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Fragmentation challenges amongst construction professional members in South Africa

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A research report submitted to the Faculty of Engineering and
the Built Environment, University of the Witwatersrand, in partial fulfilment
of the requirements for the degree of Master of Science in Engineering.

Johannesburg, 2017

Declaration

I declare that this research report is my own unaided work. It is being submitted for the degree of Master of Science in Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

(Signature of Candidate)

(day) ..... (month) ..... (year) .....

Abstract

Construction fragmentation remains a major concern amongst construction professionals throughout project phases in South Africa. The report identifies fragmentation challenges in the context of integration, collaboration, communication and coordination encountered by professional teams in construction projects. It also investigates whether the intrinsic properties of the construction projects, namely the project size, clients, project locations and project delivery methods, contribute to fragmentation challenges experienced by the construction professionals. To accomplish this, the study employs mixed method research by using a qualitative tool to capture the raw data from the participants, and analysing the captured data quantitatively. While the results of the study are derived quantitatively, one could not quantitatively measure fragmentation on integration, collaboration, communication and coordination, i.e. the results did not translate to weighted fragmentation. However, there are subtle, but enlightening points from the survey that expose elements of fragmentation challenges faced by the professional team. While some of these challenges seem to lead to natural solutions, it appears most of them may be solved by implementing Building Information Modelling.

Keywords: Fragmentation, BIM, Integration, Collaboration, Communication, Coordination and Construction Professional

Dedication

I dedicate this research report to excellence.

Acknowledgements

My sincere gratitude goes to the following people who were instrumental in the success of my research work: My advisor Dr Nkululeko Nokwara for giving me the direction and the guidance to articulate my research report. My supervisors Prof Sam Laryea and Prof Adesola Ilemobade for their support and trust in me. My friend Lerato Maluleke for her tireless effort of listening and advising me. My Employer Sonwabo Mtshazo who gave me endless time to finish my research report

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List of Acronyms

BIM-Building Information Modeling
- CAD-Computer Aided Design
- CAD-Computer Aided Design
- CI-Construction Industry
- CIDB-Construction Industry Development Board
- CM@R-Construction Manager's at Risk
- CMM-Capacity Maturity Model
- DBB-Design Bid and Build
- DB-Design Build
- DID-Department of Infrastructure Development
- ECSA-Engineering Council of South Africa
- FIC-Facility Information Council
- ICT-Information Communication and Technology
- IDM-Information Delivery Model
- IDP-Integrated Project Delivery
- IDT-Independent Development Trust
- IFC- Industry Foundation Class
- MQS- Malaysian Quantity Surveyors
- MVD-Model Viewer Definition
- NBIMS-National Building Information Modeling Standard
- NIBS-National Institute of Building Science
- RIMS-Royal Institute of Quantity Surveying
- SACI- South African Construction Industry
- SACPCMP-South African Council of Project and Construction Management Profession
- SACQSP-South African Council of Quantity Surveying Profession
- SAIA-South African Institute of Architects
- UK-United Kingdom

Chapter 1

Introduction

The success of multi-disciplinary construction projects requires effective integration, collaboration, coordination and communication of construction professionals' attributes in order to alleviate the industry fragmented challenges and to achieve project deliverables. Many of these professional attributes are shared amongst construction professionals to integrate, collaborate, coordinate and communicate project processes and deliverables. There are various disciplines of construction professionals with complementary skills such as the architect, construction project manager, quantity surveyor, structural engineer, civil engineer, electrical and mechanical engineer. All these professionals are involved in providing professional services by managing construction projects through the construction professional team.

Despite having a well structured construction professional team to manage the project, the professional team members are considered highly fragmented in the services they offer to manage the construction project. Fragmentation within the construction professionals is described as the decoupling and sole separation of construction services and processes offered by the project team to meet the clients' deliverables [1]. Construction professional members offer their professional attributes which are often not well integrated. Activities and processes performed within the project are discrete with limited integration of data [2]. Various professional members are usually interested only in the skills they can offer, rather than integrating their skills with fellow team members. Every professional member involved in the project has sole overall control and ownership of his/her functions as required in the project to fulfill project duties and responsibilities [3]. In essence, professional attributes are not easily accessible.

