

**Communication Management and Challenges in
Building Construction Projects in the eastern
province, Saudi Arabia**

BY

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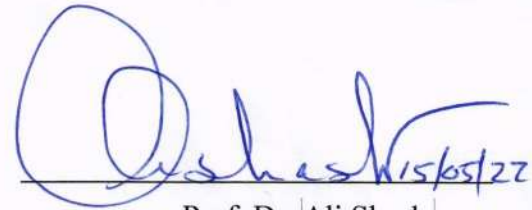
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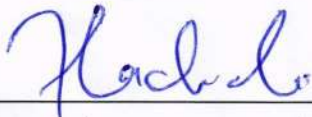
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DEDICATION

This research is dedicated to Almighty Allah; without his blessing, I would never be able to accomplish this work, who has been the greatest source of strength in my darkest times while achieving this study, who said in Sura FATIR in the Qur'an: "But it is only those amongst his worshippers that fear Allah who have knowledge." Also, dedicating this to my Prophet, Mohammad, peace be upon him, the light of humanity and our greatest mentor.

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I hope this work contributes to the current body of knowledge and promotes the growth and prosperity of humanity.

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ABSTRACT

Full Name : [AHMAD MALIK ABUSAMHA]

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Communication is a crucial factor for the successful execution and delivery of construction projects. Most of the time, the mistakes in this field are referred to as miscommunication-caused problems. The fundamental purpose of this research is to study the communication quality among the different parties responsible for constructing a building project. The required data were collected from building experts through face-to-face interviews at the beginning of the study and through a questionnaire survey during the COVID-19 pandemic. Data collection was conducted through the developed questionnaire, through structured interviews and email surveys. Questions in the questionnaire were created based on an ordinal measure, the Likert scale (5-point scale). The researcher has used both survey collection and interviews (whenever possible). Key informants were from the Saudi Arabian building construction companies in grades 1 and 2, the researcher acquired data from engineers on multiple levels in the operations and included those from building construction companies only. Building Contractors in Saudi Arabia engage periodically in communication improving practices, work to improve their internal communication

practices and tools and reduce the barriers. Communication is vital, it directly affects the quality and the output of the people within the company. Contractors in Saudi Arabia tend to follow a conventional approach that includes small to no change to improve neither communication tools and practices or reduce the barriers. Whether this communication pain point is there, finding it and addressing it in time is necessary. The results showed that the contractors lacked – most of them – an internal communication system to organize their internal communication. It was ranked first in the lack of communication tools, directly affecting all factors. The lack of centralization of communication directly affects the people and the information. As the definition of the communication terms was ranked first in the impact level of the lack of communication process, the choice of proper media was ranked second. The poor negotiation skills, ineffective reporting system and age difference were ranked first as the most occurring communication barriers. However, the most impactful barriers that were ranked first are Poor planning, Poor or undetailed drawings, and Information filtering, where the information gets mutated from the source to the destination.

ملخص الرسالة

الاسم الكامل: أحمد مالك إسماعيل أبو سمحة.

عنوان الرسالة: تحليل ودراسة التحديات في عمليات التواصل بين الافراد والمجموعات لدى مقاولي المباني في المنطقة الشرقية بالمملكة العربية السعودية: دراسة شاملة لواقع الحال.

التخصص: ماجستير العلوم في هندسة وإدارة التشييد

تاريخ الدرجة العلمية: كانون الأول، ٢٠٢١.

إن التواصل السليم يعتبر من أهم العوامل المحددة لنجاح التنفيذ والتسليم للمشاريع الانشائية. اغلب المشكلات الحاصلة اثناء عمليات التنفيذ هي مشكلات ناجمة عن سوء تواصل او سوء تفاهم بين أطراف المشروع. يهدف هذا البحث الى دراسة جودة التواصل بين مختلف الأطراف المسؤولة عن الانشاء في مشاريع بناء المباني في المنطقة الشرقية، المملكة العربية السعودية. مقاولي المباني في المملكة العربية السعودية يدخلون بشكل دوري في عمليات لتطوير بنية التواصل، ويعملون لتطوير ممارسات التواصل الداخلي، الأدوات المستخدمة في هذه الممارسات وتقليل عوائق عملية التواصل. عملية جمع البيانات لهذا البحث تمت عبر نموذج أسئلة، الذي تم توزيعه عبر البريد الإلكتروني او تم تعبئتها اثناء عمل مقابلات حية للمستهدفين اثناء جائحة كورونا. الأسئلة تم وضعها ضمن نطاق اجوبة ذات طابع عددي، مثل مقياس لكرت (نظام الدة نقاط). قام الباحث باستخدام طريقتي جمع البيانات اليدوي اثناء المقابلة، او التعبئة من قبل المستهدفين وجمعها. المستهدفين كانوا جميعهم من المؤسسات البناء السعودية من الدرجة الأولى والثانية، جمع الباحث البيانات من مختلف طبقات العمل واختص المؤسسات المتخصصة في بناء المباني. المقاولين في المملكة عادة ما يميلون الى اتباع طرق تقليدية للتطوير مما يضفي القليل او لا يضفي ابداعاً على تطوير أدوات وممارسات التواصل ناهيك عن انه لا يقلل ابداعاً من عوائق عمليات التواصل. بغض النظر عن وجود نقاط الضعف في التواصل او لا، معرفتها وتحديدتها في الوقت المناسب هو ضرورة لا بد منها. التواصل الفعال هو مفتاح لنجاح المشاريع، انه يؤثر بشكل مباشر على جودة مخرجات الافراد داخل المؤسسات. بعد البحث قام الباحث بايجاد ان اغلب المقاولين يفتقرون الى وجود نظام مركزي داخلي لإدارة التواصل الداخلي بين الأطراف، حيث انها تم تصنيفها كأكثر الأدوات تأثيراً وقلها وجوداً، مما يؤثر بشكل مباشر على جميع العوامل الأخرى. عدم وجود هذا النظام المركزي يؤثر بشكل مباشر على الأشخاص ونوعية المعلومات

وجودتها، كما تم إيجاد ان تعريف المصطلحات الخاصة بالتواصل وتوضيحها لجميع الأطراف كانت صاحبة اعلى تصنيف من حيث مستوى التأثير على جودة التواصل، كما ان اختيار الوسيط المناسب للتواصل تم تصنيفها ثانيا من حيث مستوى التأثير. سوء مهارات التواصل لدى الأشخاص، سوء نظام إدارة التقارير الراجعة وفروقات العمر بين الأشخاص كانت هي أكثر العوائق حدوثا. أخيرا، تم إيجاد ان أكثر العوائق تأثيرا على عملية التواصل هي سوء التخطيط، سوء او نقص تفاصيل المخططات التنفيذية وعملية تنقية المعلومات وتحريفها قبل نقلها.

CHAPTER ONE:

INTRODUCTION

1.1 Background

The origin of the theory of communication dates to the twentieth century when the leading time theorists interpreted our current understanding of communication theory. Rooting back to Shannon and Weaver's mathematical theories (1949) and the psychological and social viewpoints during the twentieth century (Ritchie, 1986), it was concluded that the communication theory comprises subfields and disparate areas instead of defining it as a coherent body of knowledge. Traditionally in organizations, communication analysis scrutinizes the flow and movement of information and data within networks and channels (Thompson, 1995). Communication researchers began exploring the theory in 1970 that organizations are methods or processes instead of entities, ergo, referred to as communication (Hawes, 1999). This theory views communication as fundamental and essential in organizations and is a means of understanding why or how a business could fail or succeed.

1.2 Problem Statement

Communication is a critical factor for the successful execution and delivery of construction projects. Most of the time, the mistakes in this field are referred to as miscommunication-caused problems (Latham, 1994). In the context of construction, there exist complex

procedures. The construction process efficiency is clearly and mainly determined by understanding each party's responsibilities in the process and the quality of the relationship between the professionals, engineers, foremen and labors (Emmerson, 1962). Because of its unique set of responsibilities, this type of business creates an overly complex atmosphere of contractually driven relationships. These relationships are usually unstable and subject to many changes due to the dynamic nature of the work-based industry (Hoezen et al., 2006). This environment created a culture that presents an unfortunate reality of disagreements and challenges due to the absence of common respect (Dainty et al., 2006). Although managers in various businesses and industries attempt different tasks and actions, it has for quite some time been perceived that they invest most of their time engaged in communication (Baguley, 1994). This activity, if seen as an - in a general sense - social action, communication exercises can be in the form of discussions, listening to partners, organizing, gathering data, coordinating subordinates, composing letters, or moving information or data through electronic gadgets, for example, phones or PCs. In many aspects, communication effectiveness defines the overall performance of the project manager and, therefore, the whole team. Sophisticated performance needs call for sophisticated communication. Hence, construction as an industry is not an exception in its dependence upon successful and efficient communication. Without the capacity to interact and communicate, it is conceivable that any modern company would cease to exist as we get to know them (Katz & Kahn, 1978). In any case, the construction process shows an exceptional complicated communication (and therefore, intriguing) atmosphere inside which to investigate the communication case. Since construction is a project-based industry, its gatherings and networks are brief in nature and relations and communications

consistently vary to give a dynamic idea of the working environment. The activities themselves can be outlined as far as their exceptionality, difficulty, and irregularity. Each project will have one-of-a-kind qualities and include various actors, all of whom will have a particular and limited contribution to the efforts. Beating the perplexing and momentary constraints that project places on its members are crucial to their successful continuous improvement (Goczol & Scoubeau, 2003). Consequently, while construction is an environment inside which procedures and methods have been refined to encourage effective communication inside it, a component of weakness consistently exists that can weaken the communication networks needed for project success.

Poor communication in a company or an organization could lead to disastrous results. For employees, an apparent miscommunication is the misinterpretation of the managerial actions and decisions by the employees who will have a bad reaction to such decisions. Likewise, the management could misinterpret the employees' needs, which will directly affect the firm's overall performance and increase the turnover rate. Nowadays, effective communication has increased importance due to what today's world describes as a "knowledge-based economy." This knowledge-based revolution highlighted the tendency of the market to be dominated by the service segment organizations with the clear and gradual wear of the manufacturing-based organizations. The biggest construction firms have become managerial firms (service sector), outsourcing the industrious capabilities, and acting as effective managers of the construction process. The construction project environment presents a unique case of the communication arena in which their solutions can be seen as effective in other sectors. In order to understand the communication challenge more clearly, this is best shown through an example. Let us take the case of the

construction of an essential, local single-floor extension for an old brick house. The communication matrix for such a small or even forthright project will include communication between the owner, the architect, the suppliers, the constructor, his manpower and the management and planning team as the minimum. Now, let us consider a more sophisticated example, such as constructing a new sea-mounted bridge. These projects could take years and years of planning and studying before any of the on-earth activities could mobilize. It will include probably thousands of people and hundreds of different companies and organizations from all over the globe working in an integrated cooperative, collaborative scheme.

The flows of data and information between individuals on the site level and in the head offices and the filters between the site and head offices associated with such endeavors are undoubtedly massive, yet they should be carefully taken care of and managed if the anticipated outcomes are to be accomplished. Though, in both cases, the success or failure of the construction project mainly depends on the efficiency of such individuals involved in communication to carry out their requirements and the other perspectives. However, the carrying out of effective human communication of the data and information has the power to destroy such walls and challenges by getting people to be together, in that way propagating enhanced cooperation and collaborative working scheme within the industry. Consequently, effective communication can be the foundation of future industry improvements. Henceforward, a set of enquiries appeared when we study the human communication in the industry, and it is necessary to provide answers to them:

- What are the current project communication management processes and practices adopted by construction and project managers in the building construction projects in the Eastern Province, Saudi Arabia?
- What are the main communication tools adopted by project managers and used by the different parties involved in the building construction projects in the Eastern Province, Saudi Arabia?
- “In general, what are the main barriers to achieving the proper carryout of communication in the building construction projects in Eastern Province, Saudi Arabia?

1.3 Research Objectives

The fundamental purpose of this research is to study the communication quality among the different parties responsible for constructing a building project (The field) in the Kingdom of Saudi Arabia. The specific objectives of the study are:

- Determine the current communication management practices followed during the construction of building projects in Eastern Province, Saudi Arabia, between the project management, the project owner, the project designer, and the contractor's head office.
- Identify the current norms in the means and tools to communicate among the various internal and external parties during the construction of building projects in Eastern Province, Saudi Arabia.
- Identify and classify the primary communication challenges (Communication barriers) during the construction of building projects in Eastern Province, Saudi Arabia.

1.4 Significance of the Study

In the last couple of years, the kingdom of Saudi Arabia has witnessed substantial urban advancement and development. The Saudi government has launched the “Vision 2030” with an open eye toward a bright future, a human-centered future, seeking a comprehensive quality of life changes and an overhaul of the current economic and social structure. In this context, the government has aimed to accomplish several milestones. These fields include the construction of three new Saudi cities that will represent the future of city planning in Saudi Arabia. Those cities will directly contribute to the pillars of the vision and contribute to the quality-of-life part of those (SCEDA, 2016). In this context, the construction industry is one of the primary arms of the government in helping to achieve that vision. Thus, the achievement of the projects in a successful manner is mandatory, particularly in those days.

Communication is frequently treated as a backstage or highlighted variable in deciding a firm's overall performance. From a conceptual point of view, it is linked to an organization's structural, cultural, initiative, and prizes (Church, 1996). This definition puts communication as the key to all organizational activities. Thus, for project managers, understanding the human differences in social, cultural, and structural contexts will contribute to their ability to deliver their projects successfully. Consequently, in addition to researching the human interaction as a process and studying the influence of such interactions on the effectiveness of the communication, this will allow the consideration of such mutually significant aspects to be understood and a more inclusive understanding of how we can manage such communication more efficiently. The significance of this research lies in the following:

- The investigation of the human communication phenomena in this industry will help understand the challenges within both the contemporary context (project) and the firm context (HO) of the business.
- Effective communication defines the performance of the project managers. A superior understanding of the challenges, the tools, and the reason behind them will enable them to communicate successfully and, thus, a successful project.

The primary benefit of this research is to enable project managers and construction firm owners to understand the communication process, barriers, and the methods to overcome them in tools to carry out an effective communication on all levels. The secondary benefits of this research are as follows:

- Examining the communication process at various levels fluctuating from interpersonal communication between individuals in a project, the interpersonal communication in the head office to the intercommunications between the head office and the ground troops (site).

Finally, this study will close a gap in the literature that lacks research on communication and human interactions in the Kingdom of Saudi Arabia, especially in the building sector.

1.5 Scope and Limitations

The proposed scope of this research is to study the communication challenges in the field (project site) and investigate project managers and their equivalents. The research was limited to building contractors.

The issues to be studied and analyzed are the communication challenges in the job site and how they tend to be miscommunicated when they are transferred to higher levels in the job

site (the communication filters), the tools and method to carry out the information in the Jobsite. The issues will be analyzed from the contractor's point of view. Only contractors classified as grades 1 and 2 are considered in this study. Furthermore, the contractor should be specialized in building construction as their primary field (constructor with more than one specialty will be considered if their central was building construction). No restriction for the type of project delivery system was taken into consideration. Due to cost and time constraints, this research will be conducted in the eastern province of Saudi Arabia. However, since Saudi Arabia undergoes the same regulations throughout the kingdom, the results and findings of this research can be brought into greater context and generalized to the whole kingdom's local market for the same sector.

CHAPTER TWO:

LITERATURE REVIEW

This chapter presents a review of published research work on communication. The discussions are divided into five sections.

The first section aims to define communication. The second section introduces the theory of communication, discusses the literature behind human behavior and lists the history of human communication throughout the ages. The third tries to analyze the communication structure in the literature from individuals to corporations and list a detailed structure for the communication process. The fourth section lists most of the catastrophes because of poor communications. Finally, the last section presents various advancements in communication technologies in the construction industry and their evolution.

2.1 Definition of Communication

We can look at communication as the metaphorical “thread” over which our human communication data is transmitted from one human to another (Axley, 1984). As Thompson once mentioned, it is indeed the essence of a human connection, and without it, we cannot have any meaningful or coherent connection or activity (Thompson, 1995). Moreover, if we want to define the word communication, it will become more complicated because this word and its definition have a vague multidimensional idea behind it. It could have a wide range of different implications, contexts, ways, and outcomes, and so it will imply different actions to different people in different scenarios. Communication, most of

the time, includes the transmission of data. It is a general term that contains many meanings, such as processing information, knowledge, and technology (Cheng et al., 2001). Skyttner described the act of communication in (1998) as a “bridge a distance of some descriptions,” which can vary from a slight distance with a simple bridge (between two individuals) to far distances and complicated bridges (across the globe). In another context, in (1986), Hargie described effective communication in interpersonal proximity as a social skill that involves efficient interactions between individuals. Most of the time, interpersonal communications between individuals include conveying ideas, facts, emotions, and principles (Kakabadse & Margerison, 1988)(Kakabadse & Margerison, 1988). Therefore, interpersonal communications could be considered an independent and value-driven form of connection. However, as Eisenberg et al. (2013) proposed, communication could be a “transactional process” where some possessions are traded between the people involved.

Moreover, seeing all these definitions of communication proposes that communication and its essence are about transferring some data between individuals. Thus, in most scenarios, the main idea of communication is that one party transmits information to another. This interaction is controlled, to some extent, by the social and cultural norms and rules. Nevertheless, social behavior determines the meanings of this information to us as humans (Gayeski, 1993).

2.2 Theory of Communication and Communication History

The following is a theory that has divided the human communication system throughout the years since its existence. This theory was brought to the public and gained public attention in 2000 when (Logan & Heyer, 2001) authored the book “the sixth language;

learning and living in the Internet age.” Throughout the years, this book shows that communication was through three communication eras: the oral era, printing, typing, and writing, and finally, the digital era (the electronic era). This theory was first introduced by Marshall McLuhan and Harold Innis (Innis, 1964). Logan & Heyer in 2001 witnessed the communication advancements after McLuhan and Innis and, consequently were able to demonstrate and proof how communication will keep evolving over the years.

McLuhan and Innis divided mankind's history into three periods dependent on the methods of responsiveness their media made accessible to them. The first one of the oral conventions extends from the time humankind first was able to speak till 5,000 years ago when they started literacy. The second one, the literacy era, incorporates the period from the letters and writing invention to the power and electricity revelation and its utilization as in the telegraph. This previously mentioned writing period is sequentially broken down into three subdivisions, the first starting with the appearance of literacy symbols, the second with the creation of the phonetic alphabet, and the last with the development of the print machine. The third communication period is the digital river of information, which covers the period from the primary utilization of the telegraph in 1844 till today (Innis, 1964) (Innis, 1964).

Innis said in 1972 regarding the writing era: “We can conveniently divide the history of the West into the writing and the printing periods. In the writing period, we can note the importance of various media such as the clay tablet of Mesopotamia, the papyrus rolls in the Egyptian and the Graeco-Roman world, parchment codex in the late Graeco-Roman world and the early Middle Ages, and paper after its introduction in the Western world from China”.

2.2.1 Oral Era

The first era of the oral convention extends from the time humankind first was able to speak till 5,000 years ago, when they started literacy. Speaking or the oral convention typically survived both writing and digital eras, yet its capacity changed. It held its strength for discussion and everyday use; nevertheless, it was never again utilized as the vault of a culture's customs as it had been in oral time, nor the methods for spreading news from one town or village then onto the next. The wandering minstrel who had passed on the stories and the news across time and space was soon replaced by the written instead of spoken, making it through time, libraries, and space by the messengers (Walter, 1982).

2.2.2 Literacy Era

Now, with writing, communication has taken a new path. The communication methods started to be a type of art or poetry, but the question here is, where did writing start? The creation of writing was long thought to be originated from one source. It was presented in theory called “monogenesis.” All literature about that theory believed there was only one origin to writing. Then it spread through cultural diffusion (Olson, 2009). However, this theory was later disproved, and scholars discovered that writing was invented independently in at least four independent civilizations: ancient Mesopotamia (3,100-3,400 BC), Egypt (3,200 BC), Low land Mesopotamia (650 BC) and China (2000 BC) (Schmidt, 1996). The idea of writing has, ever since, been advancing and evolving, in modern days, primarily because of the inventions and the modern technologies throughout the hundreds of years. The pen a start, the printing machine, the PC, and the cell phone are innovative advancements that have changed writing, composition, and the medium through which the composed words are delivered. The appearance of the digital writing technologies, the PC

and the cell phone made it possible to make characters by pressing a key on a keyboard, rather than a movement with a hand, and a new era has emerged.

