

The Study of Effective Communication to Overcome Design Change in Construction Project

Nurul Nasirah Mayudi¹, Zailawati Khalid^{1,*}, Norliana Sarpin¹

¹Department of Construction Management, Faculty of Technology Management & Business, Universiti Tun Hussein Onn Malaysia, Parit Raja, 86400, Batu Pahat, Johor, MALAYSIA

*Corresponding Author

DOI: <https://doi.org/10.30880/rmtb.2022.03.02.037>

Received 30 September 2022; Accepted 01 November 2022; Available online 01 December 2022

Abstract: Effective communication in construction industry is a core competency element to the success of the project. Communication becomes a huge problem and a major component in defining events in the construction industry as the industry becomes more complicated and the industry organization becomes thinner. Ineffective communication leads to insufficient instruction, which might cause work to be completed in the incorrect order. The issues that arise in the construction industry are due to a lack of communication. One of the repercussions of ineffective communication on construction projects is the occurrence of rework and redesign. Reworks and design changes are frequently carried out during the project lifecycle as a result of inadequate communication, resulting in time and expense overruns. Therefore, the objective of this study is to identify the consequence of ineffective communication in design change in construction project and to determine the effective communication to overcome design change in construction project. The approach of this study is using qualitative method by interview of three contractors and three architects who were working in Selangor. Primary data was obtained through a qualitative approach to collect complete information related to the objectives of the study. Data analysis procedure for the interview result was analyzed by using thematic analysis method. The finding of this study revealed the consequences of ineffective communication towards design change are cost overruns, time overruns, rework and high accident rate. Therefore, by effective communication can overcome design change in construction by improving communication through innovation, by using 3D project model, Virtual Reality (VR) and by using Building Information Modelling (BIM).

Keywords: Effective communication, design change, construction project

1. Introduction

Changes in design have a significant impact on the performance of a construction project (Olawale & Sun, 2010). Design changes in construction projects are unavoidable and cannot be avoided. Changes in design are the most common cause of delays in building projects' completion times and costs (Muhamad & Mohammad, 2018).

According to Han, Peter & Pena (2013), design flaws have resulted in certain reworks in building projects, resulting in a 5% to 20% increase in the project cost. Cost overruns as a result of design revisions are a common occurrence. As a result, practically every country is seeing the negative impact of design changes on project cost performance. Many studies have been undertaken to determine the causes of design changes, which vary depending on the type of project and the demographics of the location.

On the other hand, design changes have always been an innate feature of the construction industry. According to Abou Chakra (2019), 51% of rework is caused by miscommunication between the owner and designer during the design stage. Based on Obonadhuz, Eze, Siunoje, & Sofolahan (2021) stated that, cost overruns, schedule overruns, a high accident rate, incorrect activity execution, and rework and redesign are some of the major consequences of ineffective communication on construction projects. Effective communication is a powerful project integration strategy that ensures construction projects are completed on time and on budget.

In the construction industry, effective communication is a critical component of project success. However, performing effective communication has always been a difficult assignment since the business is fragmented, dynamic, and consists of numerous parties (client, consultant, contractor), all of which contribute to poor communication. There has not been a publication that addresses ineffective communication in a wide sense, particularly identifying and measuring the causative variables and impacts in the construction business (Rahman & Gamil, 2019).

Apart of that, because the construction industry is complicated, fragmented, dynamic, and involves numerous stakeholders, effective communication is critical to overcoming these obstacles (Gamil & Rahman, 2017). Obonadhuz *et al.* (2021) define many failures and poor project results recorded on building projects have been attributed to communication issues. Ineffective communication has a lot of negative consequences, and it is frequently caused by issues that come from construction companies' management processes.

According to Olanrewaju, Tan, & Kwan (2017), ineffective communication can be explained in terms of the communication process's lack of success and effectiveness. Based on Hussain, Othman, Gabr, & Aziz (2018), ineffective communication is a typical issue in construction projects, and its consequences cannot be overstated because it has an impact on project success.

Based on Gamil & Rahman (2017), it reported one of the repercussions of ineffective communication on construction projects is the occurrence of rework and redesign, as well as a high accident rate. Ineffective communication leads to insufficient instruction, which might cause work to be completed in the incorrect order. According to Obonadhuz *et al.* (2021), employees become demotivated and lose interest as a result of reworking and redesigning their jobs. Rework exposes workers to accidents since they are rarely planned.

Moreover, the majority of issues that arise in the construction industry are due to a lack of communication. Reworks and design changes are frequently carried out during the project lifecycle as a result of inadequate communication, resulting in time and expense overruns (Hussain *et al.*, 2018). Based on Yap & Skitmore (2018), building projects in Malaysia encounter time–cost overruns of between 5% and 20% due to design changes.

