

IMPROVING COMMUNICATION IN MANAGING INDUSTRIALISED BUILDING SYSTEM (IBS) PROJECTS: VIRTUAL ENVIRONMENT

Mohd Affendi Ahmad Pozin¹, Mohd Nasrun Mohd Nawi¹, Mohamed Nor Azhari Azman², Angela Lee³

¹School of Technology Management and Logistics, Universiti Utara Malaysia, 06010 Sintok, Kedah

²Faculty of Technical and Vocational, Universiti Pendidikan Sultan Idris, 35900, Tanjung Malim, Perak, Malaysia

³School of Art, Design and Architecture, University of Huddersfield, United Kingdom

Abstract

Traditional approaches are still dominant in virtually all construction projects in Malaysia. This was highlighted as the main barrier for further developing the Industrialised Building System (IBS) construction process. Indeed, traditional approaches implemented in IBS have been recognised by several studies as failing to support effective work teams when team processes are disconnected from each other (fragmented), thus failing to produce an effective communication process. Additionally, IBS construction involves large numbers of teams with different expertise and from different organisations, all of which are handled by different numbers of management processes, for instance in planning, manufacturing, transportation, positioning and assembling the structures that involve minimal additional site work. With the increasing demand in building bigger and better buildings and structures, construction projects are becoming more complex to manage by project managers, as they have to manage every single phase by coordinating and monitoring the entire project while at the same time, consider different values and interests from every project team members. Hence, high intensity levels of communication processes involving project team members are importance in order to produce high quality information in decision-making process and conveying instructions to all team members. Regarding the issues of communication practices inside construction projects, this paper explores how communication is applied by the project team management in managing different construction stages inside an IBS construction project with several of stakeholders from diverse locations, and different cultural and organisational backgrounds. Even though a few studies had highlighted communication barriers in the construction field, only a few investigated virtual team practices in the IBS construction industry, especially in Malaysian construction. In this context, preliminary interviews were conducted on several project managers with vast experience in managing IBS construction projects. The content analysis method was used as the technique to ensure the gathered data were comprehensively and accurately analysed. The results showed that most project teams communicated virtually within and among teams for the duration of the project implementation, which the phenomenon is resulting from modern organisational form. There are five categories associated with virtual team work environment, namely distributed area, open discussion, team attitude, communication technology, and reliability of task, all of which are exceptionally pertinent in virtual team, compared to traditional team, work interaction practices.

Keywords: *Virtual team; Communication; Project manager; Industrialised Building System (IBS)*

INTRODUCTION

Pressures from development and modernisation has initiated the effort from the Malaysian government to move into utilising globalisation technology, with a new systematic building development process. As a result, from the initiative in 2014, the construction industry contributed to the Malaysian economy by accounting for over USD32 billion and this sector is expected to grow due to the initiatives planned in the Eleventh Malaysian Plan (RMK 11), which is expected to expand to 10.3 per cent per annum over the next five years.

Therefore, the construction industry is a major contributor toward the Malaysian vision of becoming a high-income nation by 2020.

Thus, through the Construction Industry Master Plan (CIMP), the Construction Industry Transformation Programme (CITP) 2016-2020 was launched by CIDB to improve quality of the standard industry utilising strategic goals to bring the Malaysian construction sector to the next level, with a new vision of transforming the industry by facilitating high technology and modern construction method adoption with the appropriate training quality, to align the supply and demand of workforce, the availability of high-quality information, and to address the low productivity issue.

The CITP is supported by 18 initiatives to enhance the productivity of the construction workforce. One key initiative is to support higher technology adoption, both in terms of advance technology used in the construction method, such as Industrialised Building System (IBS) (Lim et al., 2016), and the advanced materials used in the construction. As a result, the Malaysian construction industry has attempted to implement IBS during the time the nation was reaping the benefits of producing high quality buildings, timely construction completion, and cost savings through standardisation in long-term ownership cost (CIDB Malaysia, 2012). In general, the concept of IBS is the construction involving pre-fabricated components manufactured off-site, where each component is systematically produced by using machine, formwork, and other advance mechanical tools (CIDB, 2009). The construction process begins when each component of specific requirements is manufactured off-site and after completion, each component would then be transferred to the construction site for assembly, where the installation and integration into the structure would entail minimal additional site work. Indeed, this process works systematically, which optimises the use of materials, finishes the project in a timely fashion, and there is less impact from changing weather conditions on construction operations, as well as increasing site neatness and safety. By the end of the introduction of the IBS method, several keys projects were successfully implemented using the IBS method, and some of these latest construction projects include the Mass Rapid Transit (MRT) transport system, 1 Malaysia Financial District, Sungai Buloh and Sungai Besi mixed development projects, and Lightweight Railway Train (LRT) system (CIDB Malaysia, 2012).

