FARU FACULTY OF ARCHITECTURE RESEARCH UNIT UNIVERSITY OF MORATUWA, SRI LANKA
FARU 2023 - 16TH INTERNATIONAL RESEARCH CONFERENCE www.faru.uom.lk
Empower Communities December 2023

BUILDING INFORMATION MODELLING AS A DISPUTE AVOIDANCE MECHANISM IN SRI LANKAN CONSTRUCTION PROJECTS

JAYARATHNA H.M.M.U.[1]*, FRANCIS M.[2] & LIYANAWATTA T.N.[3]
[1, 2, 3]*Department of Building Economics, The University of Moratuwa, Moratuwa, Sri Lanka*
[1]*manekaupamali@gmail.com,* [2]*mathushaf@yahoo.com* [3]*thilinil@uom.lk*

Abstract: Due to the complicated nature of building projects and the participation of several participants, disputes are inescapable in the building projects. The disadvantages of the Dispute Resolution Mechanisms (DRM) utilized in the projects have shifted the focus to conflict avoidance according to the premise that prevention is more effective than cure. On the other side, the chance of disagreements appears to be lower in projects procured by utilizing Building Information Modelling (BIM). However, there is a growing need to explore conflict avoidance from the standpoint of integrating Building Information Modelling in the Sri Lankan context. Therefore, this study seeks to investigate the applicability of integrating BIM as a dispute avoidance mechanism in Sri Lankan construction projects. A qualitative research approach was adopted to fulfil the study's goal. Specifically, the case study method was utilized, selecting suitable cases from the Colombo area that incorporate BIM in their respective building projects. Semi-structured interviews were used to acquire research data from nine experienced individuals with BIM experience who were engaged in the selected cases. A strategic framework was developed based on the analysed causes of disputes in the selected cases, dispute avoidance tactics adopted in the cases, and BIM features that affect dispute avoidance strategies. The study concluded that BIM can be used as a potential dispute avoidance mechanism in Sri Lankan construction projects.

Keywords: *Building Information Modelling; Construction industry; Disputes; Dispute avoidance.*

1. Introduction

The construction industry is a vast and diverse sector, encompassing lots of companies and professional bodies (Ngosong, 2014). According to Boadu et al. (2020), the construction sector makes a substantial contribution to the economic prosperity and social development of a country. According to Aidibi (2016) points out that due to the increasing complexities and sophistication of building projects, disputes are considered an inherent part of the construction project life cycle. Disputes might arise if construction project members from various professions prioritize their own ambitions for their personal advantage over working together towards a common objective (Cakmak, 2022). Therefore, it is important for project team members, bound by a contractual agreement, to identify and manage conflicts proactively before they escalate into disputes (Danuri et al., 2015).

Although several studies have been done on project disputes, disputes remain frequent in the construction sector and have been a significant concern in the construction industry (Cakmak, 2022). At the same time, even though there are numerous amounts of dispute-resolution techniques are available in the construction industry, disputes are prevalent even now (Edirisinghe et al., 2020). However, only few studies on dispute avoidance procedures have been undertaken in the Sri Lankan context, and therefore, this study aims to address that research vacuum.

In line with the findings of Epasinghe et al. (2018), it is increasingly vital to build a unified platform for construction project management to maximize the efficiency and effectiveness of construction project outcomes. When consider about Building Information Modeling (BIM), it is a model-based intelligent process that provides support in the planning, design, construction, and operation of buildings and infrastructure (Naamane and Boukara, 2015). On the other hand, BIM is defined as a common knowledge source of data about a facility that provides a trustworthy basis for judgments throughout its life cycle; characterized as existing from inception to destruction (Yin et al., 2019). Wang et al. (2023) have shown that BIM has the potential to minimize project uncertainties, design flaws, modification orders, and delays, thereby facilitating better dispute management in the construction sector. Building construction

*Corresponding author: Tel: +91 7845700486 Email Address: manekaupamali@gmail.com
DOI: https://doi.org/10.31705/FARU.2023.6

can benefit greatly from BIM services (Manzoor et al., 2021) since construction designs can be exceedingly complicated and need a great deal of intricacy.

So far, existing construction dispute literature focuses on dispute resolution rather than dispute avoidance and prevention (Naji, Mansour and Gunduz, 2020). Further, even though BIM has lately gained significant attention in the construction industry, no study has investigated BIM's significance in dispute avoidance in building construction. Henceforth, this study aims to investigate the potential of BIM as a dispute avoidance mechanism in Sri Lankan construction projects, filling the existing research gap and contributing to effective dispute avoidance strategies.

