BUILDING INFORMATION MODELLING (BIM) AS AN EFFECTIVE COMMUNICATION CHANNEL AMONG MALAYSIAN CONSTRUCTION PROFESSIONALS IN DESIGN AND BUILD (D&B) PROJECTS

[1]Seri Nanisa Sima Yusoff, [1]Juliana Brahim & [2]Zainidi Mat Yusoff
[1]*Faculty of Architecture, Planning, and Surveying, Universiti Teknologi MARA (UiTM) Shah Alam, Selangor, MALAYSIA.*
[2]*DPIK Project Management Sdn Bhd, Petaling Jaya, Selangor, MALAYSIA*
*Corresponding author: jubrahim@uitm.edu.my

Abstract
Effective communication is crucial in every construction project to overcome problems in traditional construction such as a misunderstanding, frequent verification and clarification, disappointment, lack of trust, and conflicts among construction players, resulting in cost overruns, time overruns, disputes, and project failure. However, the current practice in the traditional Design and Build (D&B) construction results in the ineffectiveness of communication due to miscommunication arises. Hence, this paper aims to highlight the benefit of Building Information Modelling (BIM) as an integrated communication platform for Malaysian (D&B) projects. A systematic literature review has been adopted on the effectiveness of BIM for communication in construction. The discussions reveal that BIM adoption able to enhance effective communication platforms, especially for the D&B project that involves many collaborations throughout a project's lifecycle. From the current practices of BIM in Malaysian D&B projects, it can be concluded that it is vital for Government to strengthen the enforcement of BIM adoption in the Malaysian construction industry, as it facilitated the delivery of information throughout the project's lifecycle, collaborative and coordinative work, and reduce the redundancies of information which consequently produced many benefits to every construction stakeholders significantly enhancing productivity to ensure the deliverable of project success.

Keywords: Building Information Modelling (BIM), Design and Build (D&B), Effective Communication

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INTRODUCTION

The construction industry is clarified as intricated, decentralized, competitive, and involves several parties, so effective communication is vital to address these challenges (Gamil & Rahman, 2017). According to Crotty (2012), as cited by Aryani, Brahim, & Fathi (2014), construction projects require complex sets of relationships between parties with different professional backgrounds to accomplish complex goals. Construction projects processes are disintegrated in nature with a complex life cycle (Al-Ashmori et al., 2020). According to Eastman, Paul, Sacks, & Liston (2011), construction project comprises of the existence of bulk documents and the exchange of fragmented information among project stakeholders, which could lead to the following problems: misunderstanding frequently arises, regular verification and clarification are often needed, dissatisfaction, lack of confidence and dispute between them due to poor communication.

Poor communication in the construction workplace can be either large or small (Gamil & Rahman, 2017). Large scale forms between construction professionals such as consultants, clients, and contractors (Chigangacha & Haupt, 2017). However, in a small scale occurs between individuals in the same firm, therefore, leads to many undesirable consequences either in large scale or small scale (Gamil & Rahman, 2017). Othman et al. (2018) highlighted that the impacts are significantly more severe in large-scale construction workplaces, where conflict and project failure may occur; nonetheless, between personnel, it can produce various effects on the work progress, accidents, and blunders during construction. In general, according to Kazi A (2005), as highlighted by (Gamil & Rahman, 2017), the majority of the problems in the construction industry are caused by improper and ineffective communication. For instance, the roof collapsed of Sultan Mizan Zainal Abidin Stadium, Terengganu, in 2009 and 2012, the parapet wall slab of highway construction fell in 2020. Consequently, this paper aims to highlight the benefit of Building Information Modelling (BIM) as an integrated and effective communication platform for Malaysian (D&B) projects.

METHODOLOGY

A systematic literature review was conducted on the past literature from 2006 to recent 2021 regarding the communication process in the D&B BIM Project. The review covers the challenges and strategies for improving communication in a construction project using the BIM concept. Various sources were reviewed, such as books, journal articles, international conference papers, and materials available on the internet.

OVERVIEW OF COMMUNICATION IN THE CONSTRUCTION INDUSTRY

Communication can be expounded as exchanging information with other people to reach a common understanding (Adu-Oppong & Agyin-Birikorang, 2014; George & Jones, 2012; Keyton, 2017; Savolainen, 2017). As stated by Pfeiffer (1998) and agreed by George & Jones (2012) and Kapoor (2020), the communication process usually involves five (5) key elements; sender (source), message, channel, receiver, and feedback, as shown in Figure 1.