Fragmentation within construction has been observed from different view points. Firstly, there seems to be disintegration of professional attributes resulting from the segregation of geographical locations of the professional team members. As already been mentioned, members of the professional team are segregated and localised in the services they offer [4]. Professionals, while executing their specialised functions, maintain sole ownership of their practices which tend to result in organisational boundaries on how construction design, knowledge and information are shared amongst involved individuals on a project [5]. In fact, certain project information and knowledge from various disciplines tend to be localised, buried and invested within a particular practice only [5]. This affects project information as the project starts to exemplify all the

challenges faced by that particular practice.

On the other hand, professional members focus more on the benefits they can get from the project since their sets of objectives are primarily organisation related and embedded within a specialized particular practice that enhances an individual of a particular practice only as opposed to the entire professional team. Moreover, a persistent traditional alignment of sequential processes carried by the professional team tends to arise. Basically, the architect completes the designs first before handing them over to other design team members. This process has been proved to be time consuming and costly as it does not synchronise with any revised design changes automatically [6]. Another concern is that of the constant change of professional members within a construction project, which has proved to compromise communication process [7].

Arguably, professional members are faced with challenges to integrate, collaborate, coordinate and communicate their attributes within the construction project. With evolution in technology, the Information Communication and Technology (ICT) sector has subsequently evolved and developed a wide range of tailor-made ICT tools. Tools such as 2D CAD, 3D CAD, 4D CAD, mobile data, GPS, document management system, project web and E-commerce were developed to enhance the application of technology in the construction industry [8]. The tools have been used mainly to improve data and information sharing amongst project participants, but they are very limited in integrating various disciplines involved in the construction project [9].

With continuous evolution of technology, Building Information Modeling[1] (BIM) found its way into the construction industry. There has been an increasing uptake of BIM in most developed countries that brought integrated project processes within the construction sector [10]. On the South African landscape, South African Construction Industry (SACI) is experiencing a paradigm shift, as it started to utilize (BIM) to integrate project processes between various stakeholders involved in construction projects and to deal with the industry fragmented challenges [11]. BIM has gained much recognition in the construction industry and seems to offer project integrated solutions that can alleviate fragmentation challenges, but only to those professionals that have implemented it in their practices and projects.

The National Building Information Modeling Standards (NBIMS) committee of USA defines BIM as a digital and intelligent model with distinct parametric features to represent the physical and functional characteristics of the facility [12]. It is described as a virtual model of a constructed facility, showing all functional elements of the facility as designed and integrated by the design team by consolidating all information of the project into one holistic model so that the stakeholders can query, simulate and make decisive actions of the facility [12]. In other words, BIM gives an individual a clear picture of the end product before it is constructed.

Despite BIM technology now being available in the SACI, construction professionals are still faced with fragmentation challenges to integrate, collaborate, coordinate and communicate their professional attributes. With evolving BIM tools that have been developed to offer potential benefits for construction processes, construction professionals still cannot exploit maximum ben-

[1] BIM will be explained in more detail in Sections 2.3-2.5.

efits of integrating, collaborating, coordinating and communicating their professional attributes.

There is still no standardised approach on how the members of the professional team integrate, collaborate, coordinate and communicate their attributes on a construction project in order to mitigate fragmentation challenges. In fact, the SACI is considered a late adaptor of Information Communication and Technology (ICT) tools such as BIM and hardly applies more advanced applications on construction projects [8]. The status quo of BIM usage in SACI is barely known. BIM is considered to be less advanced and more uneven in SACI[2]. BIM usage in the SACI is limited and not as effective and efficient as expected [13]. Construction fragmentation remains a major challenge to the construction industry. Therefore, this research aims to identify fragmentation challenges amongst the professional team members with regards to integration, collaboration, coordination and communication and identify applicable solutions deployed by the professionals to mitigate those fragmentation challenges in South Africa.