2. Literature Review

According to Moavenzadeh (2018), the construction industry, in both established and developing nations, is described as the economic sector that converts various resources into constructed buildings through planning, design, construction, maintenance and repair, and operation.

According to Mukilan et al. (2019), the construction sector is a complex environment in which stakeholders with varying perspectives, abilities, and degrees of expertise in the construction process collaborate. Hence, the complexity of the construction sector leads to disputes, which have a negative impact on construction projects (De Alwis, Abeynayake and Francis, 2016). For instance, Martin et al. (2016) researched that, global estimates show that 40-50% of all construction projects are now behind schedule, with inefficiencies incorporated into project execution being a major driver. According to Farooqui et al. (2012), disputes in the construction industry can arise from various sources, including the actions or inactions of the project owner and the consultants involved. Cheung (2014) further highlights that ineffective dispute resolution can create project delays, erode team spirit, raise project expenses, and harm corporate relationships. Supporting these observations, Gamage (2022) emphasizes that construction projects are often plagued by disputes. Similarly, Gamil and Rahman (2022) assert that disputes are a common occurrence in the construction sector, often perceived as an unavoidable, endemic, and chronic obstacle.

2.1 DISPUTES AVOIDANCE STRATEGIES

Dispute avoidance is the act of preventing problems from becoming unresolvable and generating an adversarial relationship between the parties. Danuri et al. (2015) state that, the fact that the mechanism exists before the conflict occurs is important to dispute avoidance. The disputes must be extensively studied as soon as feasible to establish the reasons for the disputes and tie them to the pre-construction phase to reduce or eliminate them before construction begins (Naji, Mansour and Gunduz, 2020).

Table 1 presents a comprehensive overview of various dispute avoidance tactics compiled from 19 different sources by diverse authors.

Table 1: Dispute Avoidance Strategies

Dispute avoidance strategies	Sources
Briefing stage	
Choosing the most appropriate procurement method	[4], [19], [20]
Choosing a collaborative approach or cooperation as a procurement strategy	[6], [7], [13], [16]
Specify the quality requirements that will be followed	[4]
Assess the financial risks posed by changes in government policy	[4]
Pre contract stage	
Proper contract document preparation	[2, 4], [19]
Intervention of an independent third party at the beginning of the contract (for example, DB/DRB/DAB/DRA)	[1], [7], [8], [9], [10], [11], [12], [14], [15], [18]
Implementation of appropriate contract dispute clauses	[11]
Proper risk allocation	[2], [3], [4], [7], [11], [19]
Determine the relationship between the prevalence of disagreements and the pre-construction period	[17]
Contractors' selection	[4]
Early contractor participation	[13], [15]
Contractors' handling of time	[4]
Post contract stage	
Proper contract document administration	[19]

Negotiating in a differentiated matter event	[3], [19]
Early notice and conflict settlement	[19]
Constructability	[13]
Lean manufacturing / Supply chain integration	[13]
Alignment of stakeholder management	[13]
Utilize ADR filter techniques	[3], [11]
Teamwork	[4], [6], [11], [15], [19]
The Parties' Roles	[4]
Investigate the prevalence and reasons of disagreements	[6], [15, [17]
Quality control	[4]
Relationships have improved	[5], [18]
Patch fairness perceptions	[19]

[1] - (Ariffin and Sutrisna, 2010); [2] - (Cheung, 2014); [3] - Connerty (2006); [4] - (Danuri *et al.*, 2015) ; [5] -(De Alwis, Abeynayake and Francis, 2016) ; [6] - (Elhag, Eapen and Ballal, 2020); [7] - (Gebken and Gibson, 2006); [8] - (Hardjomuljadi, 2020); [9] - (He, 2010); [10] - (Illankoon *et al.*, 2022); [11] - (Lee, Lee and Thurasamy, 2020); [12] - McGeorge et al. (2007); [13] - (Mosey, 2019); [14] - Mustaffa and Bowles (2004); [15] - (Naji, Mansour and Gunduz, 2020); [16] - (Phillips-Alonge, 2019) ; [17] - (Rauzana, 2016); [18] - (Thusharika and Abeynayake, 2016); [19] - (Zhu and Cheung, 2020)

The data presented in Table 1 indicates that conflict avoidance strategies can be implemented at different stages, including contract preparation, procurement method selection, and construction execution. According to De Alwis et al. (2016), researchers prioritize balanced risk allocation as a conflict avoidance method since construction-related hazards are one of the leading causes of disputes.