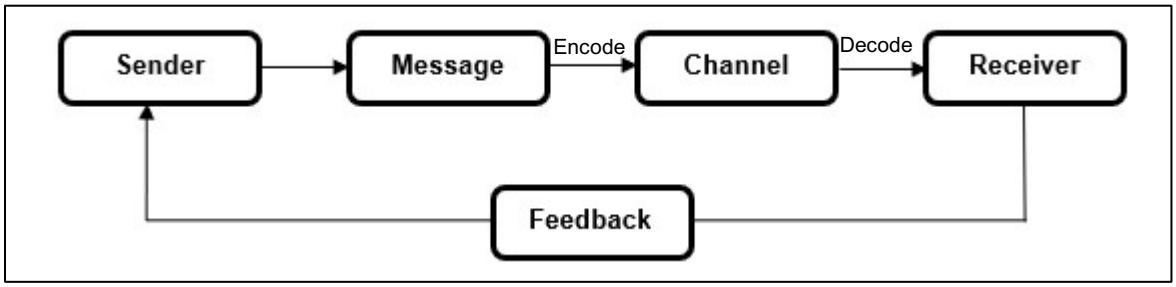

Figure 1: Key elements of the communication process (George & Jones, 2012)

Figure 1 above shows the key elements of communication, which have been summarized by George & Jones (2012) and Adu-Oppong & Agyin-Birikorang (2014). The first element is the sender who initiates the information (George & Jones, 2012), such as the client, main contractor, and Architect, responsible for conveying the information or idea to the receiver. Next is the message, which is the sender's information to deliver or share with other people (George & Jones, 2012). The sender then encodes the information by selecting words, symbols, or gestures with which to compose a message either in the form of verbal, nonverbal, or written language (Adu-Oppong & Agyin-Birikorang, 2014) based on the available channel, which is the carrier/medium of the communication, such as letter, email, instant messenger and others. The receiver then decodes the information to interpret and understand the information's significance (George & Jones, 2012) contained in a sender's message. Lastly, Adu-Oppong & Agyin-Birikorang (2014) stated that feedback is when the receiver responds to the sender's message and reverts the message, allowing the sender to determine the receiver has well-received and acknowledged the message. Adu-Oppong & Agyin-Birikorang (2014) also highlighted and agreed that the closer the sender is to the receiver, the more influential the message and channel.

According to Olanrewaju, Tan, & Kwan (2017), most construction disputes arise due to breaches or inadequate communication among construction professionals in a project. Communication is usually required to convey information, a generic term that embraces meanings such as Knowledge, processed data, skills, and technology (Soliman, 2017). Berenger & Agumba (2016) agrees with the statement of Dainty, Moore, & Murray (2006), wherein construction project, the disparate location of many of these involved with projects regularly necessitate communication over longer distances. Moreover, Soliman (2017) added that the level of communication efficiency among construction professionals is substantial and influences a project's performance time. Therefore, the need for precise, clear, and comprehensible information has been steadily rising within the construction industry (Dinis, Sanhudo, Martins, & Ramos, 2020), where the efficiency and effectiveness of the construction process strongly depend on the communication quality (Goh, Goh, Toh, & Ang, 2014; Hoezen, Reymen, & Dewulf, 2006). In the construction industry, inadequate communications have numerous impacts and repercussions, such as cost overruns, time overruns, conflicts, and subsequent project failure. (Gamil & Rahman, 2017).

Importance of Effective Communication in the Construction Industry

Effective communication is a critical success factor that links all the other aspects of project success during all stages of a project life cycle (El-Saboni, Aouad, & Sabouni, 2009). Effective communication

is requisite as it practically influences every aspect of organizational behavior (George & Jones, 2012). The importance of effective communication discussed by Adu-Oppong & Agyin-Birikorang, (2014) and George & Jones (2012) are listed below:

- Providing Knowledge – especially for the project team regarding the project goals and work methodology- ensures the team's awareness of the acceptable standard (George & Jones, 2012) of work such as ISO, QLASSIC, or CONQUAS of changes, and others.

- Reduce conflicts – Effective and open communication in the workplace, such as toolbox meetings, can help prevent and resolve many disputes, especially among foreign workers. Workplace conflicts are easily resolved through open and transparent communication and mutual discussions, leading to personal and professional growth (Adu-Oppong & Agyin-Birikorang, 2014).