According to Norouzi, Shabak, Embi & Khan (2015), miscommunication or disconnect between the architect and the client during the design process is the main category of issues. Miscommunication is characterized as an inability to communicate effectively and efficiently, which frequently causes misunderstanding and annoyance. The ineffective communication between the architect and the client is to blame for a disproportionately high number of flaws in the architectural design. Therefore, the research objectives are namely (1) To identify the consequence of ineffective communication towards

design change in construction project, and (2) To determine the effective communication to overcome design change in construction project

The scope of this study is focused on the objective of this study. This study required a contractor G7 and Architect consultant in Selangor area. According to Laporan Ekonomi Negeri Johor (2019), Selangor is the first largest state to contribute in the construction sector. Besides that, based on Construction Industry Development Board (CIDB), Selangor are the highest number of contractors G7 compare to the other states as well as the number of Architect firm in Selangor. It is because Selangor is a rapidly growing state in the construction sector (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2020).

2. Literature Review

Communication in the construction industry is managed via channels in all companies, therefore each department or unit is responsible for disseminating pertinent information to create a full communication system. However, due to the industry's complexity, several concurrent communication issues arise because no proper channeling is used to monitor and control the communication process (Fichet & Giraud, 2007). According to Obonadhuz *et al.* (2021), Architectural drawings with Structural and Mechanical and Electrical (M&E) services are less accurate due to a lack of communication and leads to design changes in construction project.

When changes are made to the project design or requirements, design alterations, also known as design deviations, occur. According to Yap, Abdul-Rahman, & Wang (2016), they described design changes as frequent additions, omissions, and alterations to both design and construction work in a construction project that occur after contract award and affect contract clauses and work circumstances that make construction dynamic and unstable. Changes in design in construction projects are unavoidable and cannot be avoided. Changes in design are the most common cause of delays in building projects' completion times and costs (Muhamad & Mohammad, 2018).

2.1 Types of communication involved in construction

Verbal communication involves using speech to exchange information with others where we communicate verbally in face-to-face conversation. Meetings, interviews, conferences, speeches, and phone calls are other forms of verbal communication. We can communicate verbally to exchange ideas, understand diverse points of view, and solve problems. Verbal skills are among those most valued by employers to improve professional work performances (Melody, 2002).

A written communication is a communication by means of written symbols either printed or hand written. Also include questions related to communicating with others through written word like emails, notes, memos and proposal as well. For business purposes, managers must deliver their messages clearly, sufficiently and effectively if they want to be successful. Poorly written messages create confusion and fail to achieve intended purpose. Communicating through writing is essential in the modern world and is becoming ever more so as we participate in what is now commonly called the information age (Perumal & Bakar, 2011).

In 1990, the era of Information Technology (TM) or known as Information and Communication Technology (ICT) began to take root and many applications focus on the integration aspect. All tools in TM are used for improve quality, safety, time savings and construction prices. The concept of Electronic Data Interchange (EDI) is used for transmission work data arranged from one computer to another using methods electronics. The advantages of computer software are not in terms of speed and ability to store and process data with over and over again, even reducing human fatigue and carelessness. By using a computer, everything can be done faster, more accurately and cost-effectively effective. Computer-aided Design (CAD), Short message service (SMS), Email, Fax delivery, i-Supervision and video conferencing are the methods used in digital information communication (Misnan *et al.*, 2009).

2.2 Consequences of ineffective communication influencing design change in construction project

According to Obonadhuz *et al.*, (2021), ineffective communication has a negative impact on project time and expense, according to them. As a result, inadequate communication is a primary source of time and expense overruns. Employees become demotivated and lose interest as a result of rework and redesign. Rework exposes workers to accidents since they are rarely planned. Gamil & Rahman (2017) reported that ineffective communication on construction projects can lead to rework and redesign, as well as a high accident rate. Ineffective communication leads to insufficient instruction, which might cause work to be completed in the incorrect order.

Cost control is critical throughout the project because going over budget is perceived as a failure (Hussain *et al.*, 2018). According to Gamil *et al.* (2019), when it comes to inadequate communication, there is a link between cost and time overruns. Poor communication leads to time overruns, which in turn lead to cost overruns owing to the project's late delivery and any rework required as a result of incorrect activity execution. Aside from that, cost overruns are caused by inaccuracies in project implementation. This problem arises from a lack of communication among project participants.

Time overrun is a common occurrence that can result in penalties and losses for the shareholders involved. To ensure that the project is delivered on time, the timetable must be continually updated and presented to the shareholders (Hussain *et al.*, 2018). Based on Gamil *et al.* (2019) study, poor communication, produces significant time overruns since late transmission of information creates delays in the execution of any activity, resulting in severe time overruns. Furthermore, bad communication is crucial because it causes delays at every stage of a construction project, and there is a pressing need to process and send information on time, as efficient communication leads to successful time planning.

Rework has become one of the most collective concerns in construction projects. Rework can be described as unneeded effort of redoing an activity or operation that was enforced in a wrong way from the beginning (Muhamad & Mohammad, 2018). According to Olanrewaju, Tan, and Kwan (2017), in the construction business, the immediate consequences of lack of communication include rework. Besides that, Obonadhuz *et al.* (2021) stated that, the major effects of ineffective communication on construction projects are rework and design change.