2.2 BUILDING INFORMATION MODELLING

Rapid technology improvements, along with severe rivalry in the construction industry for improved services, have sparked a fundamental shift toward the use of new approaches in the built environment. Building Information Modelling (BIM) has evolved as a cutting-edge method of project management and many experts and practitioners believe that BIM technology will become as essential to building design and construction as the tee square or hammer and nail. Further, Perera et al. (2022) demonstrate that, BIM is increasingly being used as a technology that enables information integration, interoperability, data sharing, and exchange in several fields of study such as architecture, engineering, and construction.

The new definition of BIM was established with the idea of 3D modelling of a project, but it was eventually expanded to 4D related to construction processing and scheduling, 5D modelling with project cost estimation, 6D modelling with project sustainability, 7D modelling with facilities management and application, and even nD modelling (Ahmed and Hoque, 2018). According to Bew (2008), BIM maturity level can be identified as below figure. The UK Department of Business Innovations and Skills (BIS) created the maturity model presented in the below figure.

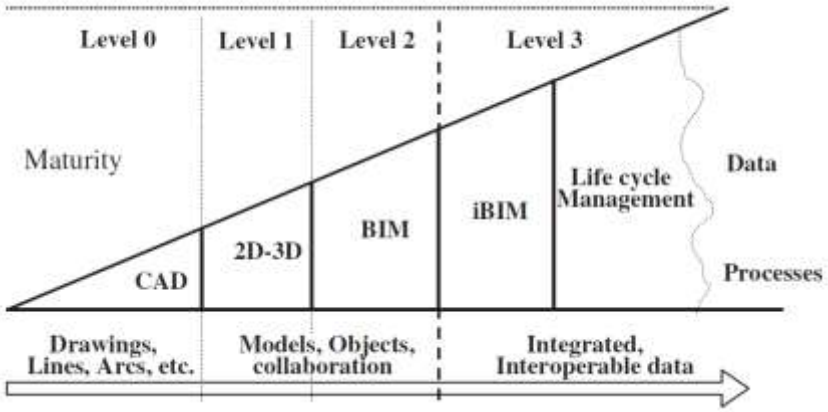

Figure 1: BIM maturity levels according to Bew (2008)

Table 2 shows the BIM authoring software that provides each function of designing, scheduling, cost estimation, visualization and facilities management with respective of Yin et al. (2019); Martinez-Aires et al. (2018); Hallowell et al. (2016); Porwal and Hewage (2013) .

Table 2: BIM Authoring Software

Function	Software Name
Design	Revit; Tekla Structure; MicroStation; ArchiCAD
Scheduling	Navisworks; Vico Office; Synchro Pro
Cost estimation	CostX; Cubicost 5D BIM; Solibri
Visualisation	Revit; Navisworks; Enscape; Tekla BIM sight; Solibri; odel Viewer; Trimble Connect; Rendra
Facilities Management	Vela; FIMS Holder Custom Program

Given the significance of building construction in terms of finance, sustainable development, the environment, and quality of life, the construction industry is one of the most important aspects of environmental sustainability (Manzoor et al., 2021). This worldwide trend has inspired the deployment and integration of novel construction methods, design ideas, and digital technologies such as modular prefabricated construction and BIM to minimize the lifespan effect of buildings (Ansah et al., 2021).

According to Manzoor et al. (2021), when BIM is integrated into building constructions, it improves safety performance parameters, collaboration, stability, better construction planning, monitoring and tracking during construction, automated assembly, project lifecycle data support, and design clash reduction. According to Nguyen et al. (2021), BIM volume management models provide an accurate volume analysis solution that automatically adapts to design changes, centralizes data storage, promotes efficient stakeholder interaction, and allows retrieval of information from BIM model objects.

The utilization of BIM in complex industrial projects has proven to be instrumental in improving dispute resolution and enhancing overall project efficiency. To effectively address disputes, all project stakeholders are required to engage in project reviews using BIM and digital models within specified timelines(Kjartansdottir & Snaebjornsson, 2017). One of the key advantages of BIM is its ability to facilitate traceability of information related to disputes. Furthermore, BIM implementation enables the development of robust processes and the structured organization of project information, particularly through the concept of Level of Detail. However, it is worth noting that the industry still faces challenges in fully understanding, mastering, and implementing this concept (Lee et al., 2012).