However, the initial ambitious goal of incorporating the IBS method into a minimum of 70% of various construction projects in Malaysia is far from reality. One reason for the slow IBS uptake is because of the need by all involved parties to deal with new innovative technology, new construction skill knowledge, and failure to deliver expected return (Akmam Syed Zakaria et al., 2017).

IMPACT FROM FRAGMENTATION

Fragmentation was identified as one of the main barriers in adopting IBS in the Malaysian construction industry (Mohd Nawawi et al., 2014). Fragmentation issues commonly represent negative impact on project performance, productivity, knowledge sharing, and innovative solutions. Fragmentation occurs when the entire process of the construction project is broken down into teams in separate parts, in between the design and construction stages. From this scenario, the segregation process would naturally create diversity of discipline specialisation from over the distributed area. Moreover, this would create limited coordination, and integration of an organisation, and thus cohesive teamwork becomes

ineffective. Therefore, this would affect the quality of design process and ultimately, the project outcome. Meanwhile, fragmentation often increases project complexity, rework, increased costs, and longer construction duration. According to Anumba (Evbuomwan & Anumba, 1998), the complexity of the modern organisational structure would force the communication process to become more critical, especially when dealing with many fragmented parties, long life cycles, and multiple organisational structures, all of which would eventually degrade construction performance to become lower than usual (Dainty et al., 2006). As a result, project teams would find it difficult to communicate directly with each other and this will increase unnecessary expenditure and retard the progress and quality of the project (Senaratne & Ruwanpura, 2016). Furthermore as mention by Ruuska, the complexity of the construction project is becoming more critical when handling multiple teams and additional requirement processes (Ruuska, 1996). This phenomenon is infectious in IBS construction projects, since the IBS process involves numerous practitioners in coordinating and planning several construction processes from the design stage to logistics that entails the delivery of IBS components from the factory to the construction site project (transportation), and eventually the positioning and assembly of the manufactured components into a structure with minimal additional site work (Mohd Nasrun Mohd Nawi & Angela Lee, 2012). Thus, the sequential nature of these activities is highly embedded in the construction processes and seems to override itself with new procurement and management methods, e.g., strategic alliances and new methods of teamwork, such as virtual teams (Chen & Messner, 2010; Chinowsky & Rojas, 2003; Abadi, 2005; Affendi et al., 2016). Therefore, some of these challenges in the communication process of IBS construction have been identified from previous studies, as shown in Table 1.

This situation gives a substantially negative impact on the government and industry, especially when attempting to accelerate adoption of the IBS method. The implementation of IBS method needs more support from stakeholders and construction players in the industry, so as to align it with the national agenda.

Table 1. Communication challenges inside IBS construction projects

Challenges of IBS Construction	Description
Fragmentation issues	Separation of expertise within different organisations (e.g., client, consultant) and different design and construction stages
Bureaucracy	Some organisation make it difficult to share knowledge and establish discussions, either during the implementation of a stage or in the planning stages of approval
Poor integration	Project team failure to communicate effectively regarding different values and interests to a project need
Design process	Ineffective design and planning process which needs to be redesigned again to suit the IBS plan
Competency	Incompetence in handling the documentation process and passive use of computer systems
Lack of coordination and planning	Ineffective communication in handling project tasks, especially in coordinating of design, transportation, and installing processes

