, service, behavior, expertise, and knowledge. These categories can be divided into two themes, which are project and technical aspects. Cost is the greatest challenge to creating trust in BIM-based construction projects. Many people are still not interested in BIM as it is cost-prohibitive. It is challenging to create trust when there is no desire. According to the results, respondents stated that expertise is the second most significant challenge to creating trust in BIM-based construction projects. Due to a lack of

in-house expertise, the projects may be inefficient and lose money, which is contrary to their intended goal. Organizations need to provide their employees with sufficient BIM training and experience so that they can embrace innovation and create a new culture in the construction industry.

Furthermore, the strategies used to create trust in BIM-based construction projects are management, preparation, capability, cooperation, awareness, individuals, education, and government. These categories can be divided into two themes, which are organization and society. Respondents' greatest recommendation for creating trust in BIM-based construction projects is extensive organizational preparation. BIM training should be provided to a certain level to ensure an understanding of BIM management, submission methods, and a variety of other tasks required while using BIM. Individual training is the second most crucial strategy for creating trust in BIM-based construction projects. Every person involved in a BIM-based construction project must improve their attitudes, awareness, ability, and knowledge levels. When everyone continuously improves themselves, issues that individuals bring to construction projects will be eliminated, and the projects will proceed more smoothly.

Achieving the research aim would help the construction industry by providing insights into BIM trust concerns. The research findings could help policymakers and project managers to develop suitable plans for implementing BIM and allow organizations to create more trust and faith in the transition to BIM. Greater awareness of the factors behind distrust in BIM would lead to better communication and more trust. Moreover, overcoming the challenges would help to create trust in BIM-based construction projects. Lastly, the strategies used to create trust could help policymakers, project managers, and decision-makers to develop suitable plans for implementing BIM and allow organizations to generate more trust and faith in the transition to BIM. As a result, organizations may develop better plans for future BIM implementation.

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