Moreover, the adoption of BIM allows all parties to utilize the same data system and communication platform throughout the project, and improved information management leads to greater collaboration among stakeholders. The built model provides a clear visualization of the project, allowing project risks to be properly identified, avoiding rework, and producing better products. Better BIM accuracy leads to better project decision-making, which leads to faster and more efficient project implementation. Further, Alghazali (2018) emphasizes that BIM captures all construction information in detail, especially dates, orders, variants, specifications, and data that may help in the resolution of conflicts between the two parties.

3. Methodology

This research was primarily conducted under the qualitative approach. Since in-depth investigation is needed into the application of BIM as a dispute avoidance mechanism in construction projects in Sri Lanka, the qualitative approach was considered as the most suitable method. To obtain the research objectives, three building construction projects were selected from BIM-integrated construction projects followed by case studies.

Since the research is focused on the application of BIM as a dispute avoidance mechanism of building construction in Sri Lanka drawing conclusions from multiple cases was mandated to conduct the cross-case analysis. Following that, three construction projects which had integrated BIM were selected for the data collection. The selection of construction projects integrating BIM was guided by purposive sampling and restricted to three such projects due to time constraints and limited accessibility.

The research question of the study mainly reflected the aspects of implementing BIM for dispute avoidance in construction projects, as the unit of analysis. The construction projects, which is using BIM formed the boundary of the study, since any disputes that arose during the project, and how BIM was employed to mitigate or avoid these disputes have been analyzed based on the selected three construction projects. Accordingly, the profiles of the three selected cases are tabulated in Table 3.

From each selected case, three respondents were chosen purposively based on their employment roles in the respective projects. To gather comprehensive data, three semi-structured interviews were conducted with each selected case. Semi-structured interviews provide flexibility, allowing for variations in content and direction between

interviews, thus enabling in-depth analysis of the relevant field (Saunders, Lewis, and Thornhill, 2012). Accordingly, the details of the interviewees are summarized in Table 4.

Table 3: Profiles of the selected cases

Description	Case A	Case B	Case C
Project Type	Government Office Building	Government Office Building	Hotel and Residences
Height	89m	96m	Residential Tower: 223 m Hotel Tower: 137 m
Number of Stories	14 stories	17 stories	Residential Tower: 48 stories Hotel Tower: 29 stories
Location	Colombo 02	Colombo 01	Coast of Colombo
Procurement Type	Traditional	Design and Build	Management oriented
Work Status of the Project	90% completed	30% completed	60% completed
Method of Measurement	SLS 573	SLS 573	SLS 573
Contract Type	Measure and pay	Lump sum	Measure and pay

Table 4: Details of the interviewees of case study interviews

Case	Respondent	Designation	Work Experience	Experience in BIM Technology
Case A	A1	BIM Team Leader for QS division	10-15 Years	5-10 Years
	A2	Architect	10-15 Years	5-10 Years
	A3	Quantity Surveyor	10-15 Years	5-10 Years
Case B	B1	BIM Manager	Over 20 Years	10-15 Years
	B2	MEP Engineer (BIM team leader for the MEP division)	5-10 Years	5-10 Years
	B3	Senior Project Architect	Over 20 Years	10-15 Years
Case C	C1	Quantity Surveyor	5-10 Years	5-10 Years
	C2	Senior Architect and BIM team leader	15-20 Years	10-15 Years
	C3	5D BIM Quantity Surveyor	5-10 Years	5-10 Years

The content analysis technique is one of the most common strategies to analysed qualitative data (Elo et al., 2014). Therefore, the manual content analysis was used to analyse the data from the qualitative approach and the analysed data were further discussed in the following sections.

4. Findings and Discussion

4.1 DISPUTE AVOIDANCE STRATEGIES

According to the literature, the procedure of dispute avoidance can begin with a briefing and continue throughout the duration of the project. Based on the literature of this study, dispute avoidance techniques are classified into three (03) stages: briefing, pre-contract, and post-contract (Table 1). As a result, the dispute avoidance methods found from the data gathered from interviewee comments regarding the implemented techniques in the cases and recommended strategies by the respondents are shown in Table 5.