1.1 Context of the study

Construction professionals are faced with fragmentation challenges of integrating their professional attributes in construction projects. Fragmentation challenges have been largely discussed with respect to integration, collaboration, coordination and communication. Integration in a professional team happens when disciplines from all over different geographic locations come together to merge their attributes and methods into a single cohesive unit [14]. Collaboration in this context refers to the creativity and collective of members of the team interested in sharing information and facilitating knowledge amongst each other [15]. This is a process where the professionals utilise tools that will enable them to facilitate knowledge and information sharing [5]. While collaboration requires openness, honesty, trust and mutual respect amongst team members, it fosters team members to contribute, complement and develop suggestions from each other's tasks [15]. In a construction environment where the professional team is characterised by unfamiliar faces with temporary relationship for the duration of the project, the professional team must maintain its professionalism in perusing new ideas, solving problems, and proposing solutions and make decisions including understanding each other's roles in a project [16, 15].

The professional team needs to collaborate so that all the professional attributes can be well integrated. The professional team consists of a project manager or the principal agent who plays a coordination role by controlling and managing all activities so that all professionals are in one harmonious accord with the project process and activities, and that team members communicate the same language in a project [17]. While the team integrates, collaborates and coordinates their imputes, there is a process of communication involved through which information is transferred from one person to another. Communication within the construction professionals happen when information is shared through available media of instructions and the respective recepient reciprocate the information [18]. Communication in construction projects tends to be very diverse and complex as it involves professionals that are often segregated in their locations while aiming to interact with each other in an effort to transfer information. In addition, the tempo-

[2] Building Information Modeling Summit Africa, 2012.

rary and unique characteristic of the construction project often results with different professional team per new project. Hence projects tend to exhibit unfamiliarity of professional individuals which makes communication to be very complex and even difficult to maintain as individuals find themselves with little incentive to share and exchange information[18].

The professional members deal with fragmented relationships on various occasions throughout the project. Certain procurement methods such as design bid and build fragment the professional team-contractor relationship whereby the design phase is traditionally treated as a separate activity to the construction phase [4]. The contractor only becomes part of the project during the construction phase. This creates an adversarial relationship between the professional team and the contractor in that the contractor may later want to prove that the exclusion of his/her early involvement may to some extent compromised the design to have the expert knowledge of the contractor during the design stage [19].

Fragmentation also exists on the consultant and sub contractor parties. Once the team expects intense production which may require specialized skills that is beyond the contractor's knowledge, the case tend to involve time lost to acquire the exact specialized skills [1]. The point here is that construction skills are dispersed in various locations and there has to be a link in a form of a project team and processes to integrate professional attributes. Given the fact that specialized knowledge of a particular discipline is embodied in a particular organisation means that project knowledge and information is accumulated in the experiences and the know-how of particular professionals. These also include both the technologies and operative methods used, which may necessarily work for a particular firm only. Another challenge faced by construction professionals is that each of the professional has working principles ingrained within by their working practices, which often cause transformation barriers for collaborating purposes [20].

The alleged fragmentation has contributed to the industry both negatively and positively in that as much as fragmentation diminishes the production capacity of the industry, it also fosters the industry to focus on looking into and adapts some integrated construction technologies to deliver projects. On the contrary, fragmentation has led the industry to be such a late adaptor of more integrated construction methods and hardly applies the available latest technology to meet the demands of the industry [8]. Inevitably, for the construction industry to be client oriented in a fragmented state, the demand side of the professional team requires immense integration of communication and information sharing to manage the construction project [21]. The ever-increasing complex scope of construction projects and emerging new trends in technology put the industry under immense pressure to maintain high standards of being client oriented and competitive through its emerging and work changing practices [22].

The concept of utilising BIM is viewed as the best strategy and technique to provide efficient communication and information on construction projects. Reading from[23] citing The Business Value for BIM; The McGraw Hill Report defines BIM as the process of developing and advancing the use of digital models for designing, constructing and operating through the life cycle of construction project. BIM is an advanced 3D virtual building model digitally built to contain all aspects of building information. BIM represents real building virtuals over the whole life cycle of the facility, carrying all information related to the building including its physical and func-

tional characteristics [10]. The use of BIM encompasses specific benefits that can aid to improve communication, coordination and collaboration, thereby improving the collective understanding of design client (Building Information Modeling Summit Africa, 2012). The collaboration characteristic of BIM enables individuals to work together as a team towards developing a successful project by bringing the contribution of project designers and building professionals into a single synchronised building model rich of information.