2.2.3 Electronic Era

Newspapers, as per McLuhan, are a result of the printing machine and the telegraph. The electrical and digital flow of data changed the mentality of writers as McLuhan and Innis (1964) describe them “live mythically and in-depth”. As an outcome, the authors got worried about psychological research, human societies sciences, and sociology. The psychological writing and continuous flow of conscious method were created. The electricity created another sudden flip that influenced the oral speech, a restoration of the oral convention in the art and music, and a world of schools in the 19th and early 20th centuries, as illustrated by jazz and the utilization of African shrouds in Cubism. The educational structure also was affected by those new advancements in communications. Particularly training way on the Jobsite to the formal way of education. The letters in order, dynamic science, and the formal rationale offered to ascend to the academies of higher discovering that first showed up in old Babylon, Greece, and Egypt. The print machine offered to ascend to the modern educational system of mass schooling and large-scale manufacturing lines. The broad communications of radio, TV and broadcast communications contracted the world to the elements of a worldwide village. Neither the mentioned authors nor many of their peers have lived post the eighties, two industrial revolutions that had taken the PC to the next level, making computers more mobile and easier to acquire, and the invention of the Internet. On the off chance that they had the chance to watch these two wonders, they would have isolated history into four periods instead of the three they picked. As Logan said about those authors who have not lived till

this day: “I believe, like me, they would have added a fourth era by making a distinction between the era of electric media of mass communication from the era of electronic media of mainframes, microcomputers and the Internet.” Logan keeps going in his assumption, saying that even though the scattering of electronic data matches that of electric data, there is a significant contrast. From the users' point of view, the electric media are somehow inactive data consumers, though the electronic media's users can cooperate effectively with the data they get (Logan & McLuhan, 2016).

2.3 Communication Structure

The “chain” or “line” communication structure involves direct lines of communication between members of each rank directly above and below the message's origin point, but not with members on any other point in the chain. This arrangement has been seen as a communication structure in almost every culture. For instance, in this context, a department head can communicate directly with the vice president directly above him or the manager directly below him but not with the line worker several steps below him or the company president several steps above him. The advantage of this structure is that it provides clear accountability because everyone knows where instruction or decision originated.

The history of communication technologies (media and appropriate inscription tools) has evolved in tandem with shifts in political and economic systems and, by extension, systems of power. Communication can range from subtle exchange processes to entire conversations and mass communication. The history of communication itself can be traced back to the origin of speech circa 100,000 BCE (Miyagawa et al., 2018). The use of technology in communication may be considered since the first use of symbols was about 30,000 years BCE. There are cave paintings, petroglyphs, pictograms, and ideograms,

among the symbols used. Writing was a significant innovation and printing technology, and, more recently, telecommunications and the Internet.

2.3.1 Communication in Projects

The construction industry professionals shall improve internal and external communication in construction projects. Communication within a project is a superior practice and indicates professionalism (Cheng et al., 2001). Thus, most of the communication practices in the project happen among those professionals, the clients, the contractor, the architecture, and the designer. Moreover, (California Dept. of Transportation, 2007) (California Dept. of Transportation, 2007) stated:

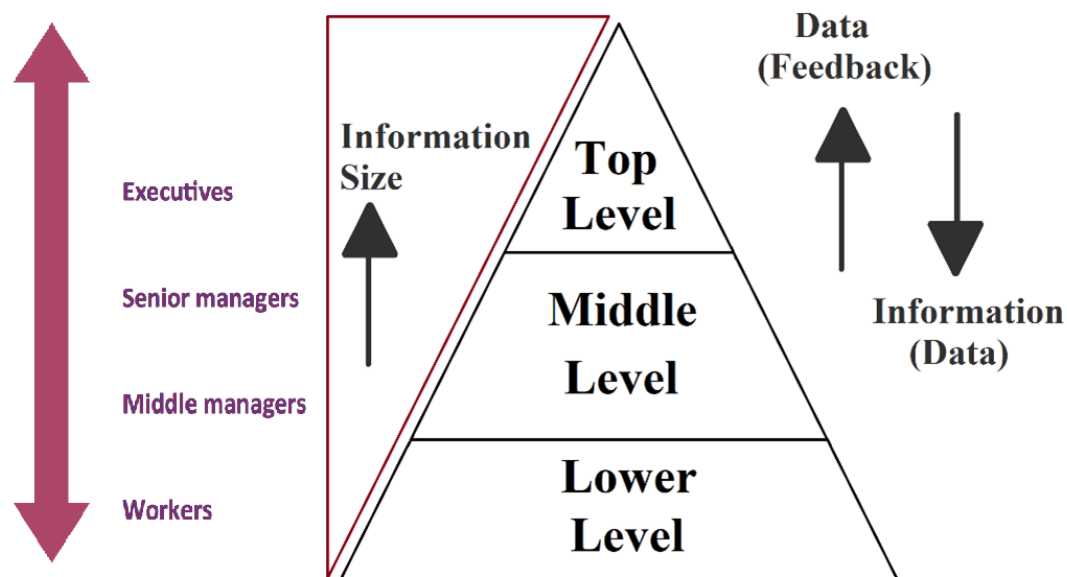


Figure 1 Information exchange in project

“The project team must provide timely and accurate information to all stakeholders (people affected by a project). Members of the project team prepare information in various ways to meet the needs of various project stakeholders. Team members also incorporate feedback from these stakeholders.”

The project is conducted within its information. Looking at the organizational hierarchy, the message, or information, generally circulates from its upper levels downwards and subsequently, the feedback generates oppositely (Ruuska, 1996). Illustrated in Figure 1 are managers of the upper levels that are in contact with the most information. Ergo, enabling them to govern information and manage the project itself sufficiently. Construction project managers' vital key to success is project communication management through managing information.

2.3.2 Communication in Construction

The construction industry requires careful communication management to be successful, primarily due to the decentralized nature of the industry. Tai et. al. (2009) highlighted this importance due to the widely differing responsibilities of different stakeholders and the geographical distribution of stakeholders.

Poor communication practices can relate to increased expenditure for a project (Anumba & Evbuomwan, 1997). Furthermore, the efficiency of the processes is related to the standard of communication processes employed. The literature identifies four areas where improvements can be required:

- Reduced failure rates can be seen when improvements are made between teams (Franks, 1998)
- Better technical solutions may be found with a more open communication plan (Lenard & Eckersley, 1997).
- Early improvements in communications can directly influence stakeholders' precipitance of project quality (Emmitt & Gorse, 2009).

- Communication improvements at times of briefing allow for better decision making (Nutt, 1988).

Kao et al. (2008) express that communication must be considered carefully for construction projects. However, the topic is a complicated one. The critical reasons for the complexity of construction industry communications were highlighted:

- Numerous project participants, each requiring different methods of communication
- Long-term projects with different tasks at various times. Rapid changes in communications, partially due to changing stakeholders, therefore complicate the matter.
- Stakeholders are generally organizations, not individuals, each of which has a unique structure. This fact can complicate transmitting information to various levels of these different organizations due to increased numbers of variables.

The construction industry is primarily based on team efforts. Many people can be involved with a single construction project, so effective communications are essential to prevent time from being wasted during communication transmission.

2.3.3 Interpersonal Communications

Interpersonal communications are essential skills for professionals, as interpersonal (face to face) is one of the most used communication methods (Emmitt & Gorse, 2009). Interpersonal relationships can be developed between individuals based on each participant's behavior and responses (Kreps, 1986). These forms of communication are natural and thus allow for a maximum level of feedback. Therefore, natural interaction allows for less guarded forms of exchange between individuals (Trenholm & Jensen,

1995). Interpersonal communication is more than just speech; but also includes body language, posture, and expressions. It allows for rapid transmission of information between individuals.

2.3.4 Communication Management Processes

Duncan (1996) said that project management teams include the procedures needed to enable the researchers to gather data and generalize, collect, disseminate, store and, finally, conduct disposition of the information gathered. The communication management processes used by businesses in the Saudi Arabian construction industry provide a direct link between people and the information transfer process; without this information, workers would be unable to provide satisfactory results during the progression of the projects. As such, all project members should understand how the communications procedures for project work and how these communications are important for the project's progression. Furthermore, people should be aware of the project management teams responsible for managing communications between the team and the stakeholders.

Four processes outline project management: communication planning, information distribution, performance reporting, and, finally, management of project stakeholders (Abou-Rjeily & Fawaz, 2008). Every process in this list is linked with other processes, as seen in Figure 1. Different processes are linked, as shown by the arrows in the figure.

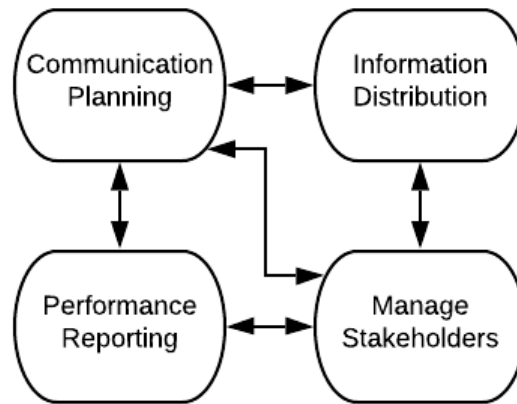


Figure 2 The process of communication management

2.3.3.1 Communication Planning

Approximately 90% of a project manager's time is spent communicating with project teams (Jennifer & Andrew, 2009); therefore, project managers must employ appropriate planning to make this possible. These plans should entail which team members require information and when they need it. Malladi (2007) explained that a project manager must identify the different communication needs expressed by different stakeholders so that the correct communications strategies may be employed for the project's success overall. Then, information can be delivered on either a preset schedule or based on the conditions of the project.

Most projects complete their communication planning early (PMI Standards Committee, 2021). The modality of current communication strategies should be considered and documented as part of this and provided on both a hard copy and through electronic methods; this should be reviewed continually as project requirements can change throughout the project. Communications planning is essential and creates a path for exchanging information between stakeholders.

2.3.3.1.1 communication requirements

Jennifer & Andrew (2009) explained that “figuring out what kind of communication your stakeholders need from the project to make good decisions. Your project will produce much information; you do not want to overwhelm every member of your project team.” Therefore, different stakeholders need distinct types of information, so project managers need to ensure that analysis is conducted to identify the types of information different stakeholders need.

The project manager can determine the need for distinct types of communications by considering the requirements of different stakeholders, which can be expressed as follows (Abou-Rjeily & Fawaz, 2008):

- Project structure of the organization in question
- Stakeholder responsibility
- Different departments involved in the project's success
- Individuals working on the project and their working environment
- Different external communication requirements and provisions

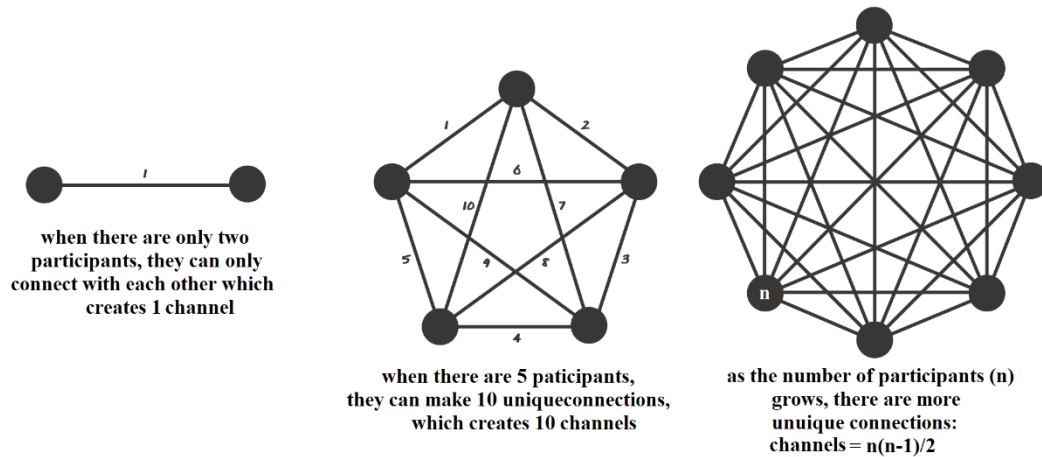


Figure 3 Channels of communication

Project managers need to identify the available communications channels within the project to manage communication successfully. The number of communication channels can be calculated as $N(N-1)/2$, with N representing the number of stakeholders involved with the project (Mehra, 2003).

As well as determining the communication requirements of different stakeholders in the project, project managers should also consider how the needed information will be delivered to the recipients. As part of this, developing technologies allow for different methods of communication in modern projects.

2.3.3.1.2 exploring communication modalities

Communication can be done in many ways, and project managers need to determine which methods are available for the project before getting started. Some such modalities for communication can include meetings, reports, memos, emails, etc. (PMI Standards Committee, 2021). Different stakeholders will have preferences for different forms of communication, so this should also be considered.

PMBOK guide (2021) explained that the following attributes need to be included for an effective plan to be determined:

- Communication items: how information is shared with stakeholders.
- Frequency: how regularly information is given out to stakeholders.
- Intention: why information needs to be distributed.
- Timings: start and end dates for the information to be distributed.
- Format: how the information will be expressed and delivered.
- Responsibilities: who in the team is responsible for communications.

Therefore, communication plans should be determined using predetermined communication strategies and modalities based on identified requirements for sharing information.

2.3.3.1.3 creating the communication plan

Stakeholder analysis should be conducted to ensure that the project management can provide effective communications as and when they are needed. Communication plans will help project managers organize project communications based on stakeholders' expectations in terms of communications and the processes and types of communications needed (Abou-Rjeily & Fawaz, 2008).

An excellent communication plan will provide the following:

- A means for information to be gathered, organized, stored, and finally distributed to the chosen recipients of the information. Plans should be available for modifications of information, where required.

- The information must be given on how communications are managed through the various levels in the project. An excellent communication structure will detail where the information originates, to whom the information mentioned above will be provided, and which modalities are suitable for this transfer.
- Information on communications modalities should be organized and provided. As a part of this, the types of communication and the type of terminology required for each communication method shall be given in detail.
- Schedules and timings should be provided for when each communication method should be used. For example, meetings should be carried out regularly, whereas other forms of communication may be needed based on project developments.
- Methods for the transfer and receipt of information must be explained.
- Details must be given for how the communications management plan can be modified in line with project requirements and progress.

Figure 4 shows a flowchart of how communication plans should be created, according to the Project Communication Handbook (California Dept. of Transportation, 2007).

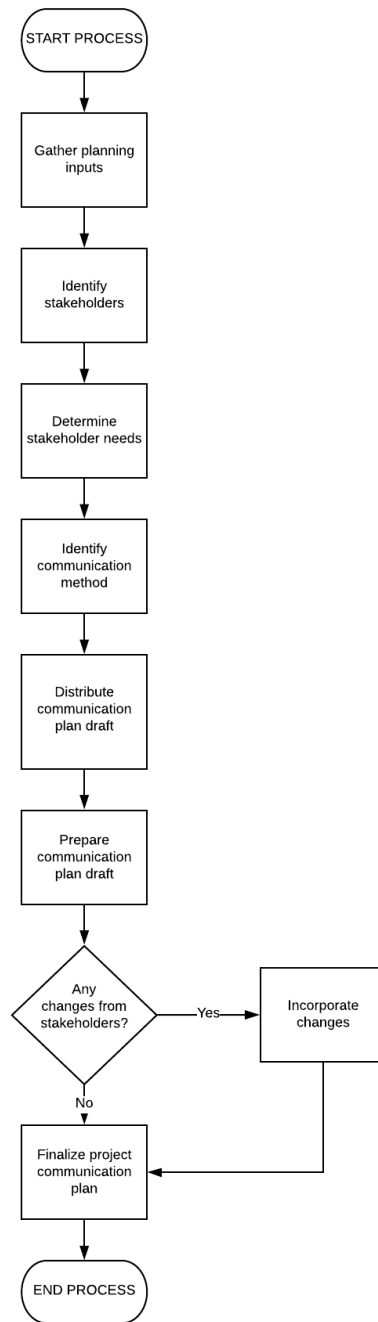


Figure 4 Communication planning process chart

Source: Project communication handbook (2007, p.9)

Gather planning inputs: a collection of data from external and internal project sources

- Identify stakeholders: stakeholders should be identified
- Determine stakeholder needs stakeholders should be managed based on their specific information needs and requirements
- Identify communication methods: different communication methods may be suitable at various times. Appropriate communication methods should be chosen.
- Prepare communication plan draft: identify the stakeholders' needs and use this information to provide appropriate modes of communication between project management teams and project stakeholders.

A draft plan can then be implemented. This process will also allow project managers to identify any limitations in the current communications plan, making modifications as required. The plan will then be finalized, although it can still be modified as the project progresses.

2.3.3.2 Distribution of Information

Information distribution ensures that stakeholders receive the information for their specific roles and responsibilities (Abou-Rjeily & Fawaz, 2008). In effect, it can be said that information distribution is the implementation of the Communications Management Plan.

Three input elements are involved in information distribution, as shown below:

- Work results: these show the progress, or lack thereof, of the project (Abou-Rjeily & Fawaz, 2008);
- Communications Management Plan: acts as a guide for how project issues can be expressed with the performing organization (California Dept. of Transportation, 2007);

- Project plan: information and requirements involved with project communications

The most generic form of communication is verbal communication (Jennifer & Andrew, 2009). This observation was further backed up by Abou-Rjeily & Fawaz (2008, p07) when it was stated that:

“When verbal communications are involved, the project manager should remember that half of communication is listening. This means the project manager must confirm the receiver understands the message being sent.”

Validation of the communication that has been sent can be determined by feedback. This can include body language changes, as well as verbal confirmation.

- The process of communication is described by Abou-Rjeily & Fawaz (2008) in the following five points:
- Para lingual: inflections in the sender's voice, including pitch and tone, can impact how the message is transmitted.
- Feedback: Direct request for feedback by the sender.
- Active listening: the receiver confirms that the message has been received verbally or through other communication signs.
- Effective listening: the receiver pays attention to visual cues and prelingual mannerisms and asks questions based on any concerns that they may have.
- Nonverbal: Body language and actions provide nonverbal communication. This includes gestures and facial expressions.

It is said that, in a verbal message, only 7% of the meaning is given verbally. The used tone provides an additional 38% of the meaning behind the message. Body language finally contributes 55% of the meaning (Mehra, 2003). The medium of communication can either help or hinder the message's efficacy.

The Project Communication Handbook (2007) expressed that there are many means of information communication. These methods can include project meetings; hard copy documentation, such as paper copies; databases; faxes; emails; audio conferences and calls; video conferences; and information delivered through the project's website. Specific projects may have other communications methods specific to the project demands.

Management teams should actively seek feedback on the existing communications plan. These can be summarized as follows:

- Project records: these include memos, emails, correspondences, and other information that may be important to the project. This information should be saved for future reference throughout the project (PMI Standards Committee, 2021);
- Project reports formal forms of communications regarding project activities. Report requirements differ based on the stakeholder receiving the information (Mehra, 2003);
- Project presentations: generally used to convey messages to customers, management teams, and stakeholders involved in the project. Formality and presentation methods can be altered based on the recipients in question (Abou-Rjeily & Fawaz, 2008).

2.3.3.3 Reporting project performance

Project performance should be routinely updated for stakeholders and project managers to allow for updates to be provided. Performance reporting entails collecting, organizing, and disseminating project-relevant information (Abou-Rjeily & Fawaz, 2008). Factors such as scope, schedule, cost, and overall results of the project's endeavors can be included (PMI Standards Committee, 2021).

Performance reporting requires input from the project plan to be successful since this includes details regarding the work breakdown structure and the project's scope and requirements (Mehra, 2003). Performance information can also be included in project reporting.

Performance review meetings should be held routinely by the project manager. These meetings allow the management team to determine whether the current project progress is in line with the expectations in terms of timeline and budgeting. Project quality—and the effects on the overall project—can also be discussed (California Dept. of Transportation, 2007) As per Fawaz (2008), To conclude the meeting, the project manager can then discuss past and current risks that may face the project and how this could directly impact the success rate of any project.

2.3.3.4 Manage stakeholders

Stakeholders are people or entities affected by a project, as shown in Figure 5. Numerous parties may show an interest in the project briefing stage, with or without the knowledge of management teams.

Projects with more stakeholders can be far more complicated than those with fewer stakeholders (interested parties) because each stakeholder typically has his or her interests which can, in turn, lead to conflict between the stakeholders (Karlsen, 2002). Thus, stakeholders must be identified and managed carefully.

Mehra (2003) expressed that stakeholder management must be employed to control communications based on the requirements of different stakeholders. Furthermore, the PMBOK Guide (2021) expresses that those stakeholders can be managed using the Communication Management Plan and Organizational Process Assets. Literature must be assessed in order to develop a successful communications plan. Past events should also be considered.