Table 5: Dispute Avoidance Strategies Used in Selected Cases

Stage	Dispute Avoidance Strategies		
	Case A	Case B	Case C
Briefing Stage	Choose the right contract type and procurement type. Finalizing the designs early Centralized model for designs Draft models properly	Choosing a collaborative approach as a procurement strategy Specifying the quality requirements Designers should provide sufficient time	
Pre-Contract Stage	Negotiate better payment terms. Proper contract preparation	Early contractor participation Properly defining the scope of the project	Properly prepared contract documents

	Review the documents before the tendering stage Collaboration of the parties during the pre-contract stage	Properly prepared contract documents	Adopting DAB from the initial stage
Post Contract Stage	Establishing good accounting and financial practices Invoice promptly and regularly Proper management and contract administration Monitoring Quality assurance Recruiting skilled and technical expertise professionals Maintaining a better communication	Quality control	Proper resource management Maintained daily record Proper management and administration of the contract Coordination meetings Workshops Conducting weekly progress reviews Teamwork

In the case studies conducted, several dispute avoidance strategies were identified beyond what was found in the literature review including, centralized model for designs and designers should provide sufficient time, review the documents before the tendering stage, collaboration of the parties during pre-contract stage,, establishing good accounting and financial practices, invoice promptly and regularly, proper resource management, maintained daily record, monitoring, coordination meetings, workshops, conducting weekly progress reviews and maintaining a better communication. According to the analyzed data, it was observed that in case A, the consultants have the main responsibility in implementing dispute avoidance strategies in that project. In case B, the client has the main responsibility for implementing dispute avoidance strategies. In case C, the contractor has a higher responsibility when implementing dispute avoidance strategies. Considering all three cases collectively, it can be concluded that the consultants had a higher overall responsibility in implementing dispute avoidance strategies.

4.2 BUILDING INFORMATION MODELLING

Table 5 provides an insight into the specific BIM authoring software employed in each case for various project tasks. This selection reflects the unique requirements and preferences of each project, highlighting the diversity and versatility of BIM technologies in supporting different aspects of the construction process.

Table 6: BIM authoring software used in selected cases

Task	Case A	Case B	Case C
Designing	Revit	Revit Enscape 3D Max	Revit Enscape
Estimating	CostX	CostX	CostX Cubicost 5D BIM
Coordination	Navisworks BIM 360	Navisworks BIM 360	Navisworks BIM 360

The adoption of Building Information Modeling (BIM) can significantly enhance the efficiency of a system and bring about numerous benefits. According to Alghazali (2018), the worth of this model may be determined by its ability to reduce rework, either by re-keying information into models or making appropriate modifications to this occurrence. According to the findings of the data collection, the benefits of adopting BIM can be summarized as outlined in below Table 7;

Table 7: Benefits of Adopting BIM in Each Case

Clash detection	Improves communication	High speed of construction
Minimum clashes between elements	Successful teamwork	Decrease in construction errors
Less variation	Higher quality designs	Minimized expensive and time-consuming changes
Less claims on the time extension	High-quality construction output	Reduce the amount of rework
Time saving	Deliver the exact idea of the designers through the Revit model	Avoid last-minute modifications and unexpected issues

Faster designing	All the information is incorporated in the BIM model	Access the information in real time
Reduction in waste	Can see the simulated construction	Time saving
Less rework and resolution	Effective exchange of information	Enhance the efficiency
Design modifications in the project can be conveyed effectively	Worked collaboratively	Enhance the collaboration
Modification to the project can identify correctly and do efficiently	Readily available information	Enhance the accuracy
Higher coordination and collaboration	Higher coordination	Visualize the building before construction
Easy to communicate between parties	Time saving	Reduction in delays
Higher interoperability	Enhance efficiency	
Higher the mutual understanding among the parties	Shorten the whole construction process duration	
Optimal resource control		
Quick and accurate cost estimation		

According to Shin et al., (2022), BIM saves all project information in detail, including the ability to include schedules, orders, variations, specifications, and data, which can aid in the avoidance of disputes between the two parties. Table 8 presents the key findings according to disputes avoided by those BIM features.

Table 8: BIM feature effect in dispute avoidance

	Disputes related to;		
	Identifying clients' requirements Inadequate specification	Unforeseen changes	
	Disputes related to cost	Design defects	Dispute related to variations
	Drafting errors	Design defects	
	Lack of communication between parties		Lack of communication between parties
	Design defects		
		Lack of accuracy	
		Lack of accuracy	
			Quality issues Buildability issues
			Lack of resource management
			Time constraints

As Alghazali (2018) claimed, the adoption of a BIM environment in the construction industry can contribute to dispute avoidance effectively. According to the responses of interviewees of selected cases, all the respondents agreed that there is a reduction in causes of disputes after adopting BIM. Finally, a strategic framework has been developed based on the analysed causes of disputes in the selected cases, dispute avoidance tactics adopted in the cases, and BIM features that affect dispute avoidance strategies, as shown in Figure 2. This serves as a valuable tool for industry professionals to recognize potential causes of disputes in building construction projects, appropriate dispute avoidance tactics, and how BIM can be employed to avoid disputes in the construction industry, Sri Lanka. By utilizing

this strategic framework, stakeholders involved in construction projects can gain insights into potential dispute triggers, and adopt relevant dispute avoidance strategies, to avoid disputes before they occurred effectively. Further, the framework aims to enhance project management practices, foster collaboration, and promote successful project outcomes in the Sri Lankan construction industry.