The study conducted by [24] on construction projects in remote areas identified discrete locations of construction professionals as a major concern for collaborated decision making in relation to the management of project processes. In this study, the use of BIM offered efficient and effective project management from a digital visual perspective as it afforded the professionals the opportunities to design, query and manage the construction processes in an integrated way. BIM with its digital features provided the stakeholders with building virtuals in order to behold the end product of the facility before it was built. BIM maintained effective collaboration and coordination between stakeholders. It was considered as a panacea for curbing the interdisciplinary inefficiency of construction projects brought by fragmentation [24]. However, BIM benefits are only realized by those professionals who have implemented BIM on their practices and on a project level. BIM has some specific features that can effectively manage integration, collaboration, communication and coordination processes of construction project that are hampered by fragmentation [25].

The professionals who have deployed the use of BIM in their practices or on a project level seem to have a good story to tell about BIM experiences. The reality in South Africa is that BIM is seldom used on construction projects [13].Its application is limited to large complex projects and to only few professionals who advocate its usage on construction projects [11]. While fragmentation remains a challenge amongst construction professionals to integrate their professional attributes, the report aims to identify fragmentation challenges amongst the professional team members with regards to integration, collaboration, coordination and communication and identify applicable solutions deployed by the professionals to mitigate those fragmentation. In addition, the report reviews existing literature on BIM with an aim to suggest opportunities BIM tools provide to professionals to attain greater integration, collaboration, coordination and communication on construction projects.

1.2 Problem Statement

Despite BIM technology now being available in the SACI, construction professionals are still faced with fragmentation challenges to integrate, collaborate, coordinate and communicate their professional attributes. With evolving BIM tools that have been developed to offer potential benefits for construction processes, construction professionals still cannot exploit maximum benefits of integrating, collaborating, coordinating and communicating their professional attributes. There is still no a standardized approach on how the construction professionals integrate, collaborate, coordinate and communicate their attributes on a construction project in order to mitigate fragmentation challenges. This could be that professionals use technology tools that

are outdated and that are not aligned with current integrated technology trends. Perhaps the recent trending technology tools require extensive knowledge and intellectual skills to operate or are even costly.

Fragmentation, if not well managed can lead to lack of integration, coordination and inadequate collaboration between professional team members which subsequently lead to inadequate capture, structuring, prioritization and implementation of clients' needs. This ultimately impairs design intent rationale, leading to unnecessary design changes and liability claims. Consequently, true analytical data of the project life cycle is compromised in this regard [4]. All the above mentioned problems put pressure on project scope, time and cost, resulting with insufficient pre and post design specifications [26]. This ultimately results with project termination and some dispute resolution claims. All these challenges embodied in the nature of fragmentation contribute to the professionals being pessimistic in the way the industry is adopting and implementing new regulations that call for the latest construction technologies to deal with the complexity of construction projects.

Fragmentation remains a major challenge amongst construction professionals even though there are integrated technology tools such as BIM to enable professionals to integrate their professional attributes effectively. Given the fragmentation challenges that inter alia include segregated professional team, localised project information, misconfiguration of specialised knowledge and discrete construction process; the SACI is considered a late adaptor of ICT tools such as BIM and hardly applies more advanced applications on construction projects [8]. In fact, the status quo of BIM usage in SACI is barely known. BIM is available and ready for adoption yet fragmentation is thriving amongst the construction professional members.

1.3 Research Questions

- What are the challenges brought about by fragmentation on construction professional team members in the context of integration, collaboration, communication and coordination?
- Do the intrinsic properties of the construction projects, i.e project size, clients, project locations and project delivery method contribute to fragmentation challenges experienced by the professional team?

1.4 Research Aim

The study aims to identify fragmentation challenges concerning integration, collaboration, coordination and communication encountered by professional teams in a construction project and to describe a thematic framework emerging from the observed fragmentation challenges among professional team members regarding integration, collaboration, communication and coordination during the construction projects.