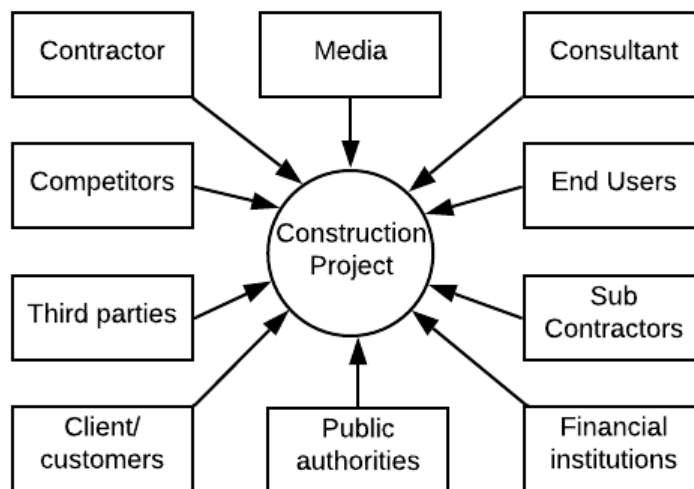


Figure 5 Stakeholders representation in project

Source: Karlsen (2002, p.20)

There are countless benefits of effective communication; a list of them is expressed below:

- Well-made working drawings which are handled with seriousness and professionalism will require no, or few, alterations, or demolitions once work has been carried out.
- Artisan workers with the freedom to perform their duties will prevent the wastage of materials.
- Good client-worker relationships will be promoted.
- Project duration reduced
- Superior profits will be available to the contractor, with superior client satisfaction.
- Few or no arguments between team members and better relationships between clients and contractors.

2.3.3.5 Literature Summary of Communication Processes

Effective communication can help promote construction projects' success rate and productivity in material use and wastage, operative safety, and contract continuity (Carter, 2003). Table 1 Shows the summary of the essential communication management processes throughout the literature.

Communication Management Process	References
Communication Planning	1. Communicating project objectives clearly. (Faniran & Caban, 1998) (Kerzner, 2009) (Mantel & Meredith, 2011) (PMI Standards Committee, 2021) (Russell & Taylor, 2003)
	2. Distributing activities schedule. (PMI Standards Committee, 2021) (Russell & Taylor, 2003) (Zwikael & Globerson, 2006)
	3. Clarify to team precedence relationships. (Russell & Taylor, 2003)

	4. Making time estimates in collaboration with team members.	(PMI Standards Committee, 2021) (Russell & Taylor, 2003)
	5. Involvement in determining resource requirements to meet objectives.	(PMI Standards Committee, 2021) (Russell & Taylor, 2003)
	6. Perform a situation analysis.	(Mantel & Meredith, 2011)
	7. Clarify the work evaluation process.	(Mantel & Meredith, 2011)
	8. Creation of feedback loops.	(PMI Standards Committee, 2021)
	9. The choice of proper media.	(PMI Standards Committee, 2021)
	10. Design of visual aids.	(PMI Standards Committee, 2021)
Distribution of Information		
	11. incorporating the performance of the stakeholders	(Atkinson et al., 1997) (Wateridge, 1998)
	12. Clear identification of performance parameters	(Dvir et al., 2003)
	13. benchmarking	(Lema et al., 1994) (Camp, 1989) (Zairi, 1994) (Watson, 1993) (Karlof et al., 1993) (Shetty, 1993) (Abdul-Kadir, 1996)
Reporting project performance		
	14. Having a clear point of contact	(Mehling, 2010) (PMI Standards Committee, 2021)
	15. Agree on the definitions of the communication terms (e.g., done, in progress)	(Mehling, 2010)
Manage stakeholders		

Table 1 Communication Management Processes, literature summary

2.3.5 Communication Tools

Practical communication tools can help to make communications more effective and beneficial. Nevertheless, these tools may render poor communications without proper guidance and knowledge on using them effectively. Table 2 Shows the summary of the most critical communication tools for the construction industry throughout the literature.

	Communication Tools	Reference
Verbal	1. face-to-face meetings	(Ponton et al., 2020)
	2. Mobile phone calls communication	(Barzaiq & Loke, 2011) (Senaratne & Ruwanpura, 2016)

	3. Video calls communication	(Barzaiq & Loke, 2011) (Senaratne & Ruwanpura, 2016)
	4. Radio handheld transceiver	(Beyh & Kagioglou, 2004)
	5. Video live conferences	(Barzaiq & Loke, 2011) (Senaratne & Ruwanpura, 2016)
Visual	6. Visual signs	(Bust et al., 2008) (Tezel et al., 2013)
	7. CAD Drawings	(Cory, 2001)
	8. Hand drawn sketches	(Rose, 2005)
Written	9. Letters	(Dainty et al., 2006)
	10. Emails	(Ketinger & Grover, 1997) (Fussell et al., 1998)
	11. Instant Massaging (IM)	(Cameron & Webster, 2005)
	12. Internal Network Communications	(Tam, 1999) (Charoenngam et al., 2004) (Cheng et al., 2001) (Dainty et al., 2006)

Table 2 Communication Tools, literature summary

2.3.6 Barriers to Effective Communication

Many communication barriers can impact the project's success, and these should ideally be reduced or eliminated by the project management team. Mehra (2003) found that there were 11 fundamental limitations and barriers that projects face: physical barriers such as noise; cultural limitations such as social differences; perceptual limitations such as not being able to consider others' opinions; word choice limitations such as improper encoding of a message, that may be hard to understand; experiential limitations due to a lack of experience on the part of the message sender; emotional limitations such as personal feelings and issues; linguistic limitations such as different languages; non-verbal limitations such as messages that are not spoken; gesture limitations such as misunderstood gestures and references; and language variation limitations such as accent or dialect.

Construction industry projects face some specific limitations in communications (Adedapo, 2009) which include the following:

- Poor or undetailed drawings.
- Inexperienced work causing misinterpretation.
- Poor lettering, interpreting writing difficult.
- Geographical differences prevent easy communication.
- Poor recording of items, rates, and bills of quantities.
- Fear of authority by junior staff, leading to mistakes.
- Inferiority complexes on the part of operatives can result in information being misinterpreted.
- Poor understanding of telephone messages.

Adedapo (2009) also explained that management teams primarily focus on personal communications. However, the focus must be given site-wide for effective communications to be made.

Using Feedback

Project managers must use feedback to act when it may be needed or beneficial (Wells, 1990). The receiver must ensure the feedback is understood for effective action.

Reinforcement of Backup

Adedapo (2009) stated that some information could be shared in more than one way. For example, verbal communication can be reinforced in writing too.

Direct Sample of Language

Communication barriers can be effectively eradicated by giving instructions in simple terminology. Ambiguous terminology should not be used as it may lead to complications and misinterpretation by the receiver. Table 3 is a summary table of the essential communication barriers in the literature.

Barriers to Communications	Reference
1. Poor or undetailed drawings	<i>(Adedapo, 2009)</i>
2. Inexperienced work causing misinterpretation	<i>(Adedapo, 2009)</i>
3. Poor lettering, making interpretation of writing difficult	<i>(Adedapo, 2009)</i>
4. Geographical differences	<i>(Adedapo, 2009)</i>
5. Poor recording of items, rates, and bills of quantities	<i>(Adedapo, 2009)</i>
6. Fear of authority by junior staff, leading to mistakes	<i>(Adedapo, 2009)</i> <i>(Mehra, 2003)</i>
7. Inferiority complexes on the part of operatives can result in information being interpreted wrongly	<i>(Adedapo, 2009)</i>
8. Poor understanding of telephone messages.	<i>(Adedapo, 2009)</i>
9. Physical noise, distance, time, environment, physical medium	<i>(Mehra, 2003)</i>
10. Perceptual, viewing what is said from your own mind-set	<i>(Mehra, 2003)</i>
11. Experiential, lack of similar experience	<i>(Mehra, 2003)</i>
12. Personal feelings at the moment or doing other things besides listening	<i>(Mehra, 2003)</i>
13. Non-verbal, non-word messages	<i>(Mehra, 2003)</i>
14. Misunderstood gestures	<i>(Mehra, 2003)</i>
15. Community Conflicts	<i>(Adedapo, 2009)</i> <i>(Bandulahewa, 2015)</i> <i>(Mehra, 2003)</i>
16. Insufficient technology	<i>(Bandulahewa, 2015)</i>
17. Different understanding / interpretation	<i>(Bandulahewa, 2015)</i>
18. Different cultural values	<i>(Bandulahewa, 2015)</i> <i>(Mehra, 2003)</i>
19. Lack of support and commitment	<i>(Bandulahewa, 2015)</i>
20. Varying capacity and capability	<i>(Bandulahewa, 2015)</i>
21. Unclear channels of communication	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(English, 2002)</i> <i>(Hua et al., 2005)</i> <i>(Ochieng & Price, 2010)</i> <i>(Tai et al., 2009)</i>
22. Ineffective reporting system	<i>(Bandulahewa, 2015)</i> <i>(Affare, 2012)</i> <i>(Dawood & Sikka, 2008)</i> <i>(Tai et al., 2009)</i>

23. Language difficulties, different languages or vocabulary, accent, dialect	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(Loosemore & Lee, 2002)</i> <i>(Mehra, 2003)</i> <i>(Ochieng & Price, 2010)</i>
24. Interpersonal conflict	<i>(Bandulahewa, 2015)</i>
25. Age difference	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(English, 2002)</i> <i>(Ochieng & Price, 2010)</i>
26. Conflicting interest	<i>(Bandulahewa, 2015)</i>
27. Resisting change	<i>(Bandulahewa, 2015)</i>
28. Gender issues	<i>(Bandulahewa, 2015)</i>
29. Lack necessary skills	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(Ulang et al., 2010)</i>
30. Varying concept of time	<i>(Bandulahewa, 2015)</i>
31. Organizational mishap	<i>(Bandulahewa, 2015)</i>
32. Limited resources	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(Hua et al., 2005)</i> <i>(Tai et al., 2009)</i>
33. Poor planning	<i>(Bandulahewa, 2015)</i>
34. Limited time	<i>(Bandulahewa, 2015)</i>
35. Lack of motivation	<i>(Bandulahewa, 2015)</i>
36. Information filtering	<i>(Bandulahewa, 2015)</i> <i>(Affare, 2012)</i> <i>(Thomas et al., 1998)</i>
37. Religious issues	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(Mehra, 2003)</i>
38. Poor Listeners	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(Bowen & Edwards, 1996)</i>
39. Family commitments	<i>(Bandulahewa, 2015)</i>
40. Lack of confidence	<i>(Bandulahewa, 2015)</i>
41. Poor leadership	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(Thomas et al., 1998)</i>
42. Personal preference	<i>(Bandulahewa, 2015)</i>
43. Poor negotiation skills	<i>(Bandulahewa, 2015)</i>

44. Conflicting business/industry ethics	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(Tone et al., 2009)</i>
45. Unclear Objectives	<i>(Bandulahewa, 2015)</i> <i>(Affare, 2012)</i> <i>(English, 2002)</i> <i>(Xie et al., 2010)</i>
46. Lack of concern	<i>(Bandulahewa, 2015)</i>
47. Lack of trust	<i>(Affare, 2012)</i> <i>(Bandulahewa, 2015)</i> <i>(Ochieng & Price, 2010)</i>

Table 3 Barriers to Effective Communication, literature summary

2.4 Modern Miscommunication Disasters

Miscommunication has been identified as a significant cause of many disasters. The following is just a sample of the severity of miscommunication.

2.4.1 DuPont Port Leak

In 2014, a disaster occurred where more than 10,000 kilograms of highly poisonous chemicals were released in a massive Leak. The report made by “U.S. Chemical Safety Board” showed sequences of shift miscommunications caused the reason behind that leak. This series of mistakes started five days prior to that disaster. DuPont paid a total of 372 thousand dollars in fines at the plant of LaPorte for the violation of public safety. The “Occupational Safety and Health Administration” put the firm in their “Severe Violator Enforcement Program.” A total of four died because of that disaster.

2.4.2 The Derailment of KiwiRail Train

In this story, throughout an overnight shift in 2013 in New Zealand, communication issues in the change of shifts, Wellington-bound trailer drift and thus derailing. Due to the lack of

instructions given to the employee, the maintenance crew forgot to put pins to the bolts that were in tightening the trailer in place, causing the derailment that happened ten weeks before the accident. This conclusion was made by the transportation Accident Investigation Commission. The report shows that the main reason for this disaster is improper training to follow the repair instructions and then fulfill their task. Thus, the maintenance task was done improperly. Four individuals were poorly injured as a result of that disaster.

2.4.3 The Spill of BP Deepwater Horizon

Because of the absence of proper understanding of the data, BP settled on a few poor choices that led to the Macondo well explosion. As indicated by “BOEMRE” and “US Coast Guard” information, BP neglected to share primary data from their inland staff, just as reports from Halliburton, their drilling accomplice, to the Deep-Water Horizon rig team led to the explosion. Unfortunately, eleven men were killed because of this communication issue and right around five million barrels of crude oil were leaked into the Gulf of Mexico.

2.4.4 The Gas Explosion by Kleen Energy

2010, a “U.S. Chemical Safety and Hazard Investigation Board” reported that employees at the plant had obtained contradicting communications concerning natural gas explosions. A few had been informed that blows might be taking place the day before, while others did not know about it till the day it was happening; they knew about it while there were attending to work. This mistake caused some contractors to be informed to maintain operating inside the unsafe structure for the time of the natural gas explosion activities. This catastrophe resulted in the death and injury of six and fifty humans, respectively, working inside that area because of this failure in communication.

2.4.5 BP Refinery Explosion in Texas City

Fifteen individuals died, and 180 were harmed in the 2005 blasts and flames caused by the lack of communication during the shift turnover at the BP factory. The report made by the “U.S. Chemical Safety and Hazard Investigation Board” stated that BP did not make the required training for staff for communication on shifts turnover. Throughout the shift turnover, managers and administrators ineffectively imparted primary data concerning the startup methodology. A total loss of over 1.5 billion US dollars resulted from this unfortunate incident.

2.4.6 The Fire of Bunce Field

In 2005, 43 wounds were counted right after a fire caused by poor communication during the shift handover. HSE reported that managers were confused about which one of the pipelines the fuel tank used to be filled. Vast amounts of unleaded fuel were bumped from both UKOP South lines, just like the Fina line. The perplexity happened from the poor strategies of the shift handover and the covering screens on the ATG structure. Handovers additionally just kept information about the shift turnover right at the end. There were no methods to record any incidents that might happen during the shift.

2.4.7 Gas Explosion by Esso Longford

In 1998, the inefficient shift turnover practices and the poor log entries of such turnovers paved the way to a catastrophe in which two workers died. The report made by “The Longford Royal Commission” revealed that poor turnover between two shifts implied that the following shift did not know a pump shutdown. The executives likewise neglected to communicate past occurrences to the concerned groups. An essential operating

methodology was additionally disregarded in various occurrences. Esso was requested to pay \$32.5 million to organizations that endured assets damage because of the episode.2.5.1

Tools of Effective Communication

Emmitt and Gorse (2009) stated that construction project success relies on the successful coordination of many teams of specialists. Hence, construction is invariably a team effort, so good team interaction must be shown to manage the technical and organizational complexity of these projects and meet the needs of stakeholders (Den Otter & Emmitt, 2007). This can especially be a challenge when new team members from different organizational cultures join the project, who may have various levels of knowledge and preferences of the project's existing communication systems and tools (Emmitt & Gorse, 2009). Emmitt and Den Otter (2008) expressed that existing communications tools may be ineffective if management teams do not provide clear guidance on how best to use them to new project stakeholders. Therefore, individuals' skills, knowledge, and preferences for communications systems are essential. Interpersonal communications also have an essential role.

2.5 Significance of the Research Problems

Effective communication is a skill that project managers must master if construction projects are successful. Indeed, communication and management of these is an essential task for project managers to prioritize. This is shown in literature, where importance is placed on expressing how project managers should act to enhance project communications and the tools required for effective communication. Furthermore, barriers to effective communications must be considered and reduced or otherwise abolished so that limitations are not in the place that could hinder the efficacy of communication management.

Communication Plans must be created to allow project managers to manage communication effectively. This is important; however, Saudi Arabian project managers also face the issue whereby effective communication plans are hard to find. As such, communication research specifically into the Saudi Arabian construction industry is so valuable for project managers to identify areas where improvements can be made. Consideration should be given to ensure that communication planning, information distribution, performance reporting, and management of stakeholders and team members are effective.

2.6 Summary

This chapter discussed concepts regarding communication since its early existence in the early ages of human existence, then focused on the communication management in the construction industry by project management, discussed communication management processes, tools and barriers to effective communication. The literature review was conducted to meet this goal. The above literature findings allowed the significance of existing issues to be determined. The following chapter will discuss the research methodology used during this study.

CHAPTER THREE:

RESEARCH METHODOLOGY

The project's key research issues were discussed in Chapter 1 and elaborated from the literature in Chapter 2. In this chapter, topics regarding the research problems were also identified and analyzed. Chapter 3 sets out to establish the methodologies used during the research, including required data, data collection, population and sample size, and data analysis.

The researcher has conducted structured interviews (results from the analysis will be covered in Chapter 4 of this thesis) and discussed the data and the data analysis (that will be covered in Chapter 4). The explanation of methodologies in Chapter 3 includes details regarding the planning procedures for implementing the research. Moreover, Chapter 3 will also determine how data will be gathered and analyzed during the research period.

3.1 Required Data

Every research problem statement is essential. A research problem statement allows the researcher to define the purpose of collecting the data. Two research questions were identified for the study: what existing limitations to communications exist, and what strategies have project managers undertaken to overcome communications barriers? The above questions and their answers allowed for a more effective state evaluation and opened a new improvement area. This list below provides a definition for the data to be collected and gives it a more precise context, which is listed as follows:

3.1.1 Communication Management Practices

As the researcher was investigating the communication management practices in the literature, the researcher divided the practices into four significant fields as represented in the PMBoK. As per the PMBOK Guide, four processes outline project management: communication planning, information distribution, performance reporting, and project stakeholders' management.

The definitions of the required data are under each section below:

3.1.1.1 Communication Planning

Communicating project objectives clearly

The project phases objectives shall be communicated clearly. For example: Finish the casting of fifteen columns in one week. The main objective is clear and set, and the short milestones objectives are being shared regularly with the team.

Distributing activities schedule

Ensure that all the team has access to the activities schedule for at least the upcoming two weeks, accessible by any means (Electronic, verbal or written).

Clarify to the team the precedence relationships

Ensure that the team understands the activities diagrams through meetings or documents and understands the arrangement at which the activities shall be ordered.

Making time estimates in collaboration with team members

For short-term planning, share the plan with the team on the ground to get accurate estimates of the period or involve the team in the setup.

Involvement in determining resource requirements to meet objectives

For the short-term planning, sharing the plan with the team on the ground to get accurate estimates of the resources required and collaborate with the team to ensure the resources will be there when needed through communication.

Perform a situation analysis

When facing a problem or issue on-site, the manager meets with the team on the ground to hear the suggestions they have and hear the engineering team's opinion and decide based on an analysis of the situation by all the team.

Clarify the work evaluation process

Clarify how the supervisor will determine if a job is made perfectly or rejected with comments, and make sure the team understands the coding for the inspection revisions (e. g., code A, code B, code C).

3.1.1.2 Distribution of Information

Creation of feedback loops

Enhancing the communication process by letting the team know the channels by which they can report a miscommunication (communication flaw) or suggest a better communications loop.

The choice of proper media

The proper media channel of communication as needed in the project, visuals, drawings, notes, guides. (For example, the use of visuals around the site to explain the evacuation plan and sample designs in the site offices illustrates the job idea).

Design of visual aids

The team communicates through visuals, such as sample structures, sketches, 3D models, and visual pictures to illustrate the idea of the project or the part being constructed.

3.1.1.3 Reporting project performance

Clear identification of performance parameters

A clear set of performance indicators is defined for teams. The teams know how the individuals' performance is measured and the team as a unit.

Benchmarking

Establish an Internal or external benchmarking that happens through communication within the team. Internal benchmarking compares performance between teams/departments within the same company. On the other hand, external benchmarking External/competitive benchmarking is used to compare a specific competitor for the methods and the way of execution. It compares business functions or processes that are the same, regardless of the country.

3.1.1.4 Manage stakeholders

Having a clear points of contact

Clarify whom to communicate with the stakeholders and what is the communication way and method preferred by both and make it clear to the team.

Agree on the definitions of the communication terms (e. g., done, in progress)

Agree on the main definitions of terms in the communications with the stakeholder. The terms that should have a mutual understanding include but are not limited to done, under construction, needs action, etc.