Accidents within the construction industry are common and require quick actions and feedback when they occur. Accidents on site are hazardous health and safety issues that could be rooted to poor communication of instructions to avoid these disasters (Hussain *et al.*, 2018). As they most times not planned, it can expose workers to accidents (Obonadhuz *et al.* 2021).

2.3 Effective communication to overcome design change in construction project

- i) Improve communication through innovation which is client's innovation along with the designer's innovation, it can help to overcome design change in construction. Having innovative ideas is one of the biggest challenges, and the most crucial aspect is accepting new ideas. If one of the participants proposes a new feature that solves the problem, the other participants should learn how to comprehend and accept new technology and ideas (Boujaoudeh Khoury, 2019).
- ii) By shared 3D project model is one of the effective communication tools. A shared 3D project model is central to collaborative working between project team members. Within a shared environment, members of a team can concurrently view a 3D model, discussing and agreeing changes. The common 3D project model has the potential for use at all stages in the life-cycle of a project and, as the single complete repository of project information, will ensure consistency (Dadi, Goodrum, Taylor, & Maloney, 2014).
- iii) The use of Virtual Reality (VR) in construction projects is also one of the tools that affect effective communication and can prevent design changes. According to Ahmed (2019), Virtual Reality (VR) devices allow users to view a computer-generated world in three dimensions. In

a way that is not achievable with 2D representations or 3D CAD models, virtual reality allows for incredibly realistic depictions of 3D spaces and objects.

- iv) Mavuso & Agumba (2016), stated that, effective communication throughout the project lifetime is a stimulant to project success, according to the study. Unfortunately, there have been problems in the construction business for a long time, with most issues being attributed to inadequate teamwork and ineffective communication among project participants. Building Information Modeling (BIM) has thus become a channel for promoting effective communication among project participants, according to previous studies. Because of its ability to communicate ideas and envision the project better than the old way, BIM is seen as an effective communication tool that can increase collaborative communication among project participants (Melzner, Feine, Hollermann, & Rütz, 2015).

3. Research Methodology

The methodology is necessary to assist the compilation of data and information for various sources. It involved three main stages starting from collecting the data, analysis the data, conclusion and recommendation related to the topic. Therefore, there were few procedures that has been arranged in phase to ensure the research can be completed successfully and achieve the objectives.

3.1 Research Process

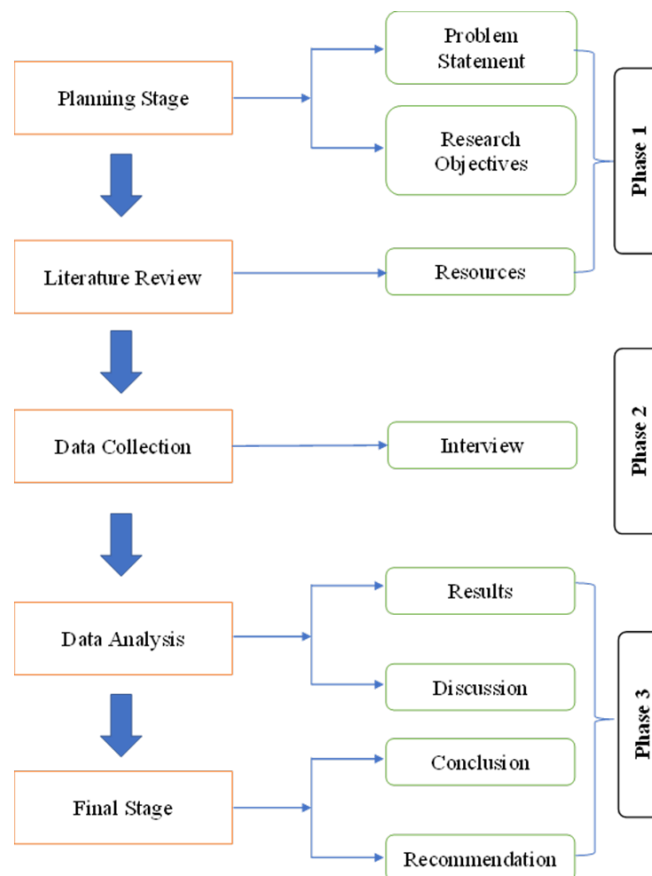


Figure 3.1: Research Process

3.2 Data Collection

Data collection method were of great importance in conducting this research to obtained accurate data and information. Accurate data and information are based on strong evidence and reasonableness. The qualitative method was used for this research.

(a) Primary Data

Primary data was the information that collected for the purpose in doing the research project. The data collected implemented in this research was a qualitative method approach. The data obtained from the respondents through qualitative approach which was interviewed to the respondents. The interview method used for data collection consists of online interview. The interview question was distributed to the contactor G7 and architecture consultants around Selangor. The question for the interview were related to objectives of the study.

(b) Secondary Data

The secondary data was obtained from conducted various reference such as books, newspaper, journal articles, online database and thesis paper which related on poor communication in design change. Secondary data involve the theories and definition which are related poor communication and design change. It also includes the facts that have been done by the researcher before. It is very important in proving the accuracy of the primary data in doing this research.