VIRTUAL TEAM AS AN ORGANISATIONAL FORM

Within the last decade, research on virtual teams were done in many areas, such as manufacturing, human resource, offshore, and small medium enterprise (SME). Current research on virtual teams are at nascent stages and have not been reviewed, especially in and around the Malaysian construction sector, more specifically regarding IBS projects. The rapid

pace of globalisation and fast development of ICT will force organisations into virtual collaborations to enhance their competitiveness. Therefore, virtual, virtualisation, or virtualised are terms that generally represent working groups of people who share their own unique expertise while supported by Information Communication Technology (ICT) to provide effective communication between individuals from different locations and time zones, working together to accomplish project goals. There are multiple definitions by different authors regarding virtual teams. According to Chinowsky, a virtual distributed team is “a group of people with complementary competencies executing simultaneous collaborative work processes through electronic media without regard to geographic location” (Chinowsky & Rojas, 2003). It was also supposed that the term “virtual” covers the wide range of activities and forms of technology-supported systems which support industries, including the construction industry (Hosseini & Chileshe, 2013b).

In others sectors, it has been observed that the implementation or adoption of virtual communication practices within the organisation is like shifting from failure to success (Duarte et al., 2006). The flexibility of infrastructure based on virtual teamwork can produce effective communication among project teams to perform the project tasks more rapidly, unlike those traditional face-to-face teams. This is because the team has the ability to work over spatial and different places (Munkvold & Zigurs, 2007), and they can effectively cooperate across disciplines from distributed teams, which is necessary for engineering projects to succeed (Zhang et al., 2010). Furthermore, supported by ICT, this could reduce relocation times and costs, as well as reducing time-to market cycles, which is one of the significant successful keys in some organisations (Chatfield et al., 2014). Moreover, it was also asserted that this team type evaluates the design in the early stages of the project as relating to different architectural, financial, or even environmental constraints, because the tools used in virtual teams would enable the design team to quickly gain insight of the project. As a result, the following reasons are why it is necessary to implement virtual project teams in IBS construction projects:

- Competency to handle distributed practitioners and site location projects.
- Less collaboration and integration from initial work.
- To support sustainable competition, and contribute agility and innovation in operations.

Moreover, understanding the landscape and key aspects of virtual teams is a necessity for enhancing flexibility and effectiveness of construction projects, due to the popularity of this phenomenon in the industry. Furthermore, in the attempt to understand and develop an effective communication process between construction project teams, some of the advantages of virtual teams over the traditional co-located teams that need to be taken advantage of are shown in Table 2.

Table 2. Virtual team versus traditional co-located team

Criteria	Virtual Team	Traditional Co-Located Team
Location	By different location and time zone	Next to one another in the same area
Task coordination	Tasks must be much more highly structured	Straightforward and performed by the members of the team together
Communication	Rely on electronic communication	Face-to-face interaction (synchronous communication)
Utilisation of resources	Increase the opportunity for allocation and sharing of resources	Variety of practices (cultural and work process diversity) and employee mobility negatively impacts performance in virtual teams

ADVANTAGES OF VIRTUAL TEAM

Since virtual teams have been implemented in many organisations, the advantages and opportunities from virtual teams brings a new dimension in managing projects globally. Opportunities can be taken by virtual teams in enhancing to a higher level of structural and demographic diversity than co-located teams. At the same time, this will increase economic development and productivity processes. For instance, there is some experience from certain organisations in improving project management issues by implementing virtual team practices.

- 1) Reduced time travel and cost: IBM was estimated to reduce USD50 million in travelling costs and downtime through virtual team approach. The expenditure of travelling time and costs on daily allowance can be reduced and even eliminated as virtual teams communicate via technology. In addition, face-to-face meeting time is reduced and it also minimises the level of disruption to the daily office routines (Baskerville & Nandhakumar, 2007).
- 2) Tampa Bay Arena, Florida. The project was conducted through a web-based construction partnering project. The potential of a project collaboration through the web was demonstrated, with the requirements and information being freely accessible with a member's security code. The result revealed that project managers found all participants to be very satisfied with the cooperation, and team-work, as well as the reduction in communication problems and response time (Guss, 1996).
- 3) Supported by great technology in virtual environment has seen positive relationship between project teams on a construction project in Dubai. Team members indicated that virtual teams are valuable in coordinating and producing effective communication, as long as it is achieved with decrease in costs, improvement in quality, and reduced time to market (Kaur *et al.*, 2016).
- 4) The use of global virtual engineering team (GVET) has been applied in the engineering, procurement, and construction (EPC) industry. These strategies are an open system to capture more experience and feedback to produce higher productivity, speed-to-market, higher labour productivity, and lower wages (Chen & Messner, 2010).
- 5) MedicDec, as a manufacturer and marketer of medical devices, developed appropriate structure of virtual teamwork model in improve organisational strategy to support optimal management of virtual teams in a systematic manner.