3.1.2 Communication Tools

A wide variety of communication tools are used for external and internal communication. These tools include mail, email, telephones, cell phones, smartphones, computers, video and web conferencing tools, social networking, and online collaboration and productivity platforms. The researcher focused on the tools shown to be important to the construction industry from the literature. Moreover, the researcher found it suitable to divide the tools into three types: verbal, visual and written. The researcher defines the tools that need more clarification.

3.1.2.1 Verbal

Radio handheld transceiver

A walkie-talkie (more formally known as a handheld transceiver, or HT) is a hand-held, portable, two-way radio transceiver. The transceiver is normally in receive mode; when the user wants to talk, they must press a “push-to-talk” (PTT) button that turns off the receiver and turns on the transmitter.

Video live conferences

They are thee meeting that includes three or more people in live meeting on shared screen with another party, these meetings usually happen over big screens and across countries and cities.

3.1.2.2 Visual

Visual signs

It is an essential tool to understand the instructions given through it. It is put on the construction site to reflect some meanings; the most used type is safety signs, and they are displayed to deliver an apparent health and safety message.

CAD Drawings

Are detailed 2D or 3D illustrations displaying the components of an engineering or architectural project. The computer-aided design utilizes software to create drawings to be used throughout the entire process of a design project, from conceptual design to construction or assembly.

3.1.2.3 Written

Internal Network Communications

It is a program or framework for internal communication that is defined as the way for organizations and employees to share information and communicate with each other internally. This definition does not focus on individuals since it is everyone's role to communicate with each other.

3.1.3 Barriers to Effective Communication

The researcher found that the barriers can be divided into three major groups of barriers that can apply to the higher and overlap on each of the lower levels. The managerial level includes Perceptual, viewing what is said from your mindset, Different understanding/interpretation, Poor negotiation skills, Lack of concern, Lack of trust, Ineffective reporting system. The site engineers level includes Poor lettering, interpreting writing difficult, Poor recording of items, rates, and bills of quantities, Experiential, lack of similar experience, Poor understanding of telephone messages, Misunderstood gestures, Information filtering, and Unclear channels of communication. Finally, the interpersonal level (labor and every person on the site), which includes: Poor or undetailed drawings Inexperienced work causing misinterpretation, Geographical differences, Fear of authority by junior staff, leading to mistakes, Inferiority complexes on the part of operatives can result in information being interpreted wrongly, Physical noise, distance, time, environment, physical medium, Personal feelings at the moment or doing other things besides listening, Non-verbal, non-word messages, Community Conflicts, Insufficient technology, Different cultural values, Lack of support and commitment, Varying capacity and capability, Language difficulties, different languages or vocabulary, accent, dialect, Interpersonal conflict, Age difference, Conflicting interest, Resisting change, Gender issues, Lack necessary skills, Varying concept of time, Organizational mishap, Limited resources, Poor planning, Limited time, Lack of motivation, Religious issues, Poor Listeners, Family commitments, Lack of confidence, Poor leadership, Personal preference, Conflicting business/industry ethics, Unclear Objectives.

The researcher defined some of the barriers below:

3.1.3.1 Managerial Level

Poor negotiation skills

When attitude during the negotiation is confrontational. Moreover, when the conversation turns out to be a fight. Instead of the parties working together to find a solution, it turns out to be each party trying to defeat the other party.

Lack of concern

Indifference and lack of interest create barriers to communication, resulting in the quality of communication suffering. The intended message is either not received, incomplete, or misunderstood.

3.1.3.2 Site Engineers Level

Experiential, lack of similar experience

The lack of shared experience between the communicator (instructor) and the receiver (student) is probably the most significant barrier to effective communication. Communication can be effective only to the extent that the experiences (physical, mental, and emotional) of the people concerned are similar.

Misunderstood gestures

When trying to communicate through a language barrier, it is natural to use gestures to illustrate your point. We assume it is helpful since our words are being visually reinforced. Hand motions are, however, culturally relative, and the wrong gesture can inadvertently lead to confusion or offence.

Information filtering

Filtering refers to a sender manipulating information so it will be seen more favorably by the receiver. The primary determinant of filtering is the number of levels in an organization's structure. A manager altering communication in his favor is trying to filter the information.

3.1.3.3 Interpersonal Level

Inferiority complexes on the part of operatives can result in information being interpreted wrongly

The operatives' feelings towards themselves include self-doubt, uncertainty about themselves, and a lack of self-esteem. It is often subconscious and is thought to drive afflicted individuals to overcompensate, resulting in spectacular achievement or extremely asocial behavior. In modern literature, the preferred terminology is “lack of covert self-esteem.”

Interpersonal conflict

Interpersonal conflict is a natural outcome of human interaction. People have quite different personalities, values, expectations, and attitudes toward problem-solving. Conflict can result when we work or interact with someone who does not share our opinions or goals.

Varying concepts of time

The concept of variation of how many things can be done simultaneously. Furthermore, it divides into two: A monochronic time system, which means that things are done one at a time and time. A polychronic time system is where several things can be done at once. Furthermore, people vary in working with them.

Organizational mishap

Alternatively, known “organizational accidents” are rare but often calamitous events in complex systems working in hazardous circumstances.

3.2 Data Collection

Data collection was carried out through the developed questionnaire through structured interviews and mail surveys. The questionnaire serves to gain insight into issues surrounding the construction industry. Questions in the questionnaire were created based on an ordinal measure, the Likert scale (5-point scale) and had five different sections. The questions were chosen about the processes, tools, and barriers to successfully managing and communicating within a construction project. The researcher has used both survey collection and interviews (whenever possible). The interviews were held in person (if possible, due to the corona pandemic) or online to provide more in-depth knowledge to analyze the preliminary quantitative study.

Key informants were from the Saudi Arabian building construction companies in grades 1 and 2. The companies were extracted from the Ministry of Municipal and Rural Affairs and Housing (MOMRA) website through their open data center, in the section of contractors' classification. All the companies that meet the characteristics of this study were emailed and contacted to get as many responses and data as we could (more than the required sample size to assure accuracy).

The researcher reached out to as many as possible to acquire as much data as possible. Participants have chosen to offer a broad representation of construction industry workers. Even though the researcher has aimed to target project managers mainly, the researcher

acquired data from engineers on multiple levels in the operations and included those from building construction companies only. However, the participants were chosen randomly with some convenience placed due to restricting factors, including time, cost of travel, distance, scheduled projects, participants' willingness to cooperate with the study, and the reliability of their responses.

A questionnaire with predetermined questions has been used as a critical research system. The questionnaire utilized an ordinal scale to measure factors' frequencies and impacts. After literature reviews and consultation with Saudi Arabian construction industry professionals, the questionnaire was created. The questionnaire format used during the research process is highlighted in Appendix A. The questionnaire had five sections: A, B, C, D., and E.

Section A was regarding respondents' personal information, including their role in projects, professions, and educational degrees. Section B was regarding respondents' organizational profile information related to the respondents' construction organization, including the organization age in the industry, organization field and size.

Section C was regarding respondents' experience with communications management systems based on projects they had previously been involved with. Twenty-six predetermined factors were collected from the literature and professionals and were isolated and listed for participants to measure and evaluate. Participants were asked to rate the impact that the distinct factors had on a scale of 1 to 5, based on the amount of impact they experienced in their previous work with the Saudi Arabian construction industry.

Section D monitored the extent to which projects implemented communications tools. Seventeen predetermined communications tools collected from literature and practice professionals were impeded in this section. Respondents were asked to rate the prompts on a scale from 1 to 5 based on the extent to which it was employed in their experiences. Again, this was carried out on a 1 to 5 response plan.

Finally, section E delineated the communication barriers and their impact on the communication system. Thirty-five predetermined barriers were collected from literature and practice professionals. They were included in the questionnaire for respondents to rate, from 1 to 5, based on the extent to which the issues were overcome in their own experiences.

3.3 Population and Sample Characteristics

3.3.1 Population

The issues were analyzed from the contractor's point of view. Only contractors classified as grades 1 or 2 were considered in this study. As described in the previous section, the open database of the ministry of municipal and rural affairs was utilized to obtain the contractors' information. Moreover, the data obtained from the ministry database were filtered out to obtain the contractor that specialized in building construction as their primary field (constructors with more than one specialty were considered if their primary business was building construction). No restrictions for the type of project delivery system were taken into consideration. This research has been conducted in the eastern province of Saudi Arabia. To increase the consistency and reliability of the data, only contractors who were recorded and classified in the governmental records were taken as the population size.

Hence, based on information obtained by the Ministry of Municipalities and Rural Affairs and Housing, the number of grades 1 and 2 contractors specializing in the building construction was fifty, thus the study population.

The questionnaires were distributed to as many construction-industry key informants. These individuals were randomly chosen; however, some liberty was taken -when possible - to select individuals who were most practical to gain data from (including willingness to cooperate and distance). Personnel has been chosen from building construction teams in Saudi Arabia – eastern province, with contracting organizations being selected to obtain input from various sources.

The research sample was limited based on only those in building construction businesses. A random sample will be taken to ensure different experiences among the participants.

3.3.2 Identification of Unit of Analysis

The unit of analysis otherwise referred to as the case, is imperative for successful research design (Yin, 2009). This study provided an effective communications plan for the Saudi Arabian construction industry.

Two primary data collection strategies were used. Questionnaires were given out with questions chosen carefully to collect the required information, and structured interviews were conducted with relevant personnel to gain further input and data from them about their experiences with communications systems in the Saudi Arabian construction industry. During this research phase, individual experiences were sought to create a broad understanding of the current Saudi Arabian construction industry. So, in this event, the unit of analysis was the communications capabilities for construction projects.

3.3.3 Sample Size

After having the population number set to be fifty, we found the required sample size using the Kish formula (Kish, 1978). The two formulas are shown below:

equations 1 and 2.

$$n_o = \frac{p \times q}{E^2} \quad (1)$$

$$n = \frac{n_o}{1 + \frac{n_o}{N}} \quad (2)$$

Knowing that:

n_o : *The initial estimate of the sample size*

p : *The planning value of the sample propotion, set 0.5*

q : *The complement of p , $1 - 0.5 = 0.5$*

E : *Desired margin of error, %10*

n : *The final estimate of the sample size*

Therefore, applying the Kish formula, a minimum of seventeen was found to be the sample size for the contractor.

3.4 Data Analysis

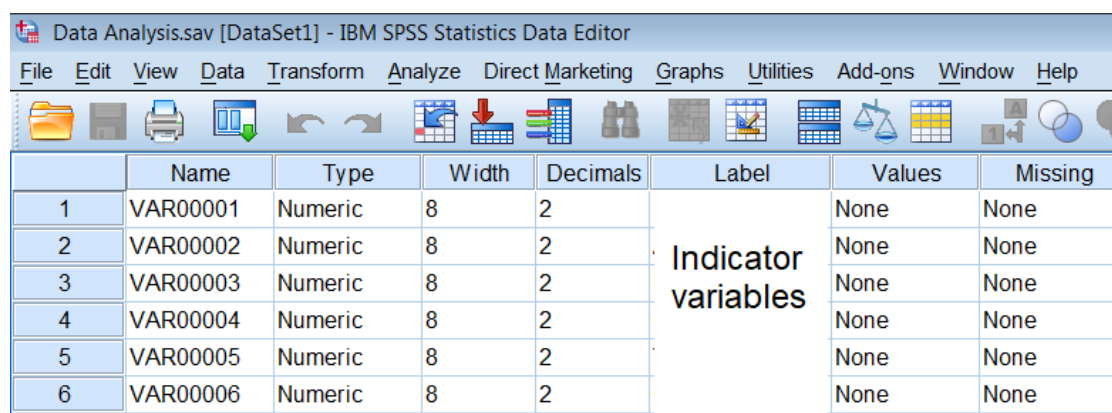
3.4.1 Data Analysis using SPSS Program

Data gathered through the structured interviews were analyzed using the SPSS software and MS Excel, version 19.0.0. SPSS, which stands for Statistical Package for the Social Sciences, is made and distributed by SPSS Inc for researchers to use as part of their data

analysis. SPSS was chosen because it can handle data of many different formats and files and use the inputted data to quickly generate tabulated reports, charts, and distribution plots and trends. The software offers a vast array of distinct functions for users and is incredibly user-friendly. This made it easy and highly practical to use when handling enormous amounts of data. It can also produce descriptive statistics from the data and complex statistical data analyses. The data were thoroughly screened and checked for errors and outliers before entering them into the SPSS software and excluded from the final data set. The data were categorized and programmed prior to entry. Prior to running the data analysis through the SPSS software, the below steps were followed:

- **Step 1: Determining Indicator Variables**

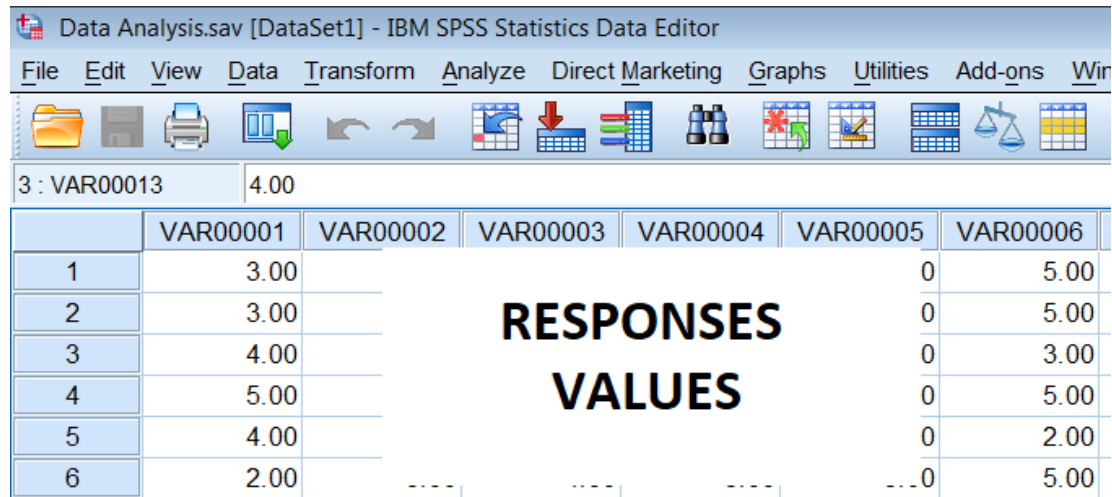
Indicator variables were defined and entered into the software. Twenty-six indicator variables were isolated and defined through SPSS' data editor software. Attributes were also defined by using SPSS' variable view: these included name, type, width, label, and values.



	Name	Type	Width	Decimals	Label	Values	Missing
1	VAR00001	Numeric	8	2	Indicator variables	None	None
2	VAR00002	Numeric	8	2		None	None
3	VAR00003	Numeric	8	2		None	None
4	VAR00004	Numeric	8	2		None	None
5	VAR00005	Numeric	8	2		None	None
6	VAR00006	Numeric	8	2		None	None

- **Step 2: Entering Data**

Data gathered (supposedly in the previous step) were entered directly into SPSS in the data view of the program. A row represented an individual respondent to the questionnaire; the columns showed the responses given by each of the respondents.



3 : VAR00013 4.00

	VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006
1	3.00				0	5.00
2	3.00				0	5.00
3	4.00				0	3.00
4	5.00				0	5.00
5	4.00				0	2.00
6	2.00				0	5.00

**RESPONSES
VALUES**

- **Step 3: Analysis of the Output**

For the Practices (Processes) and tools, the researcher has used the analysis directly by the SPSS statistical analysis functions. Means and standard deviations were identified for each aspect of the questionnaire.

	Mean	N	Std. Deviation
INDICATIVE VARIABLES	Analysis of the data		

3.4.2 Other Data Analysis Tools

For the last part of the questionnaire, the barriers, the researcher used the following analysis tools and methods (including SPSS) :

3.4.2.1 The Coefficient of Variation (CV)

Also known as relative standard deviation (RSD), it is a standardized measure of the dispersion of a probability distribution or frequency distribution. It is often expressed as a percentage. It is defined as the ratio of the standard deviation to the mean (or its absolute value). The CV or RSD is widely used in analytical sciences to express precision and repeatability. The coefficient of variation equation is shown below:

$$CV = \frac{s}{x} * 100\%$$

Knowing that:

s : Sample standard deviation

x : Sample mean

3.4.2.2 Terrell Transformation Index (TTI)

There are multiple ways of analyzing ordinal data. One of the most famous ones is the Terrell Transformation Index (TTI) (Rasli, 2006), which is a method to determine the criticality of ordinal data using the Likert scale to a scored variable after converting it to ordinal data. Terrell's transformation technique was used to transform these ordinal data variables into nominal data that were used later to determine the criticality of the variables based on the level of impact of those variables. According to Elhag et al., (2005), factors with indices of 65% and above are considered as critical factors while factors that have indices below 65% are regarded as less critical cost factors. Terrell's transformation equation is presented as follows:

$$TTI = \frac{RS-LPRS}{HPRS} * 100\%$$

Knowing that:

TTI : Terrell Transformation Index.

RS : Actual raw score.

LPRS : Lowest possible raw score.

HPRS : Highest possible raw score.

3.4.2.3 Relative Importance Index (RII)

RII, Relative Importance Index, is the mean for a factor that gives it weight in respondents' perceptions. The factor with the highest possible weight has $RII = 1$, and the following factor with a lower weight. Weighting is the summation of Likert allocation divided by the multiplication of the number of responses by the highest possible score. The interpretation of RII is like the relative risk. It summarizes the relative risk for the most advantaged group (at the top of the hierarchy) compared to the least advantaged group (at the bottom of the hierarchy). This interpretation assumes that the variables have been scored so that higher scores are consistent with increased risk. The Relative Importance Index equation is presented as follows:

$$RII = \frac{RS}{HPRS} * 100\%$$

Knowing that:

RII : Relative Importance Index.

RS : Actual raw score.

HPRS : Highest possible raw score.

3.4.2.4 Frequency Index Ranking System (FI)

Similar to the previously explained RII ranking system, the Frequency Index (FI) follows the same method in calculating the score required for ranking the factors based on their frequency of appearance in a situation. The FI has a range of values that varies between 0 and 1, where 0 means lowest chance of occurring and one means most chance of occurrence. FI has the following formula:

$$FI = \frac{\sum SF}{W(N)}$$

Where:

SF = Scale of the causes of delays.

W = the highest value of the weight, it is equal to 5.

N = the amount of the respondents.

3.4.2.5 Frequency Adjusted Importance Index (FAII)

For the sake of combining both indices into one to make it easier for ranking the communication barriers, the frequency adjusted importance index (FAII) is calculated. The values of FAII ranges between 0 and 100 where zero means least impact and 100 means highest impact. FAII has the shown formula:

$$FAII = RII \times FI \times 100$$

Where:

RII = Relative Importance index

FI = Frequency Index

3.4.2.6 Cross Tabulation

common method for researchers to perform quantitative analysis of the relationship between two or more variables is cross-tabulation. It is a matrix table typically used in multivariate market research and/or statistical analysis to analyze the relationship between variables in two or more groups. This method is compelling for researchers in how variables are grouped into sub-categories to see how a dependent variable changes the

results. It reduces confusion, where raw data can be challenging to interpret for even the most advanced researchers. When data is displayed in a tabular form, researchers can easily make sense of the relationships. One more benefit is that it offers a deeper look; because of the depth offered by crosstabs, researchers can uncover relationships between variables or segments that may have been missed if presented in another format. Data layers can be correlated rather than just one or two categories due to the variable grouping.

Finally, it offers opportunities to involve more analysis with more minor errors, whereas manual statistical analysis can take a while and introduces an increased possibility of human error. Analyzing results can be intimidating and easily confusing for those who do not have an advanced statistical analysis background. The cross tabulation structures this data into a more digestible format at the beginning of the analysis process. It provides an efficient layout for research professionals and a more actionable view for members of the team who lack advanced data analytics backgrounds.

3.5 Written Review

The researcher decided to provide a write-up of the results throughout the research process. This strategy was done sequentially instead of completed at the end of the thesis writing process. As seen in Chapter 3 and will be seen in Chapter 4, the write-up will explain the procedures used during the research process. Then, the write-up will evolve throughout the research, with visual aids being provided to allow for easy understanding of the content in the format of tables and figures.

3.6 Research Approach

In general, there are two research approaches: inductive and deductive approaches. Saunders, Lewis and Thornhill explained them by saying: “For some research projects, you will use the literature to help you to identify theories and ideas that you will test using data; this is known as a deductive approach in which you develop a theoretical or conceptual framework, which you subsequently test using data” (Saunders et al., 2007).

The deductive research approach is the one that people typically associate with scientific investigation. The researcher studies what others have done, read existing theories of whatever phenomenon he is studying and then tests hypotheses that emerge from those theories. In inductive research, the researcher collects the data, analyzes them, and then starts creating and developing theories from them, which in some cases will be literature related. This research approach requires the researcher to define his purpose using research questions.