3.3 Data Analysis

Data analysis was done by using qualitative methods. The interview result was analyzed by thematic analysis method. Thematic analysis is a common method be used to analysis the qualitative data (Joffe, 2010). It can come out theme through the process of identifying analyzing and reporting pattern with data. The pattern brings the information that related to research questions and represents the response pattern of the respondent.

Semi-structured interview was conducted to achieve the objective of the research. Selected contractors G7 and Architecture consultant from Selangor were interviewed with semi-structured questions in order to determine effective communication to overcome design change in construction project. the data categories were broken down according to the objectives in this study. After that, this category is further broken down into smaller sections that focus on the key points for each question posed to the respondents. This facilitates the analytic process and compares data from different respondents' responses.

Furthermore, the data were tabulated for easier understanding. Researcher choose this type of data analysis approach because it is easier to master and effective in making data analysis as well as able to produce good results to help achieve the objectives of this research.

4. Results and Discussion

The semi-structured interview data was conducted from six distractive interviews of three contractors and three architect working in Selangor. The following section presented results gathered from the interviews.

4.1 Respondents' Background

This section presents the background of the respondents as depicted in Table 1 which had been interview to collect the data. The respondents involved for this survey are contractor and architect who are working in Selangor with different positions. They are eligible respondents based on their position, expertise and experience in facing design change in construction projects.

Table 1: Respondents' profiles

Respondent	Position	Academic Qualification	Type of company	Working experience	Age	Type of project
R1	Architect	Bachelor of Architecture	Architectural Firm	17 years	42	Institutional, Commercial, Residential
R2	Architect	Bachelor Arch in Architecture	Architectural Firm	14 years	37	Residential, Commercial, Mixed development
R3	Project Architect	Master of Architecture	Architectural Firm	15 years	37	Residential, Commercial, Institution, Mixed development, Master planning
R4	Executive Director	Degree in Quantity Surveyor	Contractor	12 years	35	Renovation
R5	Director	Bachelor of Science in Architecture	Contractor Company	15 years	38	Design & build, Conversional, Interior design
R6	Project Executive	Bachelor of Science in Construction Management	Contractor Company	7 years	30	Residential

The first respondent was labelled as R1. R1 worked as an architect at an architectural firm in Selangor. Besides that, R1 is a graduated in Bachelor of Architecture. R1 also has wide knowledge and experience in the construction industry. At the age of 42, she has 17 years of working experience in the industry. The types of projects under the charge of R1 are institutional, commercial, and residential projects. R2, which is also an architect that is working at an architectural firm and graduated in Bachelor Arch in Architecture. Besides, R2 has 14 years of experience working in the industry. R2 is in charge of residential, commercial, and mixed-development projects. R3 is a project architect who works in an architectural firm. R3 is a graduated in Master Architect with 15 years of experience working in the industry. The types of projects that have been undertaken by R3 are residential, commercial, institutional, mixed development, and master planning.

R4 is a contractor that worked as an executive director in Selangor. Besides that, R4 has a graduated degree in Quantity Surveyor. R4 also has wide knowledge and experience in the construction industry. At the age of 35, R4 has 12 years of working experience in the industry. Renovation projects are the types of projects overseen by R4. Besides that, R5 is a director of a G7 contractor company and has 15 years of experience working in the industry. R5 is a graduated with a Bachelor of Science in Architecture. R5 has been in charge of design and build, conventional, and interior design projects. Lastly, R6 is an executive project manager working with the contractor G7. R6 graduated with a Bachelor of Science in Construction Management and has 7 years' experience working in the industry and has been in charge of the residential project.

Therefore, based on the position and years of experience of all respondents, it proves that all respondents are genuine and responsible for answering the questions provided with more effective and correct responses.

4.2 Analyses

(a) Consequence of ineffective communication influencing design change in construction project

Table 2 shows that the consequence of ineffective communication influencing design change in construction project from all the respondents.

Table 2: Consequence of ineffective communication

Item	R1	R2	R3	R4	R5	R6	Total
Cost overruns		/	/	/		/	4
Time overruns	/	/	/	/	/	/	6
Rework	/	/	/	/	/	/	5
High accident rate		/		/	/	/	4

i) Cost overruns

From the interview, four out of six respondents agree that ineffective communication influence design change leads to cost overruns. R2 and R3 stated that design change occurs when the information is not clear from the beginning or communication errors also can lead to errors on-site that involves additional or omission structures on site that need to be adjusted or demolished.

“When there are design changes, it will come to the cost implication or communication errors also can lead to errors on-site that involve additional or omission structures on site that need to be adjusted or demolished” (R3)

However, two respondents (R1 and R5) disagree with the statement and stated that:

“Cost overrun usually happened if related to additional requirements from Local Authority or the client” (R1)

“No, because in design it will fixed with the cost that already stated. So that, it will be design with the budget” (R5)

Besides that, ineffective communication leads to cost overruns owing to the project's late delivery and any rework required as a result of incorrect activity execution. Correcting any erroneous activity executions owing to miscommunication incurs costs. R1 and R2 stated that, incorrect activity execution effects the cost overruns due to contractor mis-calculate and mis-organize their work program for building construction. Plus, due to poor coordination and incorrect sequence of work will result in dismantling or abortive works and will increase the original cost. Plus, due to poor coordination and incorrect sequence of work will result in dismantling or abortive works and will increase the original cost. Furthermore, R3 and R6 also agreed that ineffective communication can leads to cost overruns.