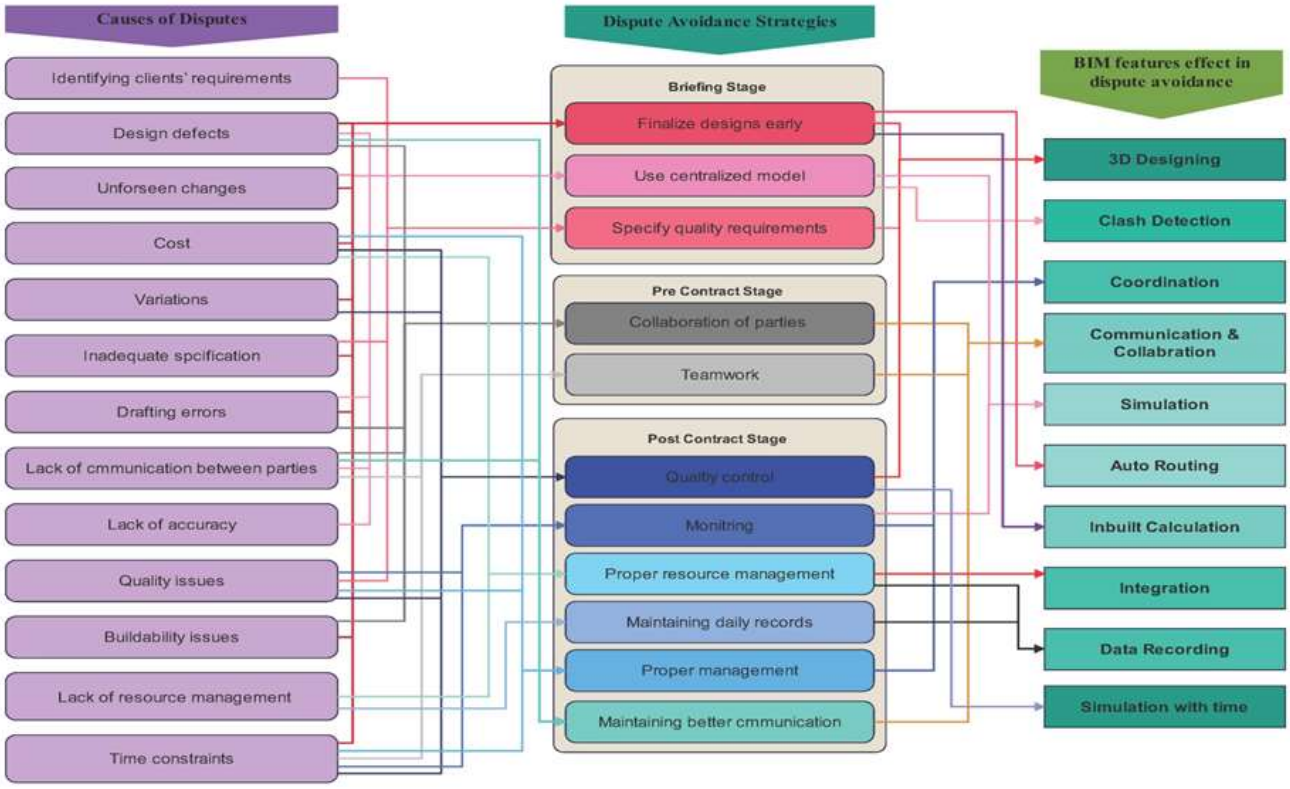

Figure 2: Framework

5. Conclusion

Because of the rising complexities and complexity of the construction sector, disputes are regarded as a component of the construction project life cycle. To reduce the possibilities of disputes, it is essential to adopt dispute avoidance practices in the projects. When considering BIM, it will massively affect in complex constructions since the scope of the projects are massive. Then, the implementation of BIM would have effect in dispute avoidance in a positive way in building construction in Sri Lanka. Dispute avoidance strategies are categorised based on the implementing stages such as design stages, pre contract stage post contract stage. According to the findings, several similar measures can be adopted at the pre-contract stage including proper preparation of contract documents to avoid disputes in construction. As for the post contract stage, proper management, and administration of the contract and quality control are similar dispute avoidance strategies which can be implemented in a construction project.