Moreover, deductive logic was adopted where pre-existing theoretical ideas or concepts were tested, Table 4 shows a side-by-side comparison of the Deductive vs inductive research approaches. Robson (2002) highlighted five steps that were considered in the inductive research:

1. Developing the research strategy through the collection of specific observations and measurements.
2. Discovering the field of interest (Topic emerges)
3. Data collection.
4. Data clusters or patterns.

5. Data analysis.
6. Emergence of themes.
7. Generalizations.
8. Dissemination of findings.

<i>Approach</i>	<i>Stage 1</i>	<i>Stage 2</i>	<i>Stage 3</i>
<i>Deductive</i>	Making a Theory / Hypothesis	Observe & analyze	Test Hypothesis / True or Not
<i>Inductive</i>	Collect Data	Observe & Analyze / Look for Patterns	Develop A Theory / Generalization

Table 4 Deductive vs Inductive Research Approaches

The summary of main differences and analysis of both approaches present in Table 5:

Deduction emphasizes	Induction emphasizes
- Scientific principles - Moving from theory to data - The need to explain casual relationships between variables - the collection of quantitative data - the application of controls to ensure validity of data - the operationalisation of concepts to ensure clarity of definition - a high structured approach - researcher independence of what is being researched - the necessity to select samples of sufficient size in order to generalize conclusions	- gaining an understandings of the meanings human attach to events - a close understanding of the research context - the collection of qualitative data - a more flexible structure to permit changes of research emphasis as the research progresses - a realization that the researcher is part of the research process - less concern with the need to generalize

Table 5 Deductive vs Inductive research

Source: (Saunders et al., 2007 P: 127)

Finally, from the above table and definitions of the research approach, the inductive type has been chosen for this study to create the hypotheses and generalization from the data analysis, observe the collected data sets, and generalize based on the patterns. With this

approach, the communication challenges in three different areas could be observed and analyzed, and we will be able to generalize the pattern.

3.7 Research Process

A research process was determined, which was outlined in several sections. These sections were research design, initial Motive; literature review; issue statement; questionnaire design; data collection, data analysis, and research analysis and a written review. The research process is described in detail in later sections.

3.7.1 Research Design

The appropriate method to conduct research was determined to be a quantitative approach, suitable for the numerical information gathered from the questionnaires (ordinal to nominal) handed out. A quantitative approach further allowed this information to be expressed clearly in the final database. Communication barriers between the researchers and participants were determined to be a fundamental limitation (Due to the coronavirus pandemic). This was considered a critical issue to approach during the research design process. As part of the effort to combat this, relevant literature covering project management and communication was studied.

3.7.2 Research Philosophy

Easterby-Smith et al. (2002) placed a great deal of importance on the need to address the issue of research philosophy by a researcher prior to commencing research. Their research concluded that there are three main reasons why this is important. They explained that having a pre-considered research philosophy is helpful when determining the design of a research project. Furthermore, research philosophy can also be essential for helping

research conclude when the research design will be most relevant. Lastly, having a well-developed research philosophy will also allow the researcher to expand upon their previous research experiences and, as such, allow for greater creativity when creating research designs.

For this study, consideration needed to be placed upon managerial behaviors and communications. As part of this goal, one of the philosophies employed in the research design process was that of “interpretivism,” as referenced previously by (Easterby-Smith et al., 2002).

3.7.3 Initial Motive

The Department of Construction Engineering and Management generously allowed enabling the initial impetus of this study. This was given for postgraduate Master of Science degree candidates. The first stage was topic searching. The researcher discovered the communication barriers between the project management team and the project workers during this stage. Even in literature, the analysis of these communications strategies was minimal; as such, the study instead became a literature review to determine a single, specific issue and focus for the study.

3.8 Summary

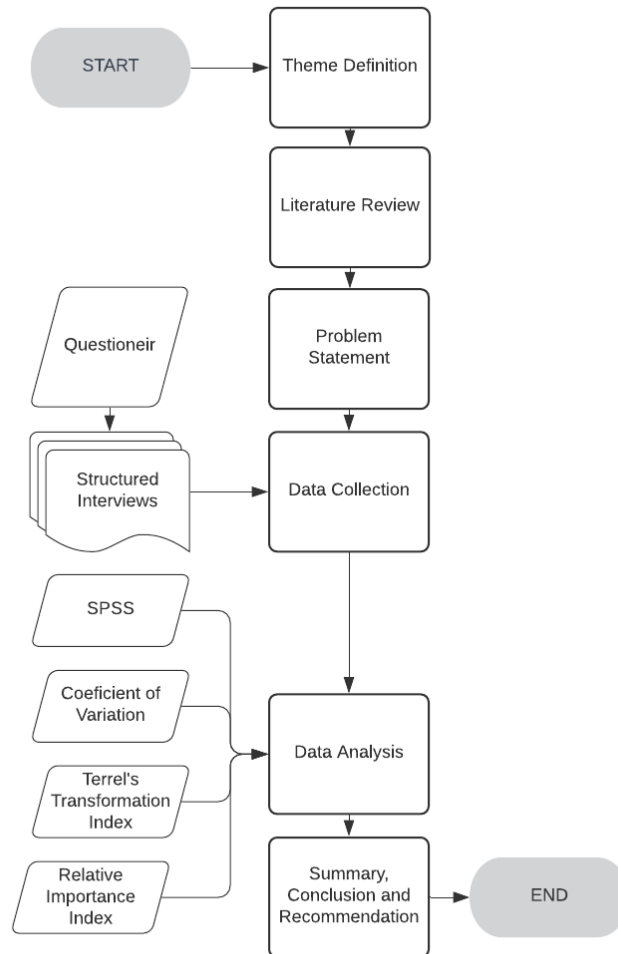


Figure 6 Research Plan Summary

Chapter 3 discussed the research approach and processes used during the research for this study. A summary of the research plan and methodology is present in Figure 6. Moreover, Chapter 4 will discuss the results obtained from the study and research in further detail.

CHAPTER FOUR:

RESULTS ANALYSIS

4.1 Overview

As part of the research method, the researcher started this inductive research in early 2019, analyzing more than one hundred research papers in the construction industry's communication-related fields, which concluded three different areas of focus in the challenges in the communication of this study: tools, practices, and barriers. This study's sample and focus group were only grades 1 and 2 contractors in the Eastern Province, Saudi Arabia. The communication was established through email, mobile calls, and referrals. A total of fifty-five contractors were directly contacted, and most of them showed interest in participating.

The data collection started in late September 2019. It was planned as structured physical interviews. From September through December, eight interviews were held a physically in-office interview. After that, in late December of that year, people started refusing to participate in the physical interviews and requesting to reschedule due to the COVID-19 pandemic breakdown, which led the researcher to find a new way of conducting the interviews, see Figure 7. Moreover, to monitor the reliability of the dataset, the researcher developed an online survey with the interview details and added a hidden timer that explicitly counts the time the person spent on each question to eliminate the rush-filling and ensure the reliability and creditability the data collected. In the physical interviews, the

average length of the interview was 30 minutes. However, in phone calls, it was around 25 minutes. The researcher set the lower bound of the time spent on the survey to be 20 minutes, less than which the participant will be eliminated to ensure data reliability and creditability. For the same reason, the researcher eliminated the data that introduced noise to the data (Outliers). This strategy eliminated fourteen responses, and the remaining 38 were used as the data set in the analysis.

4.2 Characteristics of the Respondents

Data analysis is one of the phases of measuring, analyzing, and assessing the data, enabling us to conclude some results through the research problem. Data analysis would be run with descriptive analysis, factor analysis and deductive analysis. In the descriptive analysis, summarizing data and having an overview vision of results are considered. In the descriptive analysis, we present a frequency table and charts for the general information of the sample (Gender, age, education, web experience and type of respondent). In this part, the characteristics of the samples are presented. Then, descriptive frequency statistics are demonstrated for each factor's analysis, containing mean, mod, and variance. Figure 7 through Figure 10 and Table 6 explain the data set's general demographic properties. The findings are described, ranked, and correlated in the factor analysis for communication tools, practices, and barriers. Finally, the means and variances are compared to ensure the conformity of the respondent's group in each variable. The analysis showed that nearly 70% of the participants have more than five years of experience, 86% have bachelor's degrees, and around 75% worked on more than three projects. More than 65% of the participants are from civil, construction and architectural engineering backgrounds,

whereas 35% are from electrical and mechanical engineering. Obtaining the data from such experienced engineers gives credibility and trust to the collected data.

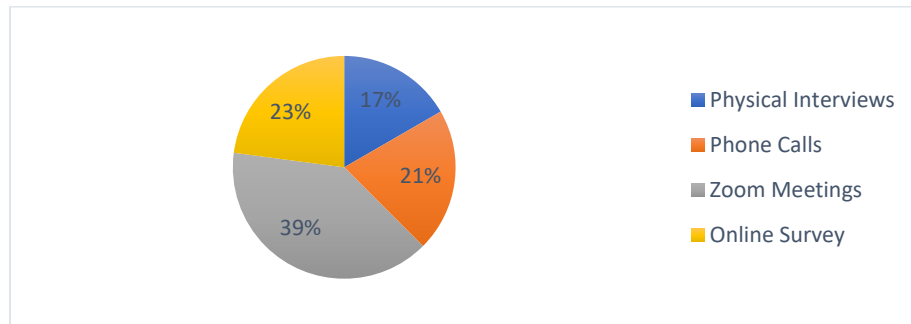


Figure 7 Participants by Interview Type

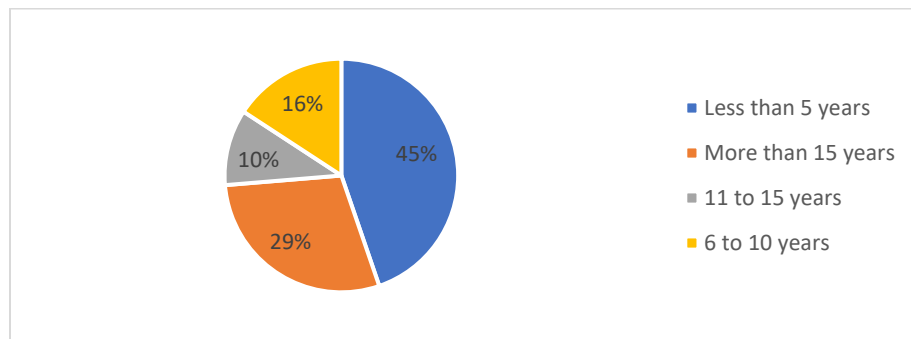


Figure 8 Participants Experience

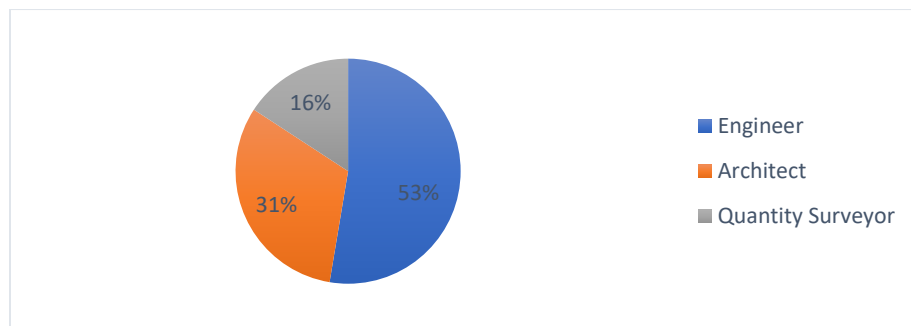


Figure 9 Participants by Job Type

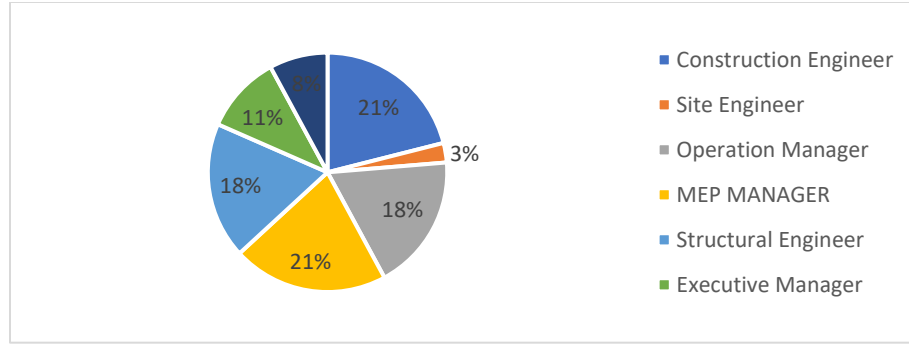


Figure 10 Participants by Job Type

4.3 Characteristics of the Organizations

The results indicate that nearly 70% of the respondents work in organizations with more than 100 employees. The 30% who worked in organizations with less than one hundred employees have some of their work subcontracted. In terms of the size of the organizations (i.e., labor counts), most fell into one of two categories, 100 to 200 employees or 200 to 500 employees (12 and 11, respectively).

Most of the organizations' annual revenue fell into one of two categories, 20 to 40 million SAR/annum or 40 to 80 million SAR/annum (13 and 14, respectively). Four respondents work in organizations with more than 100 million SAR/annum revenue. The data analysis showed that more than 55% of the responses to the questionnaire came from contracting companies and 42% from a consulting (PPM) company (21 and 16, respectively). Most of the organizations' main offices are between Khobar, Jubail and Dammam (10, 11 and 13, respectively); refer to Table 6 for more demographic information.

How many years have you been with your current employer?	%	#
Less than 5 years	31.6%	12
6 to 10 years	28.9%	11
More than 15 years	21.1%	8
11 to 15 years	18.4%	7
How many building constructions projects have you worked on?		
3 to 6.	36.8%	14
Less than 3.	26.3%	10
More than 10 projects.	21.1%	8
7 to 10.	15.8%	6
What is your educational level?		
Bachelor	86.8%	33
Masters	13.2%	5
What is the area of your education?		
Civil	34.2%	13
Construction Engineering & Management	2.6%	1
Electrical	5.3%	2
Mechanical	28.9%	11
Architecture	28.9%	11
Your organization's size is (in terms of manpower)		
500 employees or more.	7.9%	3
From 100 to 200 employees.	31.6%	12
From 200 to 500 employees.	28.9%	11
Less than 100 employees.	31.6%	12
Annual revenue (in millions of SR)		
100 or more.	10.5%	4
From 20 and less than 40.	34.2%	13
From 40 and less than 80.	36.8%	14
Less than 20.	18.4%	7
How long has your organization been in the construction business		
More than 30 years.	10.5%	4
Less than 5 years.	39.5%	15
From 10 to 20 years.	31.6%	12
From 5 to 10 years.	18.4%	7
Location of firm's main office		
Dhahran.	2.6%	1
Riyadh	5.3%	2
Khobar.	26.3%	10
Dammam.	34.2%	13
Jeddah	2.6%	1
Jubail.	28.9%	11

Table 6 Distribution of Respondents Demographically

4.4 Communication Management Processes

The communication management processes were measured using the RII and Terrell's Transformation index (TTI). Elhag et al. (2005) indicated that variables with Terrell's index of above 65% are considered critical. Results show that not all communication processes have significant impacts on project performance. As shown in Table 7, only one process “Agree on the definitions of the communication terms” has a TTI value greater than 65% in grade 1. In contrast, TTI values greater than 65% in grade 2 can be traced to five processes: “Agree on the definitions of the communication terms” (71.67%), “The choice of proper media” (67.5%), “Design of visual aids” (68.33%), “incorporating the performance of the stakeholders” (66.67%).

and “Perform a situation analysis” (67.5%). The disparity in results between grade 1 and grade 2 contractors can be linked to the fact that both contractors have different years of working experience. Apart from the TTI values, the RII values also confirmed that “Agree on the definitions of the communication terms” (97.14%) is significantly missing in communication management for grade 1 contractors. In comparison, processes missing in communication management for grade 2 contractors include “Agree on the definitions of the communication terms” (91.67%), “The choice of proper media” (87.5%), “Design of visual aids” (88.33%), “incorporating the performance of the stakeholders” (86.67%), and “Perform a situation analysis” (87.5%). These RII values are greater than 50%, meaning each respective process for grade 1 and 2 contractors significantly affects the quality of communication management in construction projects.

Based on the survey results from respondents, “Agree on the definitions of the communication terms” ranked first as the most critical communication process for grade 1

contractors and grade 2 contractors, with TTI values of 77.14% and 71.67%, respectively. This result is not surprising as building contractors are likely to use different jargons in their design documents and job descriptions, thereby misinterpreting project instructions or delaying the flow of information (Mehling, 2010). Besides, comments from respondents reveal that many contractors have problems using standardized terms in their design documents. One respondent said he had never seen a clear itemization of a checklist for the acceptance criteria over his 13 years of career. He claimed that norm and cultural definitions of the “done” are used instead. According to him, different contractors use different definitions to perform similar tasks. These comments show that many contractors working on building projects use jargons or terms that their staff may not understand.

The second most critical communication process is “Choice of proper media”. In grade 2, this process has a TTI value of 67.5%, while in grade 1, this process has a TTI value of 40%. The TTI value in grade 1 contractors is significantly low compared to the TTI value in grade 2 contractors, perhaps because grade 1 contractors are more experienced and influential than grade 2 contractors in selecting the communication channels. This process is ranked as the second most critical process, perhaps because contractors have divergent preferences for communication channels. Some contractors may prefer face-to-face communication, while others may appreciate various forms of asynchronous communication such as sending email and messages via social media platforms like WhatsApp, Zoom, Teams, and Slack. These communication-channel preferences might influence how grade 2 contractors interact with workers in the working environment. However, some participants attributed the criticality of the observed process to the lack of proper centralized technology. grade 2 contractors may not like a centralized

communication system because there are more chances that their messages can be censored, or they may not be able to communicate anonymously. Because of these disadvantages, skilled contractors may find it difficult to express themselves while working on construction projects.

Furthermore, the survey results show that grade 2 contractors consider “Design of visual aids” as the third most critical process. This process has a TTI value of 68.33% and RRI value of 88.33%, which strongly impacts grade 2 contractors’ poor communication. The respondents confirmed that visual aids help labor and site crew understand and remember safety procedures and work areas. However, they admitted that paper-made visual aids limit workers’ communication in the working environment. This observation is not surprising as the literature shows that it is time-consuming to prepare and edit visual aids. Some tasks require audio or video aids, and if contractors and their workers cannot have access to these aids, their productivity will be severely impacted.

The fourth and fifth most critical processes for grade 2 contractors are “Incorporating the stakeholders’ performance” and “Perform a situation analysis.”. The TTI value of “Incorporating the stakeholders’ performance” is 66.67% and that of “Perform a situation analysis” is 67.5%. These values show that grade 2 contractors do not prioritize the use of project management tools in communicating with others in the workplace. According to some respondents, most contractors did not use project management software applications to communicate the progress of their construction projects. Another group of participants said, “In most of the projects, it is being dealt with as a labor work with less regard to the management aspect of the work, so the communication with stakeholders is usually done through verbal updates, rather than actual reporting with proper and actual data”. This

attitude may be because contractors are unaware that they could use project management tools to communicate and collaborate with the team works. Some contractors are unwilling to adopt modern management tools as they fear losing their power and leverage.