Moreover, the following advantages of virtual teams for project management process are listed in Table 3.

Table 3. The advantages associated with virtual teams

Advantages	References
Reducing relocation travel time and cost, and organisational affiliation that traditional teams face	(Fuller, 2008)
Greater productivity, shorter development times	(Sushil <i>et al.</i> , 2010)
Better team outcomes (quality, productivity, and satisfaction)	(Gabriele <i>et al.</i> , 2004)
Effective in decision making, knowledge sharing, and communication planning	(Lipnack & Stamps, 1997)
Integrating talent in newly industrialised organisations; facilitating transnational innovation processes	(Affendi <i>et al.</i> , 2016)

PROJECT TEAMS COMMUNICATION

The construction industry is commonly known as an information-dependent industry. Thus, every single phase requires good quality communication to share a knowledge (idea, fact, and interpretation, and social emotional concept) in developing good quality project outcome. Therefore, effective communication plays a key role for success in delivering data and inter-operability between contractors, sub-contractors, and other parties related to the construction project. According to Otter (den Otter & Emmitt, 2007), the different values and interests from diverse project teams and organisations, and the success of projects depend on effectiveness of communication practices between project teams employed at the project level. For instance, since the activity of processing data in construction sites involves the use of laptop in keying-in the details of materials, the activity between employee and laptop is manually passive. The employee would spend more time dealing with co-located information when the laptop is waiting for data input. This condition decreases work productivity, and delays on-site activities. Thus, project managers should employ alternative ways for implementing project communication plans, by identifying what are ideal and appropriate tools and techniques for communication team management practices.

In particular, looking at previous study, some literature focused on the social perspective dimension on how communication process and connection between team works. As suggested by Dainty (Dainty *et al.*, 2006) “team development, team role theories, and other teamwork factors as techniques to improve team communication”. For instance, in the delivery process of IBS components, unloading to the site project, huge size of components, redesign issues, and transportation process need careful and cohesive planning from different project teams, which is important in maintaining close relationships and understanding their specific roles in the overall task so as to provide better solutions. Moreover, organisations need to look into how to manage communication work flow by adopting ICT, for example in virtual communication among construction project teams in a distributed project area. As suggested by Wikforss and Lofgren (Wikforss & Löfgren, 2007) “to solve the practical communication problems in the construction industry, the perspective must be widened from ICT to organisational and management viewpoints”. There are multiple view-points to focus on in the management of communication process on stakeholders, and communication technology in managing communication team processes, such as team role theories and team development processes. As illustrated by previous studies, changing the mind-set to further transform ICT implementation into IBS component management process is the main factor from the developer’s side. As such, team players would not understand the benefits from new technology development, even though ICT uptake increases productivity and profit in

improving IBS project management. In fact, there are various information technology (IT) tools suitable for overcoming communication barriers in facilitating the IBS construction process, such as building information system (BIM), cloud computing, mobile computing, and global virtual engineering teams (GVETs) (Tsai, 2009; Hosseini & Chileshe, 2013a).