“Errors on-site involve additional or omitted structures on site that need to be adjusted or demolished. Or missing items, example structural requirement for the new space required more cost on the project / early cost estimates” (R3)

“When major structure construct wrongly, sometimes it can affect other level. So, need money and time to reconstruct. If this part delay it can affect schedule activity and need to play liquidated ascertain damage (LAD) due to project overdue” (R6)

In additional, miscommunication during work lead to cost overruns. R1 and R5 point out that, miscommunication happened usually between the contractor and project team or client.

“That is why during construction always have technical meeting to prevent miscommunication. That is why as a contractor when we get the construction drawing, we have to the study drawing first and any discrimens need to be arise and have a discussion with the consultant to avoid miscommunication. The client will not be responsible if the problem came from contractor and consultant” (R5)

ii) Time overruns

Based on the interview, all respondents agree that ineffective communication produces significant time overruns since late transmission of information creates delay in the execution of any activity, resulting in severe time overruns. R1 and R4 stated that time overruns can happen especially since communications towards separate and different teams requires additional times. Plus, R2 point out that abortive works will result in extra time. Hence, the extra times required will lead to time overruns.

Besides, R6 highlighted that wrong instruction and communication can cause design change. This is because, extra time is required in order to redo all the wrong parts and it can affect the original schedule activity.

“Wrong instruction and communication can cause design change. To redo all wrong part, need extra time. It can affect to original schedule activity” (R6)

“If we did not highlight any dispute in the early stage, communication can break and it definitely will involve time and cause time overruns” (R5)

In additional, late transmission of information among employees may consume extra time and lead to time overruns. R1 point out that, it happens especially if the contractor has different teams of sub-contractors.

“Example new drawing was not passed between themselves quick enough. Construction proceeded based on old drawing. Therefore, they need to hack or rectify in which requires time” (R2)

“In construction, thing we need to take care is time and money. Cannot waste time or take long time to start work if not confident please quickly discuss. Do not simply conclude something that our self no sure, because it can affect many parties involve” (R6)

Besides that, ineffective communication among employees may affect work schedule and also leads to time overruns. R3 stated that, it normally happens in the design coordination phase and also in the project coordination onsite. Sometimes a critical decision has to be made at an early time is delays can cause another big effect, especially on the critical path activity on site.

“Site management personnel and project consultants must convey direct information & instruction to the right workers on-site. So that the work on-site can be executed as soon as possible” (R1)

Based on the interview, R1, R4, and R6 also stated that misconception between client and construction team in design phase can also prolong the estimated time and because time overruns in long term. However, the coordination between the client or project consultant and contractor must be conducted to avoid any delays during construction.

“Sometimes client always think they are correct. They do not want change the design. Started to fight each other. Then take long time to confirm another design. They also not accept or approve proposal from construction team” (R6)

Besides that, due to incorrect project activity execution can affects the construction works and it might get delayed which could lead to time overruns. Based on R2, R4 and R6, it leads to time overruns because when there is wrong sequence on side, it needs to be redone or abortive works and it will automatically affect the time for the project. Moreover, R3 and R5 stated that:

“Basically, the project will be executed according to the works program that the contractor submits to the architect for approval. If an early comment has been made can avoid those mistakes and the contractual obligation is always to complete the job regularly and diligently all time as per the contract” (R3)

“Once the method is wrong so they need to repeat the method. So that, it defiantly will drag longer time. For example, a job can be completed within 2 days but due to project errors or incorrect project activity, it needs to be fixed and it will drag time” (R5)

iii) Rework

Majority of the respondents agree that rework is one of the consequences of ineffective communication that influencing design change in construction project. Most rework cases arise from changes, damages, defects, errors, omissions and other non-conformances. R6 stated that, rework is one of the consequence due to miscommunication two parties received different information and both parties misunderstanding.

Meanwhile, R3 pointed out that rework or design redo started from the error in communication. The project should be executed in stages. Overlaid errors increase the cost implications which requires rework in order to avoid rectifying the errors. In additional, R5 highlighted that once communication breakdown, it will affect a lot of work including rework.

“Once communication breaks down, it will affect many things, including rework. That’s why we have project quality plan (PQP) to avoid ineffective communication. PQP will be inspect to check each of the work done according to the spec to prevent rework from happening” (R5)

Besides that, ineffective communication or lack of communication during construction phase can cause rework in construction project. R1, R2 and R4 stated that, it especially happens when the works has been subbed to other party (sub-con) and work done not in accordance to the contract. R5 highlighted that, lack of communication will also cause double handling and double works. Meanwhile R3 point that:

“Rework or redo the design are started from the error in communication. The project should be in stages to be executed. overlaid errors can be more cost implications or rework/rectify the errors” (R3)

In additional, wrong execution of activities due to design change can also cause rework in construction project. R2 and R4 stated that, it is because due to poor coordination and unclear communication leads to wrong execution of activities. Hence, communication is important in construction project.