Process	GRADE 1							GRADE 2						
	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision
Agree on the definitions of the communication terms (e.g., done, in progress)	68	14	70	77.14%	97.14%	7.10%	Critical	110	24	120	71.67%	91.67%	32.40%	Critical
The choice of proper media.	42	14	70	40.00%	60.00%	9.23%	Not Critical	105	24	120	67.50%	87.50%	29.57%	Critical
Design of visual aids.	39	14	70	35.71%	55.71%	11.25%	Not Critical	106	24	120	68.33%	88.33%	16.49%	Critical
incorporating the performance of the stakeholders.	35	14	70	30.00%	50.00%	32.26%	Not Critical	104	24	120	66.67%	86.67%	15.56%	Critical
Perform a situation analysis.	34	14	70	28.57%	48.57%	9.11%	Not Critical	105	24	120	67.50%	87.50%	25.76%	Critical
Clarify the work evaluation process.	32	14	70	25.71%	45.71%	16.89%	Not Critical	90	24	120	55.00%	75.00%	22.41%	Not Critical
benchmarking.	31	14	70	24.29%	44.29%	14.92%	Not Critical	78	24	120	45.00%	65.00%	24.50%	Not Critical
Clear identification of performance parameters.	30	14	70	22.86%	42.86%	12.87%	Not Critical	72	24	120	40.00%	60.00%	27.34%	Not Critical
Having a clear point of contact.	30	14	70	22.86%	42.86%	18.58%	Not Critical	78	24	120	45.00%	65.00%	11.60%	Not Critical
Clarify to team precedence relationships.	29	14	70	21.43%	41.43%	14.65%	Not Critical	80	24	120	46.67%	66.67%	15.40%	Not Critical
Making time estimates in collaboration with team members.	29	14	70	21.43%	41.43%	21.62%	Not Critical	91	24	120	55.83%	75.83%	26.71%	Not Critical
Creation of feedback loops.	27	14	70	18.57%	38.57%	22.78%	Not Critical	74	24	120	41.67%	61.67%	22.50%	Not Critical
Involvement in determining resource requirements to meet objectives.	26	14	70	17.14%	37.14%	17.49%	Not Critical	68	24	120	36.67%	56.67%	29.69%	Not Critical
Distributing activities schedule.	19	14	70	7.14%	27.14%	10.48%	Not Critical	69	24	120	37.50%	57.50%	29.72%	Not Critical
Communicating project objectives clearly	15	14	70	1.43%	21.43%	20.41%	Not Critical	90	24	120	55.00%	75.00%	33.50%	Not Critical

Table 7 Terrell's and Importance indices for Communication Management Processes

4.5 Communication Tools

Communication tools refer to the channels or media used by people to exchange information or interact with one another. During the survey, participants were asked to rank twelve communication tools based on how they applied the tools in the workplace. The impact and importance levels were measured using the RII and Terrel's Transformation index (TTI). Variables with TTI values of 65% or above are considered critical. While all the participants categorized as grade 1 and grade 2 considered all the communication tools relevant to workplace collaboration, they selected a few tools to be critical in facilitating communication. As shown in Table 8, grade 1 contractors considered “Internal Network Communications” as the only critical tool for communication, with a TTI value of 72.86%. However, grade 1 contractors selected “Internal Network Communications”, “Radio handheld transceiver”, “Video calls communication”, and “Video live conferences” as critical tools for communication, with a TTI value of 70%, 68.33%, 70.83%, and 67.50% (Table 8). The difference in results can be attributed to the fact that grade 2 contractors are more experienced than grade 1 contractors. Of the critical tools for grade 2, “Internal Network Communication” (21.48%) has the highest CV, followed by “Video calls communication” (19.25%), “Video live conferences” (18.58%) “Radio handheld transceiver” (18.49%). These CV values, nonetheless, are quite low, meaning there is a high agreement among the respondents. Similarly, the CV of “Internal Network Communication” (17.69%) for grade 1 is low. These low coefficients of variations indicate that both grade 1 and grade 2 contractors share the same views that “Internal Network Communication” is a critical communication tool in the construction industry.

Among all the communication tools, “Internal Network Communications” ranked first in the list of critical communication tools for grade 1 contractors and grade 2 contractors. Some respondents admitted during the interview that their organizations conducted change communication, crisis communication, or vertical communications internally. Many reasons could explain contractors' preference for internal communication in the construction sector. It may be because internal network communication enables contractors and staff to interact transparently. Through internal online chat groups, contractors may share information, request resources, and receive feedback promptly. Besides, internal network communication helps create an atmosphere of trust and accountability. All contractors are highly likely to meet individuals of the same values and career goals in the communication network.

There are significant variations in grade 1 contractors' responses regarding other communication tools with TTI values less than 65%. As shown in Table 8, in grade 1, the CV value of “Radio handheld transceiver”, “Video calls communication”, “Video live conferences”, “Mobile phone calls communication”, “Visual signs”, and “Emails” is 23.69%, 48.21%, 38.21%, 32.74%, 32.27%, 34.37%, and 32.44%. While these communication tools are not critical impediments to communication for grade 1 contractors, their high CV values show that grade 1 contractors have divergent views regarding these communication tools. The divergence can be attributed to the COVID-19 pandemic, which forced some workers to work remotely and others in the office. According to one of the respondents, “Since the beginning of the COVID-19 pandemic, he had been introduced to new tools and technologies he never used before, such as Zoom video meetings, collaborative planning video calls.” The COVID-19 pandemic likely enabled

grade 1 contractors to be exposed to different communication tools that impacted their productivity and work performance.

Table 8 shows that the most used tools for grade 1 contractors being at the bottom of the list are “face-to-face meetings,” “Emails,” “Letters,” and “CAD Drawings,” having Terrell's indices of 30.00%, 8.57% for the first two, respectively. The last two tools have TTI values of 0.00%, which indicates that all respondents rated the level of application of these communication tools “Extremely High.” All the respondents agreed on the answer, which is confirmed by the coefficient of variation (0.0%). This is the most convenient communication tool in engineering drawings. Most of the respondents elaborated on these four as they mentioned them by saying that these methods are the most conventional direct communication tools. The prominence of these tools can be attributed to their durability, ease of use, and affordability.

Unlike grade 1 contractors, grade 2 contractors pointed out other critical communications tools apart from “Internal Network Communication.” The tools include “Radio handheld transceiver”, “Video calls communication”, and “Video live conferences”, with a TTI value of 88.33%, 70.83%, and 67.5%, respectively. Their high RII values confirm the criticality of these tools in respondents' perceptions. Regarding “Radio handheld transceiver,” the respondents pointed out that the handheld receiver is an obsolete technology used on rare occasions (e.g., communication between coordinator and operator of a crane). Radio handheld transceiver has a short communication range. As a result, it cannot be used for long-distance communication. Even though this device is obsolete technology, construction organizations may prefer to use a radio handheld transceiver because it is durable, easy to use, affordable and requires no expensive infrastructure,

especially when working remotely on a construction site. When grade 2 respondents were asked why they thought “Video calls communication” and “Video live conferencing” were critical to communication, most of them attributed the prevalent use of these two communication tools to the COVID-19 pandemic. During the global lockdown, video call communication was a useful alternative to face-to-face communication. Through video calls, construction workers stuck at home could discuss their designs and collaborate on complex tasks. Without video live conferencing, many construction workers must journey to the head office or construction site to attend meetings during the pandemic. This alternative may not even be possible based on the government's travel restrictions during the lockdown.

However, some grade 2 contractors did not use those three tools. Instead, they used regular phone calls, instant messaging apps (i.e., WhatsApp), visual signs, emails, letters, and CAD drawings. grade respondents were asked why they prefer these communication tools compared to “Live Video conferences” and “Video calls communication”. Some respondents said they preferred them because they were less intrusive and formal. Emails, for instance, have transformed how people communicate in the working environment. Compared to video conferencing and video calls, email messages can be stored until workers are ready to read them. Besides, workers can easily record their messages and replies with emails, letters, and CAD drawings compared to video call communication. These advantages might have influenced grade 2 contractors to adopt regular phone calls, instant messaging apps (i.e., WhatsApp), visual signs, emails, letters, or CAD drawings.

Tool	GRADE 1							GRADE 2						
	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision
Internal Network Communications	65	14	70	72.86 %	92.86 %	17.69 %	Critical	108	24	120	70.00 %	90.00 %	21.48 %	Critical
Radio handheld transceiver	55	14	70	58.57 %	78.57 %	23.69 %	Not Critical	106	24	120	68.33 %	88.33 %	18.49 %	Critical
Video calls communication	57	14	70	61.43 %	81.43 %	48.21 %	Not Critical	109	24	120	70.83 %	90.83 %	19.25 %	Critical
Video live conferences	50	14	70	51.43 %	71.43 %	38.21 %	Not Critical	105	24	120	67.50 %	87.50 %	18.58 %	Critical
Hand drawn sketches	49	14	70	50.00 %	70.00 %	32.74 %	Not Critical	101	24	120	64.17 %	84.17 %	12.64 %	Not Critical
Instant Massaging (IM, WhatsApp, social media, Other IM Apps)	43	14	70	41.43 %	61.43 %	11.37 %	Not Critical	85	24	120	50.83 %	70.83 %	33.58 %	Not Critical
Mobile phone calls communication	40	14	70	37.14 %	57.14 %	32.37 %	Not Critical	44	24	120	16.67 %	36.67 %	23.40 %	Not Critical
Visual signs	39	14	70	35.71 %	55.71 %	34.34 %	Not Critical	59	24	120	29.17 %	49.17 %	35.46 %	Not Critical
face-to-face meetings.	35	14	70	30.00 %	50.00 %	24.59 %	Not Critical	46	24	120	18.33 %	38.33 %	31.42 %	Not Critical
Emails	20	14	70	8.57%	28.57 %	32.44 %	Not Critical	45	24	120	17.50 %	37.50 %	11.63 %	Not Critical
Letters	14	14	70	0.00%	20.00 %	0.00%	Not Critical	49	24	120	20.83 %	40.83 %	11.55 %	Not Critical
CAD Drawings	14	14	70	0.00%	20.00 %	0.00%	Not Critical	47	24	120	19.17 %	39.17 %	27.35 %	Not Critical

Table 8 Terrell's and Importance indices computation for Communication Tools

4.6 Barriers to Communication

The respondents have evaluated a list of potential barriers to proper communication in construction projects and measured their frequencies of occurrence and the level of impacts on communication in construction projects. The results are divided into these two main analysis areas, and each section was evaluated independently. A comprehensive discussion of the overall results is performed and presented in a separate section. Terrell's transformation index (above 65%) was used to determine the most critical factors (Elhag et al., 2005). The relative importance index was used to sort the barriers accordingly. Furthermore, the coefficient of variance was used to determine the consistency of the respondents' answers. An online or mobile follow-up call was conducted to question the responses and get an explanation.

4.6.1 Sender related barriers

Table 9 shows the important indices for the occurrence frequency of sender barriers. As depicted in the table, “Poor negotiation skills” and “Varying concept of time” are the most critical barriers for grade 1 and grade 2 contractors. For grade 1 contractors, TTI values for “Poor negotiation skills” and “Varying concept of time” are 71.43% and 71.43%, respectively. For grade 2, TTI values for “Poor negotiation skills” and “Varying concept of time” are 6% and 7%, respectively. The CV values of these two barriers for grade 1 and grade 2 contractors are less than 15%, meaning the responses of participants in grade 1 and grade 2 were consistent in terms of the frequency of occurrence of these barriers. In other words, grade 1 and 2 contractors admit that other barriers do not frequently affect workplace communication, such as “Varying capacity and capability”, “Poor recording of items, rates, and bills of quantities”, “Lack of confidence”, “Personal preference”, “Poor

leadership”, “Lack of necessary skills”, “Poor planning”, “Organizational mishap”, and “Poor lettering”.

Interviews were further conducted to gain insights into the frequency of these barriers. “Poor negotiation skills” and “Varying concept of time” are ranked high in the frequency of occurrence of these two communication barriers because construction management had a penchant for delaying projects and accepting a deal too quickly. Respondents attributed this problem to the failure of senior executives to plan for negotiations. All over the world, construction managers are prone to making such negotiation mistakes as construction projects have been scarce in the last three years due to the global pandemic, and managers are desperate to secure a construction contract. Participants attributed the frequency of the “Varying concept of time” to the culture of high work pressure cultivated by top-level managers and supervisors. Time perception varies across the globe. In the Middle East, time is viewed as cyclical and endless, and failure to meet deadlines in this region may not be considered a poor work ethic. Hence, managers in Saudi Arabia tend to emphasize completing a task effectively rather than worrying about getting construction projects done on time. When construction managers do not adequately schedule construction activities, miscommunication and duplicity of efforts may likely arise.

The impact level of sender barriers is shown in Table 10. As illustrated in that table, for grade 1, “Poor planning”, “Varying concept of time”, “Inexperienced work causing interpretation”, “Poor negotiation skills”, and “Lack of confidence” are the most impactful barriers to communication with a TTI value of 77.14%, 75.71%, 75.71%, 74.29%, and 72.86%, respectively. However, for grade 2, “Poor planning”, “Varying concept of time”, and “Inexperienced work causing interpretation” are the most impactful communication

barriers with a TTI value of 7.00%, 5% and 29%, respectively. Of these barriers, only “Inexperienced work causing interpretation” has a CV value greater than 20% for grade 1 (23%) and grade 2 (29%). This result shows that answers to this barrier are inconsistent among grade 1 and 2 contractors. This inconsistency can be attributed to respondents’ different perceptions of workplace miscommunication.

Both grade 1 and grade 2 contractors ranked “Poor planning” as the most impact sender barrier. The senders, in this case, are usually supervisors, managers, and top-level executives. The causes of poor planning could range from unrealistic goals, poor allocation of human and financial resources, COVID-19 pandemic to lack of managerial support. The next most important barrier for grades 1 and 2 contractors is the “Varying concept of time”. This impact is not surprising given that managers of construction organizations are from both deadline and non-deadline cultures. Compared to managers from the West, those from Saudi Arabia may not be too concerned about scheduling meetings on time or meeting construction deadlines but fixated on performing the construction tasks effectively. These results are confirmed in Table 11, as the two mentioned barriers can be seen clearly in the table with highest FAII values for contractors from both grades. The results indicate that grades 1 and 2 contractors consider the “Inexperienced work causing misinterpretation”, which is the third-most impactful sender barrier. The participants admitted that workers’ lack of experience might contribute to senders’ miscommunication. It is not uncommon for inexperienced workers to say one thing and mean another thing while discussing construction projects with their colleagues. Unlike grade 2 contractors, grade 1 contractors perceive “Poor negotiation skills” and “Lack of confidence” as critical barriers. This disparity may be because grade 1 contractors are likely to feel the impacts of constructions’

poor negotiation skills and lack of confidence in performing tasks compared to grade 2 contractors.

Barrier	GRADE 1							GRADE 2						
	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision
Poor negotiation skills	64	14	70	71.43%	91.43%	12.00%	Critical	108	24	120	70.00%	90.00%	6.00%	Critical
Varying concept of time	64	14	70	71.43%	91.43%	3.00%	Critical	102	24	120	65.00%	85.00%	7.00%	Critical
Inexperienced work causing misinterpretation	60	14	70	65.71%	85.71%	7.00%	Critical	94	24	120	58.33%	78.33%	8.00%	Not Critical
Varying capacity and capability	59	14	70	64.29%	84.29%	20.00%	Not Critical	95	24	120	59.17%	79.17%	25.00%	Not Critical
Poor recording of items, rates, and bills of quantities	59	14	70	64.29%	84.29%	6.00%	Not Critical	93	24	120	57.50%	77.50%	14.00%	Not Critical
Lack of confidence	58	14	70	62.86%	82.86%	16.00%	Not Critical	68	24	120	36.67%	56.67%	17.00%	Not Critical
Personal preference	54	14	70	57.14%	77.14%	6.00%	Not Critical	72	24	120	40.00%	60.00%	10.00%	Not Critical
Poor leadership	44	14	70	42.86%	62.86%	25.00%	Not Critical	76	24	120	43.33%	63.33%	25.00%	Not Critical
Lack necessary skills	42	14	70	40.00%	60.00%	20.00%	Not Critical	74	24	120	41.67%	61.67%	12.00%	Not Critical
Poor planning	39	14	70	35.71%	55.71%	19.00%	Not Critical	77	24	120	44.17%	64.17%	13.00%	Not Critical
Organizational mishap	32	14	70	25.71%	45.71%	3.00%	Not Critical	24	24	120	0.00%	20.00%	-5.00%	Not Critical
Poor lettering, making interpretation of writing difficult	23	14	70	12.86%	32.86%	15.00%	Not Critical	29	24	120	4.17%	24.17%	16.00%	Not Critical

Table 9 Terrell's and important indices for occurrence frequency of sender barriers

Barrier	GRADE 1							GRADE 2						
	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision
Poor planning	68	14	70	77.14%	97.14%	4.00%	Critical	106	24	120	71.58%	91.58%	7.00%	Critical
Varying concept of time	67	14	70	75.71%	95.71%	4.00%	Critical	105	24	120	70.53%	90.53%	5.00%	Critical
Inexperienced work causing misinterpretation	67	14	70	75.71%	95.71%	23.00%	Critical	100	24	120	67.89%	87.89%	29.00%	Critical
Poor negotiation skills	66	14	70	74.29%	94.29%	8.00%	Critical	94	24	120	64.21%	84.21%	14.00%	Not Critical
Lack of confidence	65	14	70	72.86%	92.86%	15.00%	Critical	74	24	120	53.16%	73.16%	19.00%	Not Critical
Poor recording of items, rates, and bills of quantities	58	14	70	62.86%	82.86%	8.00%	Not Critical	75	24	120	50.00%	70.00%	5.00%	Not Critical
Poor leadership	55	14	70	58.57%	78.57%	15.00%	Not Critical	78	24	120	50.00%	70.00%	13.00%	Not Critical
Personal preference	50	14	70	51.43%	71.43%	16.00%	Not Critical	79	24	120	47.89%	67.89%	23.00%	Not Critical
Lack necessary skills	46	14	70	45.71%	65.71%	6.00%	Not Critical	81	24	120	46.84%	66.84%	2.00%	Not Critical
Varying capacity and capability	44	14	70	42.86%	62.86%	1.00%	Not Critical	71	24	120	40.53%	60.53%	9.00%	Not Critical
Poor lettering, making interpretation of writing difficult	39	14	70	35.71%	55.71%	4.00%	Not Critical	66	24	120	35.26%	55.26%	4.00%	Not Critical
Organizational mishap	29	14	70	21.43%	41.43%	29.00%	Not Critical	26	24	120	8.95%	28.95%	32.00%	Not Critical

Table 10 Terrell's and important indices for impact level of sender barriers

Barrier	GRADE 1			GRADE 2		
	RII (%)	FIR (%)	FAIL	RII (%)	FIR (%)	FAIL (%)
Poor negotiation skills	94.29%	91.43%	86.21%	84.21%	90.00%	75.79%
Varying concept of time	95.71%	91.43%	87.51%	90.53%	85.00%	76.95%
Inexperienced work causing misinterpretation	95.71%	85.71%	82.03%	87.89%	78.33%	68.84%
Varying capacity and capability	62.86%	84.29%	52.98%	60.53%	79.17%	47.92%
Poor recording of items, rates, and bills of quantities	82.86%	84.29%	69.84%	70.00%	77.50%	54.25%
Lack of confidence	92.86%	82.86%	76.94%	73.16%	56.67%	41.46%
Personal preference	71.43%	77.14%	55.10%	67.89%	60.00%	40.73%
Poor leadership	78.57%	62.86%	49.39%	70.00%	63.33%	44.33%
Lack necessary skills	65.71%	60.00%	39.43%	66.84%	61.67%	41.22%
Poor planning	97.14%	55.71%	54.12%	91.58%	64.17%	58.77%
Organizational mishap	41.43%	45.71%	18.94%	28.95%	20.00%	5.79%
Poor lettering, making interpretation of writing difficult	55.71%	32.86%	18.31%	55.26%	24.17%	13.36%

Table 11 Frequency adjusted important indices for sender barriers

4.6.2 Barriers related to the message

Respondents in grades 1 and 2 were asked to rank the frequency of message barriers on a three-point Likert scale. Table 12 shows the TTI, RRI, and CV of their responses. As shown in that table, “Ineffective reporting system”, “Insufficient technology”, and “Non-verbal, non-word messages” are the top three most frequent message barriers for grades 1 and 2 contractors. The CV of all the three message barriers for grades 1 and 2 contractors is less than 20%, meaning all the respondents’ responses were consistent. The similarity in response can be because all the respondents work in the construction industry. Similarly, all the respondents in grades 1 and 2 consider “Physical noise, distance, time, environment, physical medium”, “Poor or undetailed drawings”, and “under objectives” to be less frequent as message barriers. This observation may be because most architects and site engineers send design plans and constructions via email or instant messaging apps, which are less prone to message barriers.

“Inefficient reporting system is ranked first as the most frequent message barrier for grades 1 and 2 contractors, with a TTI value of 68.5% and 68.33%, respectively (Table 12). grades 1 and 2 respondents attributed the problem of an inefficient reporting system to data inconsistency, improper staffing, and no administration coordination. Construction organizations often try to save costs and remain competitive by using fewer workers to achieve greater productivity. The problem with this approach is that workers become less motivated to learn how to use modern reporting systems. Besides, to save costs, some construction managers still use traditional design or project management tools rather than modern ones to document construction projects. Based on these reasons, the problem of inefficient reporting systems is likely to occur frequently in construction companies.

The second most frequent message barrier for grades 1 and 2 contractors is “Insufficient technology”. The TTI value of this barrier for grades 1 and 2 is 65.71% and 67.50%, respectively. Respondents for both grades admitted that insufficient technology had limited the organization’s ability to get its message across to workers. Most construction companies hardly use rich media, which are well suited to delivering complex messages. Instead, they rely on paper to document and store their designs. Paper documents cannot be sent electronically. Apart from the fact that paper documentation is prone to damage, it is susceptible to misinterpretation when sent to workers or clients.