1.5 Research Objectives

- To investigate and identify challenges professional team members encounter with respect to fragmentation issues around integration, collaboration, coordination and communication.
- To find out whether the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals. .

1.6 Scope of the study

The scope of the report focuses on investigating fragmentation challenges faced by construction professionals on construction projects. Part of fragmentation investigation is to outline the extent to which fragmentation affects professional teams on integration, collaboration, coordination and communication of professional attributes. The report also gives records of possible solutions the construction professionals may have identified and have acted upon to mitigate the prevailing fragmentation challenges. Building Information Modeling (BIM) is one suggested tool brought and explored further in the study to find out if it can provide opportunities to alleviate fragmentation challenges.

The population that was studied in this study is professionals within construction projects and the data collection is limited to Gauteng Province. The reason to limit the study to construction professionals is that fragmentation problem originate at the beginning phase of construction life cycle (which is planning in this instance). It is during planning phase of the construction project where the construction professionals come together to form a professional team. Therefore, the problem of fragmentation can be traced, followed and dealt best with by the professional team from the initial phase of the project.

Secondly, Gauteng Province recorded an annual economic growth rate of 1.2% during 2013, and was on top of the list in the entire South Africa. The budget was valued at R811 billion of which 33.9% contributed to South Africa's GDP [27]. This provides an enormous access to construction industry data beneficial to the study with opportunities for case studies on big projects that have experienced greater fragmentation challenges during project planning and execution.

1.7 Structure of the Report

Chapter 1: Introduction

Chapter 1 presents the introduction, context of the study and an overview of the problem statement, aims and objectives, research questions and scope of the study.

Chapter 2: Critical review of literature

This chapter reviews relevant journals and documentations concerning challenges around fragmentation, which include integration, collaboration, coordination, communication and also reviews Building Information Model (BIM) on its design, applications and implementation.

Chapter 3: Research design and methods

Potential methods for carrying out the study are first examined and used as a basis to identify an appropriate method for the study.

Chapter 4: Data Collection and presentation

Chapter 4 presents the data collected and presented by means of interviews. It categorises the interviews into four sections. Each section is given a heading and a definition before respondents were requested to give their views on questions asked per section.

Chapter 5: Analysis and results

Chapter five interprets and analyse the results. Content analysis was employed to analyse the results. The method involved the use of transcripts and coding to interpret interviews responds into short phrases.

Chapter 6: Discussion of results

Chapter six discusses the results made from interviews.

Chapter 7: Conclusions and recommendations

Chapter seven concludes on results made and give recommendations to the study.

1.8 Ethics of the study

The study attempted to apply the relevant procedure of ethics as set out and guided by the University of the Witwatersrand. Care was taken to ensure a complete voluntary participation for all respondents. Prior to data collection, informed consent of each participant was undertaken to ensure respondents have a clear understanding of the risks and procedures (if any) that may exist in undertaking the study. Furthermore, the study guaranteed participants confidentiality and anonymity in all aspects of collecting, interpreting, analysing and discussing findings from data.

Chapter 2

Review of Literature

This chapter firstly reviews fragmentation in the construction industry with the focus directed at the construction professional team. It reviews construction fragmentation literature which inter alia covers the definition of fragmentation in the construction professional domain, fragmentation challenges from professionals' view, professional-contractor fragmented relationship, project based fragmentation and construction processes on integration, collaboration, coordination and communication of professional attributes. This report considers fragmentation definition most important as it sets the tone of the extent of fragmentation phenomenon as dealt in the report. Fragmentation is a broad term, but for the purpose of the study, it is limited to the discussions contained in the study.

Secondly, this chapter reviews Building Information Modelling (BIM) in the construction industry. As such, it gives a broad view of the definition of BIM and narrows it down to BIM construction life cycle. The chapter takes further steps and reviews the notion of adopting and implementing BIM. It explains how BIM works with project delivery methods and professional contractual arrangements. Case studies of international projects that adopted and used BIM are also reviewed. It should be noted that South African Construction Industry (SACI) have limited literature that exists on BIM. Therefore, the international BIM literature was opted for review. Lastly, the report brings together fragmentation and BIM crucial elements of literature to conclusion.