“The contractor must follow the Project Consultant team’s instruction to avoid any wrong work execution” (R1)

“Wrong in constructing the structure need to redo work. Any construction needs to follow as per drawing” (R6)

iv) High accident rate

Four out of six respondents agree that consequences of ineffective communication on construction projects is high accident rate. In other instances, poor communication within work teams contributed to incidents. Meanwhile R1 and R3 did not agreed and pointed out that high accident rate happened because low or no compliance on safety aspect in the construction site, not because of poor communication.

“Normally in case of accident on site in due to the safety measure from the contractor or the worker on site itself. Error between the worker or instruction can lead to injury on site” (R3)

Hence, R2, R4 and R5 highlighted that accident in construction project happen because of no brief given to the workers before any work was carried out. When there is less communication took place, it will lead to high accident rate due to error between the workers and instruction.

“When there is a lack of communication, the percentage of accidents is high. It is more to safety awareness. That’s why there is a personal in charge who will monitor this safety (site safety supervisor)” (R5)

Based on the interview find out that, when design change occurs due to ineffective communication it can disturb the original time of construction plan. So that, when time not properly plan during construction its ca cause accident in construction project. R1 stated that, all construction works must

start at a proper timing and planned perfectly. The work on the site must be stop especially if there are weather changes on site (heavy rain / storm) to avoid any accident. Besides, R5 and R6 point out that, accident in the construction usually happens because of employee ignoring the safety on site.

“If there is no proper work plan, the construction period will be shorter so the contractor will chase the time to completed the project on time and often the safety element will be ignored as long as the work is completed on time. Therefore, this will cause an accident in the construction” (R5)

“When the work schedule is problematic, it causes the employee to be urged by the supervisor to do the work quickly to achieve the target in the allotted time. So, they have to speed up all the work until they forget about safety which should be a priority while at the project site” (R6)

Besides that, background noise from machineries disrupt communication and resulting in accident to happen. R6 stated that, ineffective communication due to unclear communication can cause accident. It is because due to unclear communication, workers might do something that are not allow and should not be done during the construction.

(b) Effective communication to overcome design change in construction project

Table 3 shows that the effective communication to overcome design change in construction project from all the respondents.

Table 4.3: Ways of effective communication to overcome design change

Item	R1	R2	R3	R4	R5	R6	Total
Improve communication through innovation	/	/	/	/	/	/	6
3D project model	/	/	/	/	/	/	6
Virtual Reality (VR)	/	/	/	/	/	/	6
Building Information Modelling (BIM)	/	/	/	/	/	/	6

i) Improving communication through innovation

By improving the communication through innovation, which is client’s innovation along with the designer’s innovation, it can help to overcome design change in construction. R2 and R4 highlighted that, technology helps to reduce human error especially in design and project coordination. For example, the knowledge of client’s innovation can also help client to understand more clearly about the project. Plus, R3 stated that, communication through innovation can helps in detecting problem at earlier stage which will give more understanding on the design proportion and the construction method.

“It will give more understanding on the design proportion, looks as well as the construction method” (R3)

“Communication through innovation can overcome design change by using the communication technologies such as WhatsApp and telegram. We can discuss about the problem directly once we detect the problem at earlier stage” (R4)

“Improving communication through innovation can overcome design change because with effective communication it can less design change problem. So that, no need redo works” (R6)

ii) 3D project model

Sharing 3D project model is one of the effective communication tools. A shared 3D project model is central to collaborative working between project team members. R2 and R5 pointed out that 3D project model can be a visualizer for the project. Hence, R1 highlighted that by using 3D project model, it can help the project team and client to correctly visualize the design because it can show images like reality and is easy to understand.

“It helps the project team and client to correctly visualize the design because it can show images like reality and is easy to understand. It also gives actual image of the design” (R1)

“It is one of instrument to explain in 3D image to the client. So, it will give more understanding on the design proportion, looks as well as the construction method” (R3)

“Act as a visualizer. It can detect clashes of the services in the first place. Plus, can visualize the space for better understanding” (R5)

“Because it can imagine like reality and easy to understand. By using 3D project model, they can see clearly thru 3D model some hidden part in drawing. Normally hidden part can cause among of the overlook. So, 3D model is one of the alternatives can help them to extra understanding” (R6)

iii) Virtual Reality (VR)

The use of Virtual Reality (VR) in construction projects is also one of the tools that affect effective communication and can prevent design changes. Virtual Reality (VR) devices allow users to view a computer-generated world in three dimensions. R6 pointed out that VR can also help client for extra understanding. It can also be used to check either the VR and the drawing are tally or vice versa. If VR is used as another alternative, the imagination to construct some products can be made with confident. Plus, R3 stated that, VR is a very good tools for client to experience the spaces and also for design and architect to improve the interior design especially.