- Motivating project team – Determine the rewards for the project team, assign specific and difficult goals, and give feedback (George & Jones, 2012)

- Increase productivity – The most significant factor in an organization's or project's success or failure is effective communication at work (Stacho et al., 2019). According to Sampietro (2016), every organization/project has a set of clearly defined goals, objectives, and vision. Wang (2017) agreed that effective communication would allow the staff to do their best in order to achieve initiated goals of the organization/project.

- Initiation of relationship – Open communication among the project team involved in the D&B project leads to better personal and professional relationships (Adu-Oppong & Agyin-Birikorang, 2014) that encourages a more pleasant working atmosphere and a stronger working relationship, which is beneficial especially to the organization/project.
  .
- Proper utilization of resources – When a project faces challenges, crises, or disputes due to miscommunication among the project team, it creates uncalled-for delays in daily work progress, wastage of resources, and reduces all in all productivity (Adu-Oppong & Agyin-Birikorang, 2014). A good communication environment is vital for any organization/project to employ resources better and increase productivity (Adu-Oppong & Agyin-Birikorang, 2014; Bucăţa & Rizescu, 2017; Teo & Low, 2016).

PROJECT DELIVERY METHODS IN CONSTRUCTION

Construction project teams comprise a huge number of professionals and different types of documentation to be coordinated (Eastman, Paul, Rafael, & Kathleen, 2008) and communicate, regardless of the contractual approach. Effective communication has a beneficial influence on social capital socialites' institutional and emotional dimensions and the mutual vision of social capital socialites. (J. Lee, Park, & Lee, 2015). Furthermore, according to Diallo and Thuiller (2005), as cited by Soliman (2017), project success is strongly linked to communication and cooperation between construction players. However, according to Muller and Turner (2005), as cited by Soliman (2017), communication issues between the project owner and project manager usually arise out of the misunderstanding due to unclear information received. Figure 2 illustrates the standard members of a project team in the project and their various organizational boundaries.

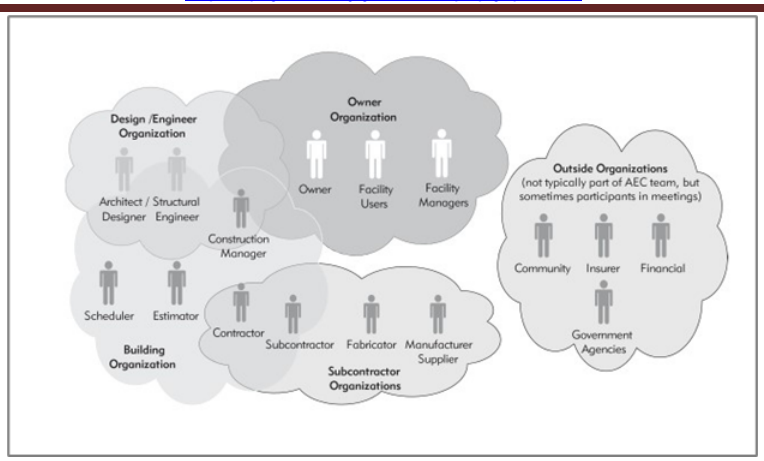

Figure 2: Typical construction project team and organizational boundaries
Source: Eastman et al. (2011)

One of the most significant options that will decide the efficiency of construction projects is the delivery process option. (Yu, Shen, & Shi, 2017). According to Sanvido & Konchar (1999) and Warne and Beard (2005), cited by Eastman et al. (2008), various delivery methods are employed in the construction industry. There are two (2) dominant contract methods, Design, Bid, and Build (DBB) and Design and Build (D&B), where each has varying success rates. Lee, Rahman, & Doh (2020) agreed that until today, the popularity of the D&B method has been increasing worldwide because of its distinctive concept of integrating design and construction, which have successfully addressed and facilitated the problems inherent in the traditional DBB method. Ling et al. (2004), as cited by (Yu et al., 2017), added that both prevalent delivery methods are widely used in various developed countries, for instance, the United Kingdom, the United States, Australia, China, and Singapore.

Design and Build (D&B) Project Delivery

Design and Build (D&B) is the most common project delivery method used (Abd Rahman, 2009; Ahmed & El-Sayegh, 2021), especially in the Malaysian construction industry. Figure 3 below shows the D&B contractual relationship in the Malaysian Construction Industry.