2.1 Fragmentation in the construction industry

Fragmentation amongst construction professionals as defined by [1] refers to decoupling and the sole separation of construction services and processes from the project team to meet the clients' deliverables. [3] explains fragmentation as a condition whereby the construction professionals that are involved in the project have sole overall control and ownership of their functions as required in the project to fulfill construction project processes. The functions and services reside solely within their professional practices with different management style for each practice [3].

Fragmentation, as largely discussed by various researchers, poses major concerns in the

way the construction professionals integrate, collaborate, coordinate and communicate their professional imputes to manage construction projects. [28] discusses the fragmented nature of construction to be an ad-hoc base where each project is essentially a model of a facility to be constructed. Professional teams focus on the by-product of a particular unique building facility that is produced only once [29]. [1] describes the construction industry to be fragmented in nature as the projects are client dependent and often result in iterations in the design phase which bring uncertainty on the professional team to integrate, collaborate, coordinate and communicate their imputes in a timely manner.

Although construction projects are similar in processes, they are unique in implementation and execution [4]. While the knowledge of the past projects though may be valuable for use, it does not take away challenges of ongoing projects. The professional team traditionally deduces the project knowledge based on some unique projects that can only be executed once [29]. Projects may be of a similar kind, but project challenges vary from project to project. The existing fragmentation as observed within the construction professional team spectrum has been found to be one of the major reasons for the (SACI) to be inefficient in terms of adopting the latest construction technologies [13].

2.1.1 Fragmentation amongst construction professionals

Fragmentation is also observed around construction professionals in that as they come together to form professional teams, they are segregated and localised in the services they offer [4]. The information and knowledge used by the professionals is localised, as it is embedded and invested within a particular practice [5]. This may raise concerns on how the professional team integrates, collaborates, coordinates and communicates its professional attributes within itself in order to offer a desired professional service to the client. [30] describes the services offered by the construction professionals as a discrete process rendered with only limited integration of data or information which ultimately makes collaboration and cooperation difficult processes to manage as far as project management is concerned [30]. This means that professional members execute their mandates solely within their practice and sometimes without the concerns or comments of other professional members in a project.

A continuous and constant change of professional team members puts great pressure on the team. The professional team is faced with challenges of managing the ever increasing scope change of work , professional identity whilst aligning itself with the emerging new trends in technology. Construction professionals still have to maintain high standards of being client oriented and competitive through emerging and work changing practices [22].

The construction professionals have contributed to their fragmentation as there tends to be a constant change of professional team members during project execution [7]. Professionals are forever looking for better opportunities and therefore, tend to move from one professional practice to another. The existing team structure must immediately accommodate new members. This results with unfamiliarity of faces and lack of trust amongst team members. Project information and knowledge tends to suffer in this regard as the project knowledge diminishes in content as it is taken away by the former team members [31].

On the other side, the same professional team members have to create time for other projects by moving between projects in order to tackle and solve issues of other projects. This affects the availability of tools and techniques used to share information as professionals become barely available nor accessible. Once the professional members become barely available nor accessible, the results is adversarial relationships among professional team members. The latter have contributed to lack of trust and tools to share information among professional team [31]. As a result, construction professionals are exposed to greater communication difficulties to share information among project participants [7].

2.1.2 Professional team-contractor fragmented relationship

Notably, there is also fragmented relationship between the professional team and the contractor, which is exacerbated by some construction procurement methods such as design bid and builds whereby the design phase is treated separately from the rest of the construction phase [4]. One effect of this is the adversarial relationship between the professional team and the contractor, which deprives the construction project of expert contractor knowledge during the design stage [19]. The other level of fragmentation that exists is that of specialized skills that is beyond either contractor's skills and requires the specialised contractors, which results in time lost to acquire such skills and to integrate such special design skills into the overall design.