“VR helps by identify the actual design more detail. For example, by using VR client and designer can visualize what type of furniture client want for their building or how exactly toilet fitting looks like” (R4)

“Yes, VR also can help them extra understanding. Sometimes they can check VR and drawing tally or vice versa. The imagination to construct some product very confident if we use VR s another alternative” (R6)

In additional, with help of Virtual Reality (VR) in construction project, it can overcome design change and helps to enhance effective communication between parties involved during design phase.

“It could be overcome design change if it was done during design phase or before tendering or construction. Plus, it helps to enhance effective communication between parties because by using VR can be used to visualization or feel of space” (R2)

“Because the client himself can check the reality of the product before the product is ready to use or apply in the building. Plus, everyone involve in the construction can check the design themselves by using VR and no need to keep calling to ask for something that they were not sure or cannot imagine” (R6)

iv) Building Information Modeling (BIM)

Building Information Modeling (BIM) has thus become a channel for promoting effective communication among project participants. Besides that, BIM is one of effective communication tools and can help in overcome design change in construction project. According to R1, BIM can help the project team & client to correctly visualize the design and solve any technical issues. R3 stated that, with the use of BIM, it will help the architect or designer and engineers to foresee the issue on the software before its implementation on site. So, it will ensure the project to be coordinated within time and cost-effectively.

“BIM is effective communication because it helps the project team and client to correctly visualize the design and communicate easily. It helps to overcome design change by solve any technical issues between different disciplines” (R1)

“BIM can identify defect clash of services and it will help to overcome design change during construction if it done before construction” (R2)

“BIM is a very good drawing and design coordination tools to identify clash from the design. But it required more time in the design period and will have fewer discrepancies on the project or construction period” (R4)

Besides that, the study found out that BIM can become a channel for promoting effective communication among project participants.

“Yes. BIM can help the project team & client to correctly visualize the design and solve any technical issue” (R1)

“Yes. Everyone is alerted of new drawings and clashes will be detected earlier” (R2)

“It will help the architect or designer and engineers’ to foresee the issue on the software before its implementation on site. So, it will ensure the project are coordinated within time and cost effectively” (R3)

In conclusion, based on the interview, there are other ways of effective communication to overcome design change in construction suggested by the respondents. R2 pointed out that sufficient market research and analysis before tendering will help in overcome design change.

5. Conclusion

This section discussed the conclusion of the research findings. Besides that, this chapter also described the conclusion and recommendations of the research conducted by the researcher. The purpose of this chapter is to discuss the level of achievement of the researcher for each of the objectives of the study that have made and determine whether the research done by the researcher achieves the objectives set or not.

5.1 Research Objective 1: To identify the consequence of ineffective communication toward design change in construction project

The finding shows that all respondents agreed that time overruns is the consequence of ineffective communication that influencing the design change in construction project. Time overruns can happen especially since communications towards separate and different teams requires additional times. Besides that, late transmission of information among employees may consume extra time and lead to time overruns happens especially if the contractor has different teams of sub-contractors. In addition, design change leads to cost overruns due to ineffective communication. It is because when the information is not clear from the beginning or communication errors also can lead to errors on-site that involves additional or omission structures on site that need to be adjusted or demolished. Correcting any erroneous activity executions owing to miscommunication incurs costs.

Furthermore, rework is one of the consequence due to miscommunication two parties received different information and both parties misunderstanding. rework or design redo started from the error in communication. The project should be executed in stages. Overlaid errors increase the cost implications which requires rework in order to avoid rectifying the errors. This study also found out that, high accident rate happened because low or no compliance on safety aspect in the construction site, not because of poor communication. accident in construction project happen because of no brief given to the workers before any work was carried out. When there is less communication took place, it will lead to high accident rate due to error between the workers and instruction. Hence, design change

due to ineffective communication required extra time that led to time overruns. Followed by cost overruns are rework and high accident rate.

5.2 Research Objective 2: To determine the effective communication to overcome design change in construction project

This study found out that, by improving communication through innovation helps to reduce human error especially in design and project coordination. It is because the knowledge of client's innovation can also help client to understand more clearly about the project. Besides that, shared 3D project model is central to collaborative working between project team members can be as effective communication to overcome design change. It is because, 3D project model can be a visualizer for the project and by using 3D project model, it can help the project team and client to correctly visualize the design because it can show images like reality and is easy to understand.

In additional, Virtual Reality (VR) devices allow users to view a computer-generated world in three dimensions. VR can also help client for extra understanding. It can also be used to check either the VR and the drawing are tally or vice versa. If VR is used as another alternative, the imagination to construct some products can be made with confident. This study also found out that, BIM is effective communication because it can help the architect or designer and engineers to foresee the issue on the software before its implementation on site. So, it will ensure the project to be coordinated within time and cost-effectively.