Excluding “Inefficient reporting system” and “Insufficient technology”, the most frequent message barrier is “non-verbal, non-word messages” (Table 12). Most respondents in grades 1 and 2 agree that 80% of workplace communication or construction sites are non-verbal. However, many workers cannot decode non-verbal communication. This deficiency seems to be a huge problem, especially when construction workers come from different cultural backgrounds. In some Arab cultures, prolonged eye contact among men may be interpreted as being interested in one another. In other Arab cultures, such facial expressions may be considered weird, suspicious, or offensive. The inability of workers to decode each other's body language and facial expressions might explain why many grades 1 and 2 contractors experienced this message barrier frequently.

Table 13 shows the impact level of message barriers for grades 1 and 2 contractors. Only four barriers are found to have a TTI value above 65%. They include “Poor or undetailed drawings”, “Physical noise, distance, time, environment, and physical medium”, “Insufficient technology”, and “Unclear objectives.” The TTI results indicate that the “Poor or undetailed drawings,” “Followed by Physical noise, distance, time, environment, and

physical medium,” “Insufficient technology,” and “Unclear objectives” are the most impacting message barriers in grades 1 and 2 contractors. Simply, grades 1 and 2 respondents consider message barriers such as “non-verbal, non-word messages” and “ineffective reporting” less critical. Several respondents were asked why and how the above four barriers significantly create misinterpretations. grades 1 and 2 respondents pointed out that because poor or undetailed drawings could result in improper construction, the receiver of the message may ask the sender to resend the drawings or redesign them. All professionals in the construction world rely on accurate and detailed drawings to make decisions. Therefore, ambiguities and omissions in the project plan could delay the project and harm productivity.

Talking about “Physical noise, distance, time, environment, and physical medium, respondents for both grades chose this barrier as the second most impactful message barrier. They reasoned that it was impossible to communicate with anyone on the construction site. Noise pollution, generated mostly from construction equipment, is not unusual on construction sites. The noise may prevent managers and workers from decoding and encoding one another's messages. The third most impactful message barrier, as shown in Table 13, is insufficient technology. Today, construction firms are still found wanting in the use of modern tools for communication. While some construction managers are using Microsoft Teams with themselves, they are yet to allow their supervisors and workers to have access to such communication tools. “Unclear objectives” is the fourth most impactful barrier. Some respondents complained that construction managers hardly provide unrealistic goals, while some said project deadlines were not strict. Unfortunately, most

construction projects fail when workers do not understand their objectives or when the project goals have no measurable metrics.

Barrier	GRADE 1							GRADE 2						
	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision
Ineffective reporting system	62	14	70	68.57%	88.57%	11.59%	Critical	106	24	120	68.33%	88.33%	14.20%	Critical
Insufficient technology	60	14	70	65.71%	85.71%	12.28%	Critical	105	24	120	67.50%	87.50%	14.89%	Critical
Non-verbal, non-word messages	60	14	70	65.71%	85.71%	15.67%	Critical	114	24	120	75.00%	95.00%	18.28%	Critical
Physical noise, distance, time, environment, physical medium	59	14	70	64.29%	84.29%	22.65%	Not Critical	101	24	120	64.17%	84.17%	25.26%	Not Critical
Unclear channels of communication	45	14	70	44.29%	64.29%	16.75%	Not Critical	89	24	120	54.17%	74.17%	19.36%	Not Critical
Poor or undetailed drawings	44	14	70	42.86%	62.86%	12.65%	Not Critical	92	24	120	56.67%	76.67%	15.26%	Not Critical
Unclear Objectives	44	14	70	42.86%	62.86%	11.65%	Not Critical	75	24	120	42.50%	62.50%	14.26%	Not Critical

Table 12 Terrell's and importance indices for occurrence frequency of message barriers

Barrier	GRADE 1							GRADE 2						
	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision
Poor or undetailed drawings	65	14	70	72.86%	92.86%	8.94%	Critical	108	24	120	70.00%	90.00%	15.20%	Critical
Physical noise, distance, time, environment, physical medium	63	14	70	70.00%	90.00%	9.63%	Critical	104	24	120	66.67%	86.67%	15.89%	Critical
Insufficient technology	63	14	70	70.00%	90.00%	13.02%	Critical	104	24	120	66.67%	86.67%	19.28%	Critical
Unclear Objectives	62	14	70	68.57%	88.57%	20.00%	Critical	102	24	120	65.00%	85.00%	26.26%	Critical
Unclear channels of communication	48	14	70	48.57%	68.57%	14.10%	Not Critical	74	24	120	41.67%	61.67%	20.36%	Not Critical
Non-verbal, non-word messages	47	14	70	47.14%	67.14%	10.00%	Not Critical	72	24	120	40.00%	60.00%	16.26%	Not Critical
Ineffective reporting system	47	14	70	47.14%	67.14%	9.00%	Not Critical	72	24	120	40.00%	60.00%	15.26%	Not Critical

Table 13 Terrell's and importance indices for impact level of message barriers

Barrier	GRADE 1			GRADE 2		
	RII (%)	FIR (%)	FAIL (%)	RII (%)	FIR (%)	FAIL (%)
Ineffective reporting system	67.14%	88.57%	59.47%	60.00%	88.33%	53.00%
Insufficient technology	90.00%	85.71%	77.14%	86.67%	87.50%	75.84%
Non-verbal, non-word messages	67.14%	85.71%	57.55%	60.00%	95.00%	57.00%
Physical noise, distance, time, environment, physical medium	90.00%	84.29%	75.86%	86.67%	84.17%	72.95%
Unclear channels of communication	68.57%	64.29%	44.08%	61.67%	74.17%	45.74%
Poor or undetailed drawings	92.86%	62.86%	58.37%	90.00%	76.67%	69.00%
Unclear Objectives	88.57%	62.86%	55.68%	85.00%	62.50%	53.13%

Table 14 Frequency adjusted importance indices for message barriers

4.6.3 Receiver related barrier

The important indices for the most frequent receiver barriers are shown in Table 15. Among the twenty-eight barriers, only six contribute significantly to the grade 1 receivers' misinterpretation of the message. The barriers include “Age difference,” “Resisting change,” “Fear of authority by junior staff, leading to mistakes,” “Lack of trust,” “Poor understanding of telephone messages,” and “Misunderstood gestures” with a TTI value of 74.29%, 71.43%, 70.00%, 68.57%, 67.14%, and 67.14%, respectively. The CV values of these barriers are below 21%, meaning most grade 1 participants' perceptions about the barriers were consistent. For grade 2 contractors, eight barriers are extremely critical to receivers' barriers. They include “Age difference”, “Resisting change”, “Fear of authority by junior staff, leading to mistakes”, “Lack of trust”, “Poor understanding of telephone messages”, and “Misunderstood gestures”, “Poor listeners”, and “Limited time”, with a TTI value of 15.45%, 19.50%, 15.55%, 15.14%, 14.21%, 12.53%, 15.84%, and 14.38%, respectively. All the CV values of these eight values were below 20%. This observation means that respondents agreed that these barriers were extremely critical to recipients' miscommunication. Overall, the results show that grade 2 contractors have two additional barriers (“Poor listeners” and “Limited time”), which are not found in grade 1 contractors. This difference might be attributed to the fact that grade 2 contractors were more experienced and knowledgeable about the construction industry.

For grades 1 and 2 contractors, six barriers demonstrate workers' lack of experience working in the construction sector. Respondents from grades 1 and 2 were asked to justify the contribution of the following barriers to their inability to make sense of the messages sent by others: “Age difference,” “Resisting change,” “Fear of authority by junior staff,

leading to mistakes,” “Lack of trust,” “Poor understanding of telephone messages,” and “Misunderstood gestures.” Most respondents admitted that they hardly got along with their boss because they treated them like “slaves,” not like partners. Central to their challenges is the inability to talk freely with their superiors. Their response is not surprising given that most managers and supervisors adopt authoritarian leadership, in which leaders expect workers to obey their orders without questioning their authority. This leadership style frequently breeds an atmosphere of fear and mistrust, thereby creating barriers to communication.

Unlike grade 1 contractors, grade 2 contractors cite “Poor listeners” and “Limited time” as receivers' barriers that occur frequently. It is expected that grade 1 contractors will mention these two barriers, but they did not. Perhaps the reason is that much is not expected from them to perform their duties effectively. Even when inexperienced workers do not perform their jobs efficiently, they are not subjected to punitive measures like grade 1 contractors. When respondents were asked why these two barriers impede communication, they said employers' minds were always preoccupied with meeting job requirements and team objectives. Their busy schedules prevented them from listening attentively to instructions from superiors. Central to this problem is the issue of stress. When employees are overworked and over-stressed, they may not be able to decode the messages sent by senders properly.

Table 16 shows all the twenty-eight variables that impact receivers' misinterpretation of messages. Of these variables, only eight barriers are extremely critical for grade 1 contractors, while only twelve barriers are extremely critical for grade 2 contractors. The critical barriers for grade 1 contractors include “Information filtering”, “Misunderstood

gestures”, “Poor understanding of telephone messages”, “Lack of trust”, “Poor listening”, “Limited time”, “Conflicting business/industry ethics”, and “Age difference” with a TTI value of 77.14%, 74.29%, 72.86%, 72.86%, 71.43%, 71.43%, 70.00%, and 67.14%, respectively. For grade 2 contractors, the twelve barriers include “Information filtering,” “Misunderstood gestures,” “Poor understanding of telephone messages,” “Lack of trust,” “Poor listening,” “Limited-time,” “Conflicting business/industry ethics,” and “Age difference,” “Perceptual, viewing what is said from your own mindset,” “Experiential, lack of similar experience,” “Lack of motivation,” and “Language difficulties, different languages or vocabulary, accent, dialect.” Their TTI values are greater than 65%; however, their CV values ranged from 17% to 22%.

After the analysis, the researcher post-interviewed grades 1 and 2 respondents. They attributed the high impact of “information filtering” to the process of information transfer. For instance, incidents on construction sites with particular actions are communicated to the management or stakeholders through a hierarchy. The weakness of this approach is that as information passes through the hierarchy of command, the message will be distorted before it gets to the target workers. One respondent said: “People misunderstanding a gesture or filtering the information before communicating it on the job site, could in some cases have catastrophic impacts; in my 17 years of experience, I have witnessed some of these in real life, where the impact could be not just losses in material and work, it might reach to a level where it is life-threatening impact”. This response shows the dangers of miscommunication along the command chain. Information filtering also prevents workers from getting a complete picture of what needs to be done on-site. Messages need to be delivered in multiple ways to receivers to eliminate or mitigate information filtering.

Barrier	GRADE 1							GRADE 2						
	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision
Age difference	66	14	70	74.29%	94.29%	17.66%	Critical	117	24	120	77.50%	97.50%	15.45%	Critical
Resisting change	64	14	70	71.43%	91.43%	19.01%	Critical	113	24	120	74.17%	94.17%	19.50%	Critical
Fear of authority by junior staff, leading to mistakes	63	14	70	70.00%	90.00%	17.45%	Critical	106	24	120	68.33%	88.33%	15.55%	Critical
Lack of trust	62	14	70	68.57%	88.57%	15.02%	Critical	111	24	120	72.50%	92.50%	15.14%	Critical
Poor understanding of telephone messages.	61	14	70	67.14%	87.14%	20.32%	Critical	104	24	120	66.67%	86.67%	14.21%	Critical
Misunderstood gestures	61	14	70	67.14%	87.14%	19.98%	Critical	102	24	120	65.00%	85.00%	12.53%	Critical
Poor Listeners	59	14	70	64.29%	84.29%	17.48%	Not Critical	100	24	120	63.33%	83.33%	15.84%	Critical
Limited time	58	14	70	62.86%	82.86%	16.62%	Not Critical	105	24	120	67.50%	87.50%	14.38%	Critical
Conflicting business/industry ethics	56	14	70	60.00%	80.00%	14.89%	Not Critical	101	24	120	64.17%	84.17%	12.40%	Not Critical
Family commitments	50	14	70	51.43%	71.43%	12.94%	Not Critical	91	24	120	55.83%	75.83%	14.75%	Not Critical
Lack of motivation	47	14	70	47.14%	67.14%	16.46%	Not Critical	78	24	120	45.00%	65.00%	18.94%	Not Critical
Geographical differences	41	14	70	38.57%	58.57%	20.42%	Not Critical	68	24	120	36.67%	56.67%	16.46%	Not Critical
Perceptual, viewing what is said from your own mind-set.	38	14	70	34.29%	54.29%	18.78%	Not Critical	69	24	120	37.50%	57.50%	15.20%	Not Critical
Language difficulties, different languages or vocabulary, accent, dialect	37	14	70	32.86%	52.86%	18.91%	Not Critical	62	24	120	31.67%	51.67%	14.39%	Not Critical

Interpersonal conflict	37	14	70	32.86%	52.86%	17.16%	Not Critical	62	24	120	31.67%	51.67%	19.13%	Not Critical
Inferiority complexes on the part of operatives can result in information being interpreted wrongly	36	14	70	31.43%	51.43%	15.48%	Not Critical	67	24	120	35.83%	55.83%	12.33%	Not Critical
Different cultural values	36	14	70	31.43%	51.43%	19.61%	Not Critical	67	24	120	35.83%	55.83%	13.10%	Not Critical
Personal feelings at the moment or doing other things besides listening	36	14	70	31.43%	51.43%	19.37%	Not Critical	65	24	120	34.17%	54.17%	13.87%	Not Critical
Lack of support and commitment	36	14	70	31.43%	51.43%	20.97%	Not Critical	65	24	120	34.17%	54.17%	18.76%	Not Critical
Community Conflicts	33	14	70	27.14%	47.14%	18.03%	Not Critical	56	24	120	26.67%	46.67%	16.89%	Not Critical
Limited resources	33	14	70	27.14%	47.14%	20.12%	Not Critical	54	24	120	25.00%	45.00%	18.82%	Not Critical
Experiential, lack of similar experience.	32	14	70	25.71%	45.71%	15.81%	Not Critical	59	24	120	29.17%	49.17%	16.93%	Not Critical
Different understanding / interpretation	32	14	70	25.71%	45.71%	12.96%	Not Critical	59	24	120	29.17%	49.17%	16.56%	Not Critical
Lack of concern	31	14	70	24.29%	44.29%	14.68%	Not Critical	52	24	120	23.33%	43.33%	14.12%	Not Critical
Religious issues	22	14	70	11.43%	31.43%	13.49%	Not Critical	41	24	120	14.17%	34.17%	14.33%	Not Critical
Gender issues	16	14	70	2.86%	22.86%	17.31%	Not Critical	31	24	120	5.83%	25.83%	16.72%	Not Critical
Information filtering	14	14	70	0.00%	20.00%	19.84%	Not Critical	29	24	120	4.17%	24.17%	13.80%	Not Critical
Conflicting interest	14	14	70	0.00%	20.00%	16.46%	Not Critical	27	24	120	2.50%	22.50%	19.22%	Not Critical

Table 15 Terrell's and important indices for occurrence frequency receiver barriers

Barrier	GRADE 1							GRADE 2						
	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision	Raw Score	LPS	Range	TTI (%)	RII (%)	CV	Decision
Information filtering	68	14	70	77.14%	97.14%	17.12%	Critical	110	24	120	71.67%	91.67%	17.08%	Critical
Misunderstood gestures	66	14	70	74.29%	94.29%	23.15%	Critical	115	24	120	75.83%	95.83%	23.83%	Critical
Poor understanding of telephone messages.	65	14	70	72.86%	92.86%	22.32%	Critical	113	24	120	74.17%	94.17%	19.53%	Critical
Lack of trust	65	14	70	72.86%	92.86%	20.10%	Critical	113	24	120	74.17%	94.17%	19.61%	Critical
Poor Listeners	64	14	70	71.43%	91.43%	19.71%	Critical	117	24	120	77.50%	97.50%	19.77%	Critical
Limited time	64	14	70	71.43%	91.43%	20.81%	Critical	110	24	120	71.67%	91.67%	22.07%	Critical
Conflicting business/industry ethics	63	14	70	70.00%	90.00%	21.10%	Critical	114	24	120	75.00%	95.00%	18.44%	Critical
Age difference	61	14	70	67.14%	87.14%	21.66%	Critical	105	24	120	67.50%	87.50%	20.57%	Critical
Perceptual, viewing what is said from your own mind-set.	59	14	70	64.29%	84.29%	21.88%	Not Critical	108	24	120	70.00%	90.00%	22.33%	Critical
Experiential, lack of similar experience.	59	14	70	64.29%	84.29%	21.96%	Not Critical	108	24	120	70.00%	90.00%	21.81%	Critical
Lack of motivation	58	14	70	62.86%	82.86%	19.84%	Not Critical	109	24	120	70.83%	90.83%	17.87%	Critical
Language difficulties, different languages or vocabulary, accent, dialect	53	14	70	55.71%	75.71%	20.83%	Not Critical	103	24	120	65.83%	85.83%	17.33%	Critical
Interpersonal conflict	53	14	70	55.71%	75.71%	22.31%	Not Critical	97	24	120	60.83%	80.83%	17.84%	Not Critical
Different cultural values	53	14	70	55.71%	75.71%	20.88%	Not Critical	91	24	120	55.83%	75.83%	19.88%	Not Critical

Resisting change	53	14	70	55.71%	75.71%	22.98%	Not Critical	91	24	120	55.83%	75.83%	19.92%	Not Critical
Personal feelings at the moment or doing other things besides listening	53	14	70	55.71%	75.71%	19.39%	Not Critical	96	24	120	60.00%	80.00%	23.81%	Not Critical
Limited resources	51	14	70	52.86%	72.86%	19.72%	Not Critical	94	24	120	58.33%	78.33%	18.33%	Not Critical
Different understanding / interpretation	51	14	70	52.86%	72.86%	17.38%	Not Critical	87	24	120	52.50%	72.50%	22.00%	Not Critical
Lack of support and commitment	50	14	70	51.43%	71.43%	20.54%	Not Critical	92	24	120	56.67%	76.67%	21.87%	Not Critical
Lack of concern	50	14	70	51.43%	71.43%	19.55%	Not Critical	92	24	120	56.67%	76.67%	19.29%	Not Critical
Community Conflicts	47	14	70	47.14%	67.14%	17.73%	Not Critical	86	24	120	51.67%	71.67%	23.19%	Not Critical
Inferiority complexes on the part of operatives can result in information being interpreted wrongly	44	14	70	42.86%	62.86%	23.65%	Not Critical	75	24	120	42.50%	62.50%	19.35%	Not Critical
Gender issues	43	14	70	41.43%	61.43%	19.40%	Not Critical	73	24	120	40.83%	60.83%	18.85%	Not Critical
Religious issues	43	14	70	41.43%	61.43%	22.73%	Not Critical	73	24	120	40.83%	60.83%	20.51%	Not Critical
Conflicting interest	35	14	70	30.00%	50.00%	19.82%	Not Critical	65	24	120	34.17%	54.17%	22.04%	Not Critical
Family commitments	33	14	70	27.14%	47.14%	20.02%	Not Critical	56	24	120	26.67%	46.67%	20.86%	Not Critical
Fear of authority by junior staff, leading to mistakes	32	14	70	25.71%	45.71%	23.92%	Not Critical	54	24	120	25.00%	45.00%	19.86%	Not Critical
Geographical differences	25	14	70	15.71%	35.71%	23.70%	Not Critical	47	24	120	19.17%	39.17%	18.74%	Not Critical

Table 16 Terrell's and important indices for impact level of receiver barriers

As for “Poor understanding of telephone messages,” grades 1 and 2 respondents claimed this barrier is the most frequent and impactful communication barrier. The respondents’ view is not surprising given that today, most construction workers have a cell phone and use this device to communicate every day. Because recipients and senders cannot see one another’s body language cues while talking on the phone, they may misinterpret their touches of sarcasm as insults and vice versa. As mentioned previously, the use of authoritarian leadership by construction industry managers indicates why many workers mistrust their superiors. When workers are not allowed to participate in companies’ decision-making, they may be less committed to paying attention to details concerning the industry. Compared to grade 1 contractors, grade 2 contractors chose four additional critical receiver barriers Perceptual, viewing what is said from your own mindset”, “Experiential, lack of similar experience,” “Lack of motivation,” and “Language difficulties, different languages or vocabulary, accent, dialect. These barriers show that the difference in workers’ experiences, culture, and ideologies could make communication difficult. Arabs and Whites, for instance, may not be to get along when ethnocentrism is enshrined in the workplace. When people from other cultures are made to feel undervalued, they tend to use ambiguous language to communicate and limit sharing of information. Ethnocentrism is deceptive because it enables some workers of any culture to perceive their own religion or culture as superior.