- **Building Information System (BIM)**
BIM is employed to increase AEC practitioners to ensure the construction process flow more effectively. BIM technology is generated by computer modelling, starting from planning, design, construction, and operation of facility. This model consists of 3D models of the project components and links with all the requirement information. BIM was developed to reduce errors and to improve productivity, cost, safety, scheduling, and quality of construction project. Thus, BIM is capable of enhancing project performance along with overcoming the problems stemming from the fragmented structure dominating the industry.
- **Cloud Computing**
The expanding complexity on IBS construction necessitates the exchanging of increasing amounts of data and information. Based on the issues of fragmented process, cloud computing can provide significant impact on effective information system utilisation for improving the effectiveness and enhancing the appropriate information flow, along with access to data, information, and services. Cloud computing is a valuable technology which sends and retrieves data and various applications by utilising the Internet and central remote servers, including application servers and database servers. This system integrates cloud computing and mobile clients (such as smart mobile devices including smartphones and tablets), servers and data centres, and logistics management, and could be applied for the pre-cast concrete supply chain management.
- **Mobile Computing**
Mobile computing enhances project management by providing activity workers with different kinds of information relating to building standards, materials, activities, and reprocesses in working periods. All kinds of activity workers frequently use verbal report via smartphone and also visual reports using pictures taken using digital cameras of smartphones. Thus, the communication process is revolutionised with the integration of mobile application processes in the AEC industry. Hence, the construction management process could be more flexible in processing data at the construction site.
- **Global Virtual Engineering Teams (GVETs)**
The construction industry has started to harness this new paradigm. In the non-construction industry sector, it was recommended that virtual teams have many advantages for the organisation. Thus, the construction industry is witnessing the emergence of GVETs regarding the capabilities of crossing over geographical and temporal borders. Thus, many teams in the construction industry are actively becoming virtual. The advantages of GVET have been confirmed to imbue high productivity, higher qualities of products and services, timeliness of completion of tasks, cost savings, and the ability to deal with current complexity in construction projects.

In particular, when looking at project characteristics, a normal project team is temporary nature. More specifically, since this group is temporary, their relationships and interactions continually change, thus reflecting the efficiency of the working place. Meanwhile, there is a different skill required to implement IBS project phase, since it requires expertise originating from a different location. In fact, practitioners may belong to different places with different languages and cultures, thus contributing to communication failure.

Another problem of the communication process arises from the structure of the organisation in distributing information flow. As suggested by Lunenburg (Karlsen, 2002), the organisation should be distributing information into three directions, which are downward, upward, and horizontal directions.

- Upward – information from subordinate to supervisor as a report for the management. This includes progress report, request for information, suggestion, and decision.
- Downward – information based on advice, instruction, and staff regulation from superiors to subordinate.
- Horizontal – shared information with same hierarchical level among teams, normally at a project-level communication in construction.

Furthermore, in overcoming the barriers from the complexities inside construction projects, project managers and teams need to communicate effectively both up and down within the supply chain, to produce information flow toward other team practitioners (Dainty *et al.*, 2006). Moreover, with the advantages of ICT, which can resolve practical communication problems in the construction industry, this perspective must be widened from ICT to organisational and management viewpoints. Coinciding with the construction teams which are widely geographically dispersed, project managers can plan the communication process by breaking it down into manageable, predictable, and orderly steps. Therefore, this research aimed to explore how project managers handle the communication process between virtual team members in coordination of design, transportation, tracking, and installation to ensure a successful implementation process during the project level.

METHODOLOGY

To examine the barriers of communication in construction projects, multiple approaches were employed in order to guarantee the data were gathered comprehensively. The approaches included a literature review and survey of industry practitioners. Additionally, the data and information for literature review were collected and gathered from libraries, articles, books, web sites, and other printed/published material sources, such as proceedings, bulletins, and international and national journals. The aim of this study was to obtain data from multi-stakeholders involved in the IBS industry. Five project managers were selected from different project teams that have experience in managing IBS construction projects for more than 10 years.

For this study, the survey technique was selected because this technique was deemed the most appropriate technique for gathering data for achieving the objectives of this study. This is because the survey technique has an effective way of obtaining information, insight, knowledge, and experience from a large group of industry players in the shortest period of

time. Furthermore, this technique is suitable to draw upon the experience of the respondent as well as the possibility of getting a reaction, for example through observation, questionnaire survey, and one-to-one interviewing.

Due to issues of confidentiality, it was decided that the name of respondents in this study would not be disclosed. Instead code names (e.g., R1, R2) were used to identify these respondents. The list of the respondents, as well as some demographic details, is shown in Table 4.

Semi-structured interview was selected as the data collection strategy from a qualitative approach, as the aim was to gain in-depth knowledge of the concepts or variables being studied, but the scope covered is restricted to the knowledge and experience of those involved only.

For the purpose of this study, the interview was conducted approximately 45-60 minutes in a quite comfortable and interruption-free setting. All interviews were audio recorded and transcribed verbatim for analysis. Then the data were analysed by using content analysis and representation via tables, documents, and expression.