Furthermore, this research also found that with enough market research and analysis before tendering can help other people to communicate more easily. Plus, with technical knowledge and experience in industry can overcome design change in construction project. Without experiences, method to read drawing in the early stage there will be errors, so with the experiences people can visualize and read manually the drawing even without a 3D view.

This research contributes to the study of how effective communication can overcome design change in construction project by expanding upon existing knowledge consequences of ineffective communication influencing design change in construction project. The data obtained from the respondents clearly shows that all of the objectives of this study have been achieved throughout the qualitative method. Besides that, this research is expected to be as references to construction industry players in order to increase the quality of communication in construction project for betterment. Plus, when effective communication overcome design change, the construction project can be managed easier and in term of time, quality and cost of a construction project will be better performed.

Acknowledgement

The author would like to thank the Faculty of Technology Management and Business and Universiti Tun Hussein Onn Malaysia for its support.

References

- Abou Chakra, H. (2019). The impact of design changes in construction projects on the cost charged by consultant offices. *BAU Journal-Science and Technology*, 1(1), 2.
- Ahmed, S. (2019). A review on using opportunities of augmented reality and virtual reality in construction project management. *Organization, Technology and Management in Construction: An International Journal*, 11(1), 1839-1852.
- Boujaoudeh Khoury, K. (2019). Effective communication processes for building design, construction, and management. *Buildings*, 9(5), 112.
- Dadi, G. B., Goodrum, P. M., Taylor, T. R., & Maloney, W. F. (2014). Effectiveness of communication of spatial engineering information through 3D CAD and 3D printed models. *Visualization in Engineering*, 2(1), 1-12.
- Fichet, H., & Giraud, L. (2007). How the information flow is processed in project-based companies compared to others and how it affects strategic drift. In: *Handelshögskolan vid Umeå universitet*.

- Gamil, Y., Abd Rahman, I., & Nagapan, S. (2019). Investigating the effect of poor communication in terms of cost and time overruns in the construction industry. *Management*, 9(2), 94-106.
- Gamil, Y., & Rahman, I. A. (2017). Identification of causes and effects of poor communication in construction industry: A theoretical review. *Emerging Science Journal*, 1(4), 239-247.
- Han, S., Peter, L., & Pena-Mora, F. (2013). A system dynamics model for assessing the impacts of design errors in construction projects. *Mathematical and Computer Modelling*, 57, 2044-2053.
- Hussain, A. M. A., Othman, A. A., Gabr, H. S., & Aziz, T. A. (2018). Causes and impacts of poor communication in the construction industry.
- Mavuso, N., & Agumba, J. (2016). Factors of communication management for successful project delivery in the Swaziland construction industry. *Proceedings of the 9th Annual Quantity Surveying Research Conference*, pp. 16-25.
- Melzner, J., Feine, I., Hollermann, S., & Rütz, J. (2015). The Influence of Building Information Modeling on the Communication Management of Construction Projects. *The 15th International Conference on Construction Applications of Virtual Reality*.
- Misnan, M. S., Mohamad Ramly, Z., Lee, C. K., & Ting, K. (2009). Pengurusan projek pembinaan: kaedah dan keberkesanan komunikasi di tapak bina. *PENGURUSAN PROJEK PEMBINAAN: KAEDAH DAN KEBERKESANAN KOMUNIKASI DI TAPAK BINA*, 111-122.
- Muhamad, N. H., & Mohammad, M. F. (2018). Impact of design changes in construction project. *Malaysian Journal of Sustainable Environment*, 4(1), 1-18.
- Norouzi, N., Shabak, M., Embi, M. R. B., & Khan, T. H. (2015). A new insight into design approach with focus to architect-client relationship. *Asian Social Science*, 11(5), 108.
- Obonadhuz, B. I., Eze, C. E., Siunoje, L. U., & Sofolahan, O. (2021). Causes and Effects of Ineffective Communication on Construction Projects. *Borneo Journal of Sciences & Technology*, 3(1), 77-92. doi:10.3570/bjost.2021.3.1-11
- Olanrewaju, A., Tan, S. Y., & Kwan, L. F. (2017). Roles of communication on performance of the construction sector. *Procedia engineering*, 196, 763-770.
- Olawale, Y. A., & Sun, M. (2010). Cost and time control of construction projects: inhibiting factors and mitigating measures in practice. *Construction management and economics*, 28(5), 509-526.
- Perumal, V. R., & Bakar, A. H. A. (2011). The needs for standardization of document towards an efficient communication in the construction industry. *Acta technica corviniensis-Bulletin of engineering*, 4(1), 23.
- Rahman, I. A., & Gamil, Y. (2019). Assessment of cause and effect factors of poor communication in construction industry. Paper presented at the IOP Conference Series: Materials Science and Engineering.
- Yap, J. B. H., Abdul-Rahman, H., & Wang, C. (2016). A conceptual framework for managing design changes in building construction. Paper presented at the MATEC Web of Conferences.
- Yap, J. B. H., & Skitmore, M. (2018). Investigating design changes in Malaysian building projects. *Architectural Engineering and Design Management*, 14(3), 218-238.