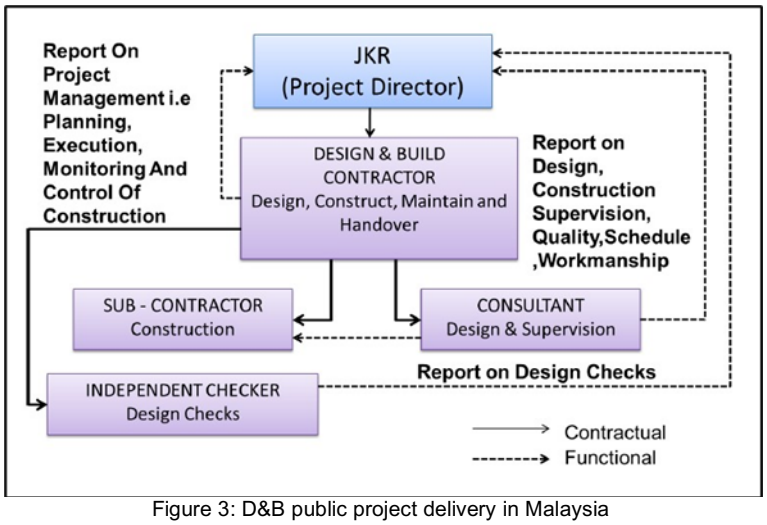

Figure 3: D&B public project delivery in Malaysia
Source: Saaidin, Endut, Abu Samah, & Mohd Ridzuan (2016)

Based on Figure 3 above shows there are many divisions of construction professionals involved in D&B project delivery. Therefore, as mentioned by Eastman et al. (2011) and Eadie et al. (2013) cited by Brahim (2018), collaborative work that occurs in the D&B project delivery method is more suitable to facilitate BIM that will be able to cater communication barriers. Brahim (2018) further emphasized that the D&B approach allows construction players to be involved early and allows variation to be made

earlier in the design process. Thus, the project can save time and resources (Eastman et al., 2011; Gardezi et al., 2014; Brahim, 2018)

BARRIERS TO EFFECTIVE COMMUNICATION IN D&B PROJECT

Effective communication is vital for every organization or project's success (Hargie, 2016). Unfortunately, existing activities that focus on modes such as phone calls, meeting and talking to people, and video conferencing does not encourage immediate access to information needed, context-based understanding, and visual contact necessary for successful communication in modern workplaces in construction projects (Dai, Oluwafemi, Peng, Cao, & Luo, 2021).

Table 1: Barriers to Effective Communication in D&B Project
Source: Soliman (2017)

Barriers	Descriptions
Organization-related	● Defer in getting agreement ● Defer in getting sign approval ● Lack of progress periodical site meetings
Staff-related	● Lack of supervision staff ● Low experience of supervision staff ● Delay site instruction ● Language barriers
Communication tools	● Neglecting verbal communication ● Not enough new communication tools ● Outdated filing system
Unclear information related	● Misunderstanding of site instructions ● Poor quality of drawings ● Unclear instructions ● Defer in developing documents, drawings, and orders

Table 1 shows the barriers to effective communication that commonly arise in common D&B projects. There are four (4) barriers involved: organization-related, staff-related, communication tools, and unclear information-related. Further details are explained below:

For organization-related, it usually occurs within the top management. The common barriers for effective communication are delays in taking agreement and signing approval primarily related to work progress and monthly claim payment (Akintan & Morledge, 2013). Other than that, lack of progress periodical site meetings has a substantial agreement between the two groups and has a high percentage of the occurrence (Soliman, 2017). Soliman (2017) also added that it is common to hold the progress meetings monthly, and the participants see that these meetings are not sufficient and lead to project delays.

The second barrier of communication is staff, which usually involves a lack of supervision, especially for incompetent staff handling critical elements such as building structure (e.g., beam, column, and slab) (Luthra & Richa, 2015). Moreover, the delay of site instruction from the project owner, such as variation, amendment, and omission, which affects the project resources, may cause conflict among project owners and project managers (Tawil et al., 2013).

The third barrier is the communication tools used to deliver the information, especially to the staff. It is found that most of the managers neglect verbal communication and prefer to convey the message through instant messenger, which possibly causes misunderstanding and failure of the message delivered to the staff (receiver). Lastly, the outdated type filing system consisted of a pile load of project documents. It can be seen that in order to retrieve project data as such technical or financial information from any former document (Soliman, 2017), it is affected by the efficiency of both technical and non-technical staff. It will be prolonged because most of the project details, such as contract documents, variation orders, reports, invoices, and details of building materials, are mostly paper-based.