2.1.3 Project-based fragmentation

Construction projects though similar in processes, are applied on unique projects which are once off and are accompanied by a new professional team members per project [4]. Certain project phases such as design phase is traditionally treated as separate activity to the construction phase [32]. Basically, the phases are sequential which is exemplified in the fact architectural designs are first developed , then passed them to the designed engineers to fill in their scope and lastly to the quantity surveyor for costing [6]. This process proved to be time consuming and costly as it does not synchronises any revised design changes automatically. In fact, sections of work are defined within individuals objectives which is often in conflict with other team members [32]. Success of the project is defined in terms of the individual achievements other than the entire professional team . Thus construction projects does not fully benefit from collective efforts of team members [32].

Some professional team members are selected based on their technical and managerial soundness of professional expertise which does not embrace or regard integration as compliance to the selection process. The same applies to the selection of main contractor [32]. This is a result that some traditional project procurement methods do not exhibit integration process which results with project team that are hostile [32].

2.1.4 Professional team-client fragmented relationship

[1] indicated that fragmentation in construction projects is also exacerbated by the fact that while the client may have no professional expertise on the projects, he/she still has a superior

say which affects decision making on project deliverables. In certain instances, the client may request design changes, and this may raise costs considerably depending on the project stage. While the client has the right to give instructions as to how the final product should appear, the timing of such instructions is important given the that design changes are more costly in the late stages of the project than the earlier stages [33].

In an effort to reform from exorbitant fragmentation processes to more integrated project processes, the professional team must find ways to strengthen project processes such as integration, collaboration, coordination and communication throughout the project. All these issues relating to fragmentation of the construction professionals proved to have contributed negatively into the construction industry especially when compared to other industries that are far ahead in the use of the latest technology to improve their productivity [5]. Fragmentation has been criticized as an extreme barrier to new change in the construction industry. It has derailed the construction industry to lag behind in adopting latest construction technology, which could have positively contributed to greater integration, collaboration, communication and coordination [13].

2.2 Construction project processes

This section of the report reviews four processes of integration, collaboration, coordination and communication. Given fragmentation challenges that construction professionals experience throughout the project, construction professionals must remain client oriented and meet project deliverables by providing their professional services. This requires their professional attributes to be integrated, collaborated, coordinated and communicated amongst each other within the project. What follows is the full description of integration, collaboration, coordination and communication as required within the construction project.

2.2.1 Integration

Integration merges different disciplines that have separate organisational culture, goals and needs into a single unified supporting unit [34]. In essence, integration demands that all professionals who are supposed to work together must come under an umbrella of oneness in sharing their attributes and be of one defined culture, aim and recognition in order to achieve integrated project goals. Integration ought to promote a unified working environment where sharing, access and exchange of information is free and available to all the disciplines involved in the project [32]. In a construction industry, integration is described as a process whereby various disciplines from all over different geographic locations come together to merge their attributes or methods into a single cohesive unit [14].

During the process of integration, professional team members are fostered to amalgamate their attributes and methods with existing project processes and activities into an integral whole to share, exchange and transfer information among team members in an open and efficient manner [14]. During integration construction professionals are unified within a project as a single entity of professional team. It is within this professional team that the professional attributes are integrated in order to achieve project goals. The term professional attributes

refers to those core skills each professional is to exhibit or contribute towards the success of construction projects [32]. In order for a project to achieve greater integration, there should be collaborative working practices, methods and behaviours that allows free accessibility and availability of information amongst professional team members [32].

[32] with the assistance of other researcher's work afforded to construct the table below which categorised integration into full integration, partial integration and nil integration. The table assisted the researcher to ascertain the extent to which the project team can describe itself to be integrated. Table 2.1, adapted from [32], depicts categories that align with integration from nil integration achievement to full integration achievement.

2.2.2 Collaboration

Collaboration is a creative and collective process undertaken by more than one individual or rather members of the team that are interested in sharing their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust, and mutual respect. Collaboration requires the professional team members to cohesively deliver best solutions that are harmonious to project goals and requirements that aim to satisfy the needs of the end user [15]. While the construction project is made up of construction processes which require different professionals to render their services, where required, professionals need to assume a complementary role in the service they offer and cooperatively work together to share responsibility, solve problems, propose solutions and make decisions on behalf of the project. Through collaboration, professional team members should become aware of each other's type of knowledge and skills and exploit such knowledge and skills for better decision-making [35].