The main benefits of BIM-integrated projects in comparison to traditional projects are time savings, speed construction, and visualization of construction before constructing it rather than 2D drawings. All these benefits occurred due to the collaborative and interoperable platform of the BIM concept. The identified BIM features that impact in dispute avoidance include, 3D designing, clash detection, coordination, better communication and collaboration, simulation, auto routing, inbuilt calculations, integration, data recording and simulation. The proposed framework serves to improve the performance of construction projects by leveraging the collaborative capabilities and diverse features of BIM, stakeholders can enhance project outcomes, and contribute to the overall success of construction projects.

6. References

Ahmed, S. and Hoque, M. (2018) 'Barriers to implement building information modelling (BIM) to construction industry: A review', *Journal of System and Management Sciences*, 8(1), pp. 45–60.

Aidibi, H.I. (2016) *Studying the effect of BIM on construction conflicts and disputes using agent based modelling*. American University of Beirut.

Alghazali, W.M.J. (2018) *"Building information modelling (BIM)" implementation in construction project and its effects in dispute avoidance and resolution*. The British University in Dubai.

De Alwis, I., Abeynayake, M. and Francis, M. (2016) 'Dispute avoidance model for Sri Lankan construction industry', in *The 5th world construction symposium 2016: Greening environment, eco innovations & entrepreneurship*. Colombo, pp. 162–173.

Ansah, M.K. *et al.* (2021) 'Developing an automated BIM-based life cycle assessment approach for modularly designed high-rise buildings', *Environmental Impact Assessment Review*, 90, p. 106618.