The fourth barrier is unclear information due to misunderstanding of unclear site instructions, especially to multicultural workers such as rules, regulations, work progress, and others (Chen, 2019; Soliman, 2017). Next, the common filling system is mainly manual. The administrative staff is responsible for filling either in the site or at the top management level for both contractors and clients. To retrieve technical or financial information from any former document is affected by the efficiency of the non-technical personnel and it will take too long. Most of the bad quality of paper-based documents, such as blurred drawings, may cause ineffective communication as the medium is unclear, which cannot convey the proper information to the staff (Soliman, 2017). Lastly, since the filing system is traditional paper-based, it will take time and cause a delay in delivering messages and work progress if any amendment of documents (World Economic Forum, 2016; Soliman, 2017).

DISCUSSIONS

From the literature review, barriers in communication among construction players in a project are the main cause of the construction industry's consequences, such as cost overruns, time overruns, disputes, and project failure. However, it is proved that Building Information Modelling (BIM) in an integrated communication platform is able to enhance the challenges that hinder effective communication among construction players, especially in D&B projects that involve many collaborations throughout the project lifecycle. The statement is agreed by Ahmad Latiffi et al. (2020) and Ariffin, Cun, Raslim, & Mustaffa (2017) that BIM is not only catered for visualization and constructability of design, reduce time, cost, and risk but also to minimize disputes among construction players throughout the project lifecycle,

BIM is an emerging global phenomenon that may have profoundly affected the growth of the construction industry. (Ariffin, Cun, Raslim, & Mustaffa, 2017). The BIM concept was already introduced in 1970 by Professor Charles M Eastman. However, in 2000, BIM was started broadly in AEC industries, and the United States of America is the first country to implement BIM in construction projects (Zahrizan, Ali, Haron, Marshall-Ponting, & Hamid, 2013). Today, BIM usage has been adopted in many countries, for instance, Australia, Denmark, United Arab Emirates (UAE), Hong Kong, Norway, Finland, China, Japan, Korea, and Singapore due to the effectiveness of BIM in reducing conflicts and changes and at the same time improve productivity during the project lifecycle. (Abd Hamid, Mohd Taib, Abdul Razak, & Embi, 2018; Harun, Samad, Nawi, & Haron, 2016; Latiffi et al., 2015; Othman, Al-Ashmori, Rahmawati, Mugahed Amran, & Al-Bared, 2020; Uhm, Lee, & Jeon, 2017; Zahrizan et al., 2013)

There are several potential improvements of communication barriers in the construction industry by means of Building Information Modelling (BIM). Brahim et al. (2018) mentioned that BIM application had been expanded throughout the construction project life cycle, especially to cope with the practical communication barriers in the D&B project, as previously stated. Eastman (2011) cited by Latiffi, Mohd, & Brahim (2015), BIM is a new and advanced approach to manage construction project life cycle activities: design, construction, and operation and maintenance (O&M), especially in Malaysia.

The first potential improvement by adopting BIM implementation is valuable benefits to the construction industry throughout the project life cycle, especially in delivering information (Othman et al., 2020). Secondly, the acceptance of BIM worldwide remarks on the effectiveness of BIM as collaborative and coordinative work (Haron et al., 2017; Omran, 2020) that facilitate as a communication medium among project teams as BIM allows better coordination of work and information (Azhar, 2011). Lastly, due to

the fact that BIM could reduce the redundancies of information in conventional D&B as it involves the collaboration of the project team at the early phase of the project (Aibinu & Papadonikolaki, 2016; Ariffin et al., 2017; Azhar, 2011; Ghaffarianhoseini et al., 2017), it is possible that BIM could improve and replace the current paper-based documentation method to fully paperless and digital documentation as a medium of communication among project team throughout the building lifecycle, and at the same time provide transparency of information based on the use of 3D modelling (Borrmann, König, Koch, & Beetz, 2018).

CONCLUSIONS

This paper has discussed the current communication effectiveness in the Malaysian construction industry from various past literature sources. Based on the literature review, it is summarized traditional communication process leads to conflicts and rework. Thus, it can be concluded that BIM is an effective communication medium, especially in D&B projects that can cope with the current Malaysian construction industry, which is still lagging in terms of technology used to accommodate communication effectiveness. Therefore, to be on par like neighboring countries, the Government needs to utilize technological resources by strengthening the current enforcement of BIM adoption starting from the public project and requiring developer or G7 to every project in order to enhance productivity, especially for project stakeholders. Thus, all stakeholders' satisfaction regarding the BIM work process as well as the standard of BIM productivity could escalate when construction players would communicate effectively among themselves using BIM.

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