Moreover, ethnocentric workers could make others false assumptions about cultural differences, thereby creating a communication barrier in the working environment.

Barrier	GRADE 1			GRADE 2		
	RII (%)	FIR (%)	FAII (%)	RII (%)	FIR (%)	FAII (%)
Age difference	87.14%	94.29%	82.16%	87.50%	97.50%	85.31%
Resisting change	75.71%	91.43%	69.22%	75.83%	94.17%	71.41%
Fear of authority by junior staff, leading to mistakes	45.71%	90.00%	41.14%	45.00%	88.33%	39.75%
Lack of trust	92.86%	88.57%	82.25%	94.17%	92.50%	87.11%
Poor understanding of telephone messages.	92.86%	87.14%	80.92%	94.17%	86.67%	81.62%
Misunderstood gestures	94.29%	87.14%	82.16%	95.83%	85.00%	81.46%
Poor Listeners	91.43%	84.29%	77.07%	97.50%	83.33%	81.25%
Limited time	91.43%	82.86%	75.76%	91.67%	87.50%	80.21%
Conflicting business/industry ethics	90.00%	80.00%	72.00%	95.00%	84.17%	79.96%
Family commitments	47.14%	71.43%	33.67%	46.67%	75.83%	35.39%
Lack of motivation	82.86%	67.14%	55.63%	90.83%	65.00%	59.04%
Geographical differences	35.71%	58.57%	20.92%	39.17%	56.67%	22.20%
Perceptual, viewing what is said from your own mind-set.	84.29%	54.29%	45.76%	90.00%	57.50%	51.75%
Language difficulties, different languages or vocabulary, accent, dialect	75.71%	52.86%	40.02%	85.83%	51.67%	44.35%
Interpersonal conflict	75.71%	52.86%	40.02%	80.83%	51.67%	41.76%
Inferiority complexes on the part of operatives can result in information being interpreted wrongly	62.86%	51.43%	32.33%	62.50%	55.83%	34.89%
Different cultural values	75.71%	51.43%	38.94%	75.83%	55.83%	42.34%
Personal feelings at the moment or doing other things besides listening	75.71%	51.43%	38.94%	80.00%	54.17%	43.34%
Lack of support and commitment	71.43%	51.43%	36.74%	76.67%	54.17%	41.53%
Community Conflicts	67.14%	47.14%	31.65%	71.67%	46.67%	33.45%
Limited resources	72.86%	47.14%	34.35%	78.33%	45.00%	35.25%
Experiential, lack of similar experience.	84.29%	45.71%	38.53%	90.00%	49.17%	44.25%
Different understanding / interpretation	72.86%	45.71%	33.30%	72.50%	49.17%	35.65%
Lack of concern	71.43%	44.29%	31.64%	76.67%	43.33%	33.22%
Religious issues	61.43%	31.43%	19.31%	60.83%	34.17%	20.79%
Gender issues	61.43%	22.86%	14.04%	60.83%	25.83%	15.71%
Information filtering	97.14%	20.00%	19.43%	91.67%	24.17%	22.16%
Conflicting interest	50.00%	20.00%	10.00%	54.17%	22.50%	12.19%

Table 17 Frequency adjusted important indices for receiver barriers

CHAPTER FIVE:

SUMMARY OF THE STUDY, CONCLUSION, AND

RECOMMENDATIONS

This chapter presents the summary of the study, findings, conclusion, and recommendations.

5.1 Summary of The Study

The origin of the theory of communication dates to the twentieth century when the leading time theorists interpreted our current understanding of communication theory. This theory views communication as fundamental and essential in organizations and a means of understanding why or how a business could fail or succeed.

This research was carried out to determine the followings: 1) the current communication management practices, which are followed during the construction of building projects among the project management, the project owner, the project designer, and the contractor's main office, 2) the current norms in the means and tools to carry out communications among the various internal and external parties during the construction of building projects and, 3) the primary communication challenges (Communication barriers) during the construction of building projects in Eastern Province, Saudi Arabia. The research was done by scanning the literature and finding the critical points of interest: practices, tools, and communication barriers. A structured questionnaire was developed to facilitate the

achievement of these objectives. A total of thirty-eight participants participated in the survey, offering their answers in the researcher's presence or with a follow-up to ensure reliable data.

5.2 Summary of The Findings

5.2.1 Communication Management Practices

- The most critical limitation in communication processes is the lack of explicit agreement on the definitions of the communication terms (e.g., done, in progress), which most impacted both grade contractors.
- The choice of proper media significantly affects the communication processes for grade 2 contractors.
- The choice of proper media, the second most critical process, affects grade 2 contractors significantly more than grade 1.
- grade 1 contractors are more experienced in selecting the proper communication channels than grade 2 contractors.
- Design of visual aids, incorporating the performance of the stakeholders and performing a situation analysis all of these practices were seen to have of significant impact on the daily communication of grade 2 contractors.

5.2.2 Tools to Carry Out Communications

- Internal network communications are the tool that most affect communication. A transparent internal system that defines and facilitates communications in grades 1 and 2 contractors is lacking.

- The lack of use of video call communication, live video conferences, and the dependency on face-to-face meetings and phone calls are directly impacting communication for grade 2 contractors.
- The COVID-19 pandemic has directly affected the communication tools used by the grade 1 contractors and a portion of grade 2 contractors.
- A noticeable difference between the tools and technologies used by different grades of contracting companies impacts the quality of communication between parties.

5.2.3 Communication Challenges

5.2.3.1 Sender Related communication barriers

- The most occurring sender-related communication barrier in grades 1 and 2 contractors is the “poor negotiation skills” and the “poor estimation of the time.” The “varying concept of time” is the second most occurring barrier to communications in construction projects.
- “Poor planning,” “varying concept of time,” and “inexperienced work causing misinterpretation” are the most impactful sender-related barriers to communications in construction projects for grades 1 and 2 contractors.
- “Poor negotiation skills” and “lack of confidence” impact communications in construction projects for only grade 1 contractors.

5.2.3.2 Message Related Communication Barriers

- The “ineffective reporting system” and “insufficient technology” are the most occurring message-related barriers to communications in construction projects for grades 1 and 2 contractors.

- The “non-verbal” and “non-word” messages are critical communication barriers in construction projects for grade 1 contractors.
- The “Poor or undetailed drawings,” “physical noise, distance, time, environment, physical medium,” “insufficient technology,” and “unclear objectives” are the most impactful message-related communication barriers in construction projects for grades 1 and 2 contractors.

5.2.3.4 Receiver Related Communication Barriers

“Age difference,” “resisting change,” “fear of authority by junior staff, leading to mistakes,” “lack of trust, poor understanding of telephone messages,” and “misunderstood gestures” are the most occurring receiver-related communication barriers for grades 1 and 2 contractors.

“The poor listeners,” “limited time,” and “different languages or vocabulary, accent, dialect” are frequently occurring receiver-related communication barriers in construction projects only for grade 2 contractors.

The most impactful receiver-related communication barriers in grades 1 and 2 contractors' construction projects are:

“Information filtering,” “Misunderstood gestures,” “Poor understanding of telephone messages,” “Lack of trust,” “Poor listeners,” “Limited-time,” “Conflicting business/industry ethics,” “Age difference,” “Perceptual, viewing what is said from your mindset,” and “Experiential and the lack of similar experience.”

“Lack of motivation,” “Language difficulties,” and “different languages or vocabulary, accent, dialect” are critical communication receiver-related barriers with significant impact in construction projects only for grade 2 contractors.

5.3 Conclusion

Contractors in Saudi Arabia engage periodically in communication improving practices, work to improve their internal communication practices and tools and reduce the barriers. Communication is vital. It directly affects the quality and the output of the people within a company. Contractors in Saudi Arabia tend to follow a conventional approach that includes small to no change to improve neither communication tools and practices or reduce the barriers. Whether this communication pain point is there, finding it and addressing it in time is necessary.

The contractors are more focused on technologies related to construction and less focused on communication technologies. The majority of the contractors lack an internal communication system to organize their internal communication. It was ranked first in the lack of communication tools, directly affecting all factors.

The lack of centralization of communication directly affects the people and the information; as the definition of the communication terms was ranked first in the impact level of the lack of communication process, the choice of proper media was ranked second. The poor negotiation skills, ineffective reporting system and age difference were ranked first as the most occurring communication barriers. However, the most impactful barriers that are ranked first are Poor planning, Poor or undetailed drawings, and information filtering, where the information gets mutated from the source to the destination.

5.4 Recommendations

This section presents recommendations to contractors aiming to improve their communication management in construction projects. Also, this section presents recommendations to contractors to eliminate or mitigate factors hindering proper communication.

5.4.1 Recommendations on Communication Management Practices

The contractors are advised to:

- Ensure periodic practical communication evaluation for the processes, tools, and practices and evaluate and hear from their employees.
- Develop complete documentation for terms and policies for communications to make the terms explicit and the choices standardized.

5.4.2 Recommendations on Tools to Carry Out Communications

The contractors are advised to:

- Consider an investment in communication tools and technologies such as internal ERPs.
- Ensure effective use of online communication channels and tools for meetings since it will reduce time waste and transportation expenses.

5.4.3 Recommendations on Communication Challenges

The contractors are advised to:

- Promote or create (if no one exists yet) a communication feedback loop to enhance communication and its attributes.

- Enhance the personality evaluation in the hiring process of communication-intensive staff as it is a crucial attribute to effective communication among the team.

5.5 Recommendation for Future Studies

- It is recommended to expand on the findings of this study to investigate the followings:
- A cross-relation between the various communication variables.
- The communication quality of the contractors and their external environment.
- Investigate the communications in construction projects other than building.
- Investigate the communications issues in owners, consultants, and Professional Project Management (PPM) organizations.
- Investigate the contractors' communications in construction projects in different regions other than the Eastern Province of Saudi Arabia to extend these findings across the nation.

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Appendix A
Research Questionnaire

Ministry of Education

King Fahd University of Petroleum and Minerals

College of Environmental Design

Construction Engineering and Management Department



Dear Gentlemen,

I, **Ahmad Abusamha**, a graduate student at King Fahd University of Petroleum and Minerals, Dhahran, KSA, under the supervision of the experienced Professor, Dr. Ali Shash is conducting research on the topic: **Communication Challenges in Building Construction Projects in Eastern Province: Current Practices and Communication Plan Development Comprehensive Study**.

The key purpose of this research is to identify, classify and rank the main communication challenges (Communication barriers) in the project (The field), in domestic building construction projects in the Kingdom of Saudi Arabia, and to identify the current norm in the means and tools to carry out such communications through a thorough interviews of the parties involved.

The required data to perform this research is collected through questionnaires and structured interviews. The questionnaire serves to gain an insight into issues surrounding the construction industry. Questions in the questionnaire were created based on an ordinal measure, Likert scale, (5-point scales) and had three different sections. The questions specifically were chosen in regard to the skills needed to successfully manage and communicate within a construction project. Meanwhile, the interviews will be held in person (if possible, due to corona pandemic), or online when available as a means of providing more in-depth knowledge to allow for analysis of the primary quantitative study.

Your valuable participation in this research would contribute positively to the overall industry including your organization. Your precious time and effort are greatly appreciated. The provided data shall be treated with an elevated level of confidentiality and shall only be used for educational and research purposes.

Yours faithfully,

Ahmad I. Abusamha

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“EFFECTIVE PROJECT COMMUNICATION FOR CONSTRUCTION PROJECT
MANAGERS IN SAUDI ARABIA”

Section A: Respondent Characteristic

This section seeks information related the respondent. Please kindly select the answer that best fits you.

1. What is your job?
 - ☐ Architect.
 - ☐ Engineer.
 - ☐ Quantity Surveyor.
 - ☐ Other (Please Specify): _____.

2. What is your role?
 - ☐ Executive Manager
 - ☐ Operation Manager
 - ☐ Construction Manager
 - ☐ Construction Engineer
 - ☐ Other (Please Specify): _____.

3. How many years of experience do you have in Construction industry?
 - ☐ Less than 5 years
 - ☐ 6 to 10 years
 - ☐ 11 to 15 years
 - ☐ More than 15 years

4. How many years have you been with your current employer?
 - ☐ Less than 5 years
 - ☐ 6 to 10 years
 - ☐ 11 to 15 years
 - ☐ More than 15 years

5. How many building constructions projects have you worked on?
- ☐ Less than 3.
 - ☐ 3 to 6.
 - ☐ 7 to 10.
 - ☐ More than 10 projects.
6. What is your educational level?
- ☐ Bachelor
 - ☐ Masters
 - ☐ PhD
 - ☐ Other (Please Specify): _____.
7. What is the area of your education?
- ☐ Civil
 - ☐ Architecture
 - ☐ Mechanical
 - ☐ Electrical
 - ☐ Other (Please Specify): _____.

Section B: Organization Profile Information

This section contains questions seeking information related to your current organization.

Please select answer that fits your organization.

1. Your organization's size is (in terms of manpower):
 - ☐ Less than 100 employees.
 - ☐ From 100 to 200 employees.
 - ☐ From 200 to 500 employees.
 - ☐ 500 employees or more.

2. Annual revenue (in millions of SR):
 - ☐ Less than 20.
 - ☐ From 20 and less than 40.
 - ☐ From 40 and less than 80.
 - ☐ From 80 and less than 100.
 - ☐ 100 or more.

3. How long has your organization been in the construction business:
 - ☐ Less than 5 years.
 - ☐ From 5 to 10 years.
 - ☐ From 10 to 20 years.
 - ☐ From 20 to 30 years.
 - ☐ More than 30 years.

4. Location of firm's head office:
 - ☐ Dammam.
 - ☐ Khobar.
 - ☐ Jubail.
 - ☐ Dhahran.
 - ☐ Other (Please Specify): _____.

Section C: Communication Management Processes

The following is a list of potential communication practices in construction projects. You are kindly requested to measure the presence level of those practices in construction projects you were involved with by placing a tic (✓) in the five-point scale where “1” means “Extremely Low“, “2” means “Very Low“, “3” means “High“, “4” means “Very High“, and “5” means “Extremely High“.

Item number	Communication practices	Level of Presence				
		1	2	3	4	5
1	Communicating project objectives clearly.					
2	Distributing activities schedule.					
3	Clarify to team precedence relationships.					
4	Making time estimates in collaboration with team members.					
5	Involvement in determining resource requirements to meet objectives.					
6	Perform a situation analysis.					
7	Clarify the work evaluation process.					
8	Creation of feedback loops.					
9	The choice of proper media.					
10	Design of visual aids.					
11	incorporating the performance of the stakeholders					
12	Clear identification of performance parameters					
13	benchmarking					
14	Having a clear point of contact					
15	Agree on the definitions of the communication terms (e.g., done, in progress)					
16	Other(s), please specify and measure a. _____ b. _____ c. _____					

Section D: Communication Tools

The following is a list of potential communication tools that are used in construction projects. You are kindly requested to measure the level of application of these communication tools in the construction projects you have been involved with by placing a tic (✓) in the five point scale where “1” means “Extremely Low“, “2” means “Very Low“, “3” means “High“, “4” means “Very High“, and “5” means “Extremely High“.

Item number	Communication tools	Level of Application				
		1	2	3	4	5
1	face-to-face meetings					
2	Mobile phone calls communication					
3	Video calls communication					
4	Radio handheld transceiver					
5	Video live conferences					
6	Visual signs					
7	CAD Drawings					
8	Hand drawn sketches					
9	Letters					
10	Emails					
11	Instant Massaging (IM)					
12	Internal Network Communications					
13	Other(s), please specify and measure a. _____ b. _____ c. _____					

Section E: Barriers to Communications

The following is a list of potential barriers to proper communication in construction projects. You are kindly requested to measure the frequency of occurrence of these barriers to communication in construction projects by placing a tic (✓) in the three-point scale where “1” means “Very Low”, “2” means “High”, “3” means “Very High”.

You are also kindly requested to measure the level of impact of these barriers on communication in construction projects by placing a tic (✓) in the five point scale where “1” means “Insignificant“, “2” means “Minor“, “3” means “Moderate“, “4” means “Major“, and “5” means “Catastrophic“.

Impact Level					Barriers to Communications	Occurrence Frequency		
1	2	3	4	5		1	2	3
Sender related barriers								
					Inexperienced work causing misinterpretation			
					Poor lettering, making interpretation of writing difficult			
					Poor recording of items, rates, and bills of quantities			
					Varying capacity and capability			
					Lack necessary skills			
					Varying concept of time			
					Organizational mishap			
					Poor planning			
					Lack of confidence			
					Poor leadership			
					Personal preference			
					Poor negotiation skills			
Barriers related to the message								
					Poor or undetailed drawings			
					Physical noise, distance, time, environment, physical medium			
					Non-verbal, non-word messages			
					Insufficient technology			
					Unclear channels of communication			
					Ineffective reporting system			

					Unclear Objectives			
Receiver related barriers								
					Geographical differences			
					Fear of authority by junior staff, leading to mistakes			
					Inferiority complexes on the part of operatives can result in information being interpreted wrongly			
					Poor understanding of telephone messages.			
					Perceptual, viewing what is said from your own mind-set			
					Experiential, lack of similar experience			
					Personal feelings at the moment or doing other things besides listening			
					Misunderstood gestures			
					Community Conflicts			
					Different understanding / interpretation			
					Different cultural values			
					Lack of support and commitment			
					Language difficulties, different languages or vocabulary, accent, dialect			
					Interpersonal conflict			
					Age difference			
					Conflicting interest			
					Resisting change			
					Gender issues			
					Limited resources			
					Limited time			
					Lack of motivation			
					Information filtering			
					Religious issues			
					Poor Listeners			
					Family commitments			
					Conflicting business/industry ethics			
					Lack of concern			
					Lack of trust			

Thank you for your time, your participation in this questionnaire is valued and your responses are much appreciated.

Appendix B

Questionnaire Information

SECTION A: RESPONDENTS' INFORMATION

Name	Organization Name	E-mail Address	Mobile Number
Amin Abu Saa	Shade Corporation Limited	a.abusaa@shadeco.com	0599489025
Mohammad Al Hrogi	Top Summit Contracting Company	hrogi850@gmail.com	0544877800
khalid Al Saif	Saudi Hadaid Company	Khalid.saif@ideal-precast.com	0558111304
Bishoy Fakhry	Ibrahim Asmael General Contracting Establishment	bishoy@asmael.com	0509628784
Ibrahim Al Ramadan	Comatec - Al Rashed	ibrahim.alramadan@comatec.com.sa	0576319685
Emad Atia	Saudi Arabian Baytur Construction Company	emad.atia@baytur.com.sa	0537509369
Hossam Ali	Al-Hogail Contracting Company Limited	hossam_ali89@yahoo.com	0593332917
Marwan Dawood	Ideal Pre-Cast Company	marwandawood@ideal-precast.com	0562899500
Mohammed Al Mutiri	SRACO Company	al-maimony@hotmail.com	0553949994
Mahdi Abu Hatab	Al-Mira Center for Trading and Contracting Limited	mahdi@al-mira.com	0505873756
Asem Snoubar	Nesma and Partners Contracting Company Limited	asems@nesma.com	0590004408
George Bouassi	Al-Nobl Contracting Company	georgebouassi@alnobl.com.sa	0504443940
Hashem El Assir	Nesma and Partners Contracting Company Limited	hashem.lassir@nesma.com	0508378956
Abdullah Al Qahtani	Zamil Steel Pre-Engineered Buildings Company Limited	eng.a.a.q@hotmail.com	0557444040

Vitae

Name : Ahmad Malik Abusamha

Nationality : Jordanian

Date of Birth : 1st May 1994

Email : malikabusamha@hotmail.com

Address : Dhahran, Al-Olaya - 34447

Academic Background : Bachelor of Science in Civil and Environmental Engineering

Academic Research : Shash, A. A., Abusamha, A., Alshibani, A., & Hadidi, L. (2022). Communication Management and Challenges in Building Construction Projects in Saudi Arabia. *International Journal of Project Management*. (Under submission).

Due to his exceptional performance in his bachelor's degree, Ahmad has been awarded a fully funded scholarship by the Saudi government which covered his study of master's degree at King Fahad University of Petroleum and Minerals (KFUPM), the top engineering school in Middle East and North Africa. As he was construction enthusiast, he chose the field of civil and environmental engineering as his major in the bachelor. During the time of the degree, Ahmad developed a set of skills and a robust understanding of the structural engineering principles and techniques, including but not limited to reinforced concrete design, steel structures and computer aided design. Ahmad has an outstanding record of certificates in several computer related programs such as AutoCAD civil 3D, STAAD.pro. In his pursuit of master's degree, Ahmad studied construction engineering and

management. He worked in multiple projects that include analysis, resources allocation, planning and scheduling.