Bew, M. (2008) 'Bew-Richards BIM maturity model', in *BuildingSMART construct IT autumn members meeting*. Brighton.
Boadu, E.F., Wang, C.C. and Sunindijo, R.Y. (2020) 'Characteristics of the construction industry in developing countries and its implications for health and safety: An exploratory study in Ghana', *International Journal of Environmental Research and Public Health*, 17(11), p. 4110. Available at: https://doi.org/10.3390/ijerph17114110.
Cakmak, P.I. (2022) 'The stakeholders' perspective on the factors contributing to construction disputes', *International Journal of Building Pathology and Adaptation*, 40(5), pp. 712–727. Available at: https://doi.org/10.1108/IJBPA-06-2020-0050.
Danuri, M.M. *et al.* (2015) 'Dispute avoidance procedure: Observing the influence of legal culture towards a workable legal system', *Social Science and Humanities*, 23(2), pp. 509–535.
Edirisinghe, W.M. *et al.* (2020) 'An investigation into the significant causes of disputes in the Sri Lankan construction industry', *EPiC Series in Built Environment*, 1, pp. 347–355.
Elhag, T., Eapen, S. and Ballal, T. (2020) 'Moderating claims and disputes through collaborative procurement', *Construction Innovation*, 20(1), pp. 79–95. Available at: https://doi.org/10.1108/CI-02-2019-0020.
Epasinghe, E. *et al.* (2018) 'Open BIM adoption in Sri Lankan construction industry', in.
Farooqui, R.U., Masood, F. and Saleem, F. (2012) 'Key causes of construction disputes in Pakistan', in *Third international conference on construction in developing countries (ICCIDC–III) : "Advancing civil, architectural and construction engineering & management*. Bangkok.
Gamage, A.N.K.K. (2022) 'Importance of effective communication to minimize disputes in construction projects', *Scholars Journal of Engineering and Technology*, 10(7), pp. 128–140. Available at: https://doi.org/10.36347/sjet.2022.v10i07.002.
Hallowell, M.R., Hardison, D. and Desvignes, M. (2016) 'Information technology and safety', *Construction Innovation*, 16(3), pp. 323–347. Available at: https://doi.org/10.1108/CI-09-2015-0047.
Hardjomuljadi, S. (2020) 'Use of dispute avoidance and adjudication boards', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 12(4). Available at: https://doi.org/10.1061/(ASCE)LA.1943-4170.0000431.
He, X. (2010) 'A framework of dispute avoidance and resolution of construction project management', in *2010 International conference on management and service science*. IEEE, pp. 1–4. Available at: https://doi.org/10.1109/ICMSS.2010.5577879.
Illankoon, I.M.C.S. *et al.* (2022) 'Causes of disputes, factors affecting dispute resolution and effective alternative dispute resolution for Sri Lankan construction industry', *International Journal of Construction Management*, 22(2), pp. 218–228. Available at: https://doi.org/10.1080/15623599.2019.1616415.
Kjartansdóttir, I.B. and Snæbjörnsson, J.; T. (2017) 'BIM, scope and definition', in I., B. Kjartansdóttir et al. (eds) *Building information modelling*. Warsaw: Civil Engineering Faculty of Warsaw University of Technology, pp. 13–19.
Lee, C.K., Lee, M.S. and Thurasamy, R. (2020) 'Using mediation in project disputes based on theory of planned behavior and technology acceptance model', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 12(1). Available at: https://doi.org/10.1061/(ASCE)LA.1943-4170.0000361.
Manzoor, B. *et al.* (2021) 'Influence of building information modeling (Bim) implementation in high-rise buildings towards sustainability', *Applied Sciences*, 11(16), p. 7626.
Martin, H., Lewis, T.M. and Petersen, A. (2016) 'Factors affecting the choice of construction project delivery in developing oil and gas economies', *Architectural Engineering and Design Management*, 12(3), pp. 170–188. Available at: https://doi.org/10.1080/17452007.2016.1151762.
Martínez-Aires, M.D., López-Alonso, M. and Martínez-Rojas, M. (2018) 'Building information modeling and safety management: A systematic review', *Safety Science*, 101, pp. 11–18. Available at: https://doi.org/10.1016/j.ssci.2017.08.015.
Moavenzadeh, F. (1978) 'Construction industry in developing countries', *World Development*, 6(1), pp. 97–116. Available at: https://doi.org/10.1016/0305-750X(78)90027-X.
Mosey, D. (2019) 'How can collaborative procurement reduce disputes?', in *Collaborative Construction Procurement and Improved Value*. 1st edn. John Wiley & Sons Ltd, pp. 371–389. Available at: https://doi.org/10.1002/9781119151951.ch19.
Mukilan, K. *et al.* (2019) 'A qualitative study and analysis of causes and disputes in claims in construction industry', *International Journal of Civil Engineering and Technology*, 10(1), pp. 951–957.
Naamane, A. and Boukara, A. (2015) 'A brief introduction to building information modeling (BIM) and its interoperability with TRNSYS', *Renewable Energy and Sustainable Development*, 1(1), p. 126. Available at: https://doi.org/10.21622/resd.2015.01.1.126.
Naji, K.K., Mansour, M.M. and Gunduz, M. (2020) 'Methods for modeling and evaluating construction disputes: A critical review', *IEEE Access*, 8, pp. 45641–45652. Available at: https://doi.org/10.1109/ACCESS.2020.2976109.
Ngosong, T.F. (2014) *The construction industry and its research rationale in Cameron and Africa*. Salford.
Phillips-Alonge, O.K. (2019) 'The influence of partnering on the occurrence of construction requirement conflicts and disputes', *International Journal of Construction Management*, 19(4), pp. 291–306. Available at: https://doi.org/10.1080/15623599.2018.1435236.
Porwal, A. and Hewage, K.N. (2013) 'Building information modeling (BIM) partnering framework for public construction projects', *Automation in Construction*, 31, pp. 204–214. Available at: https://doi.org/10.1016/j.autcon.2012.12.004.
Rauzana, A. (2016) 'Causes of conflicts and disputes in construction projects', *IOSR Journal of Mechanical and Civil Engineering*, 13(05), pp. 44–48. Available at: https://doi.org/10.9790/1684-1305064448.
Saunders, M., Lewis, P. and Thornhill, A. (2012) *Research methods for business students*. 6th edn. Pearson Education.
Shin, J. *et al.* (2022) 'A BIM-based framework for property dispute minimization – A case study for Victoria, Australia', *Land Use Policy*, 119, p. 106200. Available at: https://doi.org/10.1016/J.LANDUSEPOL.2022.106200.
Thusharika, A. and Abeynayake, M. (2016) 'Framework for mitigating contractual disputes in the Sri Lankan construction industry'.
Wang, J. *et al.* (2023) 'Adopting BIM to facilitate dispute management in the construction industry: A conceptual framework development', *Journal of Construction Engineering and Management*, 149(1). Available at: https://doi.org/10.1061/(ASCE)CO.1943-7862.0002419.
Yin, X. *et al.* (2019) 'Building information modelling for off-site construction: Review and future directions', *Automation in Construction*, 101, pp. 72–91. Available at: https://doi.org/10.1016/j.autcon.2019.01.010.
Zhu, L. and Cheung, S.O. (2020) 'Power of incentivization in construction dispute avoidance', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 12(2). Available at: https://doi.org/10.1061/(ASCE)LA.1943-4170.0000368.