Table 4. Respondent's profile

Name	Position	Experience (in years)	Company/Discipline	Location	Gender
R1	Director	10	Manufacturer/Installer	Southern	Male
R2	Project Manager	16	Contractor	Northern	Male
R3	Project Manager	10	Contractor	Northern	Male
R4	Managing Director	15	Contractor	Northern	Male
R5	Project manager	20	Contractor	Northern	Male

FINDINGS & DISCUSSION

Based on the findings from the interviews, it was confirmed that the entire elements obtained from the findings are necessary for application in IBS projects in order to achieve an effective team communication process. The findings in Table 5 shows all the recommendations discussed during the interview process.

Table 5. Summary of efficiency of virtual communication practices in IBS projects

Categories	Statement
Distributed area	<p>The big challenge is to organise people in multiple locations, which is how project managers control the communication process according to limitation of physical and social interaction, as well as limited face-to-face communication.</p> <p><i>"Usually this type of communication between project manager and other team for certain project. Before this we communicate by using phone and e-mail to connect our team on different location. Now we use WhatsApp application as a new medium to interact with others member in real time situation. But still created monthly and weekly meeting at the project site. This is how we practices".-R2</i></p>
Open discussion	<p>Respect each team's idea according to frequency of communication among teams in a construction project. This environment creates good work relationships and collaboration without confrontation among team members.</p> <p><i>"Communication through ICT has provided a good service in motion the process of everyday work, but we need to hold a weekly meeting to solve problems, especially those involving technical matters. So through this medium all participants will declare the problems that arise to get a consensus. Meeting can avoid confrontation or miscommunication among teams at the project site".-R5</i></p>
Attitude	<p>Personnel attitude becomes a potential motivator for group and individual performance, including commitment, continuity, and positive self-improvement.</p> <p><i>"The approach I took was to implement a policy of "open door" that anyone can come and discuss openly any time soon. A situation like this to reduce communication gap between me and our team. This way I can find out something with real problems and they are not awkward to share the problem. With existing technology, all the discussion by the employees I can see even though they realized I was there in the group. In addition, I also act as a mediator in decision-making in the event of a problem among the other team. What I do is to be a good listener to discuss with both sides openly".-R1</i></p>
Communication technologies	<p>ICT is used to support information effectively and obtain accurate data without any delay.</p> <p><i>"Nowadays facilities such as ICT communication tool commonly used for example WhatsApp, Line and Telegram make it easily for any business. For example the application tools are multifunction either to share a picture, make a call or video call, sharing location. In the same time the conversation can be make one-to-one or grouping".-R1</i></p>
Reliability of task	<p>Effectiveness of information feedback is needed for teams from distributed area to avoid project delay. Lack of communication will cause and affect the path of the project activity to change or divert.</p> <p><i>"All of information is normally shared through Dropbox and Google Drive. All project teams involved can access data in real time through a smart phone. Through this application, all types of data and information such as pictures, drawing plan is easily referred".-R4</i></p>

CONCLUSION

The aim of this research was to explore how project managers manage their communication between project teams in the construction process. It begins with the identification of construction manager experience in handling IBS projects, followed by communication challenges in handling distributed teams in construction projects. Here, project managers are selected as the keys party with the responsibility to initiate, plan, execute, monitor, and close a complete construction project. Communication issues in the

construction sector had been highlighted by numerous researchers as a critical factor in the delivery of effective team communication practices. Unfortunately, the efficiency of communication practices of virtual teams in construction projects lacked investigation, especially in relation to IBS construction project team communications. Based on data collection from several project managers, this study found that most project teams communicate virtually with one another along the duration of the project implementation. These phenomena are a result of the modern organisational form. There are five categories associated with virtual team work environment, namely distributed areas, open discussions, team attitudes, communication technology, and reliability of task, as presented in Figure 2 previously. These categories are exceptionally pertinent in virtual team, as compared to traditional team, work interaction practices. In contrast there is a need for similar studies in order to support project managers in managing an effective controlled environment. This is because virtual teams are demonstrating a steady decrease in social interaction, communication, and emotional expression levels. Thus, emotional intelligence needs to be identified in order to support effective communication and manage emotions in the virtual environment, especially in Malaysian IBS projects.

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