With collaboration processes described above, four key elements are noteworthy namely:

- all members of the team in the project are to familiarize themselves, be honest and possess mutual trust and respect for one another;
- all members are to contribute, complement and develop suggestions from each other's tasks;
- all collective members are to pursue new ideas, solve problems, propose solutions and make decisions for the best of the project;
- all collective members are to be knowledgeable about each other's role or tasks in the project.

2.2.3 Communication

Communication is a means through which information is transferred from one person to another [18]. Information in the context of construction projects, inter alia, includes sharing knowledge, processed data, skills and technology [18]. Various professionals in a construction project make communication to be very diverse and complex as professionals are often segregated in their practices while aiming to interact with each other in an effort to transfer information [18].

Table 2.1: Evidence of integration practices

Examples		Full achievement	Partial achievement (O)	No achievement (X)
A	Single team focus and objectives	All members have the same focus and work together towards team objectives	Members pursue individual objectives but in line with the overall project objectives	Individually pursued objectives by members without regard or in isolation to others and project objectives.
B	Seamless operation with no organisational defined boundaries	Members form a new single project team with no individual member identity or boundaries	Members operate as individuals but make efforts to collaborate with others on the project	Continued alignment and affiliation to individual organisations that make up the project team
C	Mutually beneficial outcomes	Pursuance and attainment of project goals that benefits all members	Attainment of project goals in conjunction with other members whose involvement are necessary	Individually defined project objectives without compromise or consideration to others needs
D	Increased time and cost predictability	Openly accessible design and construction cost information gathering and managemen	Systematic follow up of design and construction cost information	Disjointed design and construction costs information gathering and application
E	Unrestricted cross-sharing of information	Availability and access to all project information to all parties involved in the project	Access to project information by a section or sections of the project team	Project information only available to members with responsibility for the section of work
F	Team flexibility and responsiveness to change	Requisite personnel join and leave the project team as their skills are no longer required or are needed	Retention of members no longer required and trained to adopt new requirements	Use of the same project team members even when they had outlived their effectiveness
G	Creation of single and colocated team	A single project team with all members located together in a common office	Individually operated sub-teams but co-located within a single office environment	Individually located and operated teams
H	Equal opportunity for project inputs	Consultation of members for contribution at all phases of project before decisions are made	Contributions are welcomed but not explicitly invited from members in making decision on the project	Little attempt to consult members in key project decisionmaking processes
I	Equitable team relationships and respect for all	All members are treated as having equal and significant professional capability needed on the project	Recognition of professional competence, but mainly in their respective field of expertise	Team members contribution restricted to their functional project role
J	No blame culture	Collective identification and resolution of problems. Collective responsibility for all project outcomes	Cooperation of team members in resolving problems, but with ultimate responsibility resting with a single party	Individual members are singled out for problems that occur on the project and for undertaking corrective measures

This may affect the professional team on how they share their knowledge and communicate information around the team.

Communication within the professional team context may involve conveying an instruction, exchanging or requesting information when it is needed or responding to a specific request [14]. There are various tools used by professionals to convey their information, which include direct speech, writing, graphical, electronic media and/or even the combination of these forms [18]. These forms of tools assist professional individuals to channel information to the right person at the right time to achieve effective communication and attain greater coordination [14].

In achieving an effective communication, a two way process is expected to take place whereby the sender of the information convey information and the transmitter is expected to give feedback about the information [18]. Construction projects are temporary in nature and unique, with new sets of professional teams per project that exhibit unfamiliarity of professional individuals. As a result, communication tends to be complex and even difficult to maintain as individuals find themselves with little incentive to share knowledge or methodologies.

The four key elements about construction communications are as follows:

- segregation and different geographical locations of professional team negatively affect professional team to share knowledge or methodology in an open manner;
- all members of a team are to contribute, complement and develop suggestions from each other's tasks. Team members may convey instructions, exchange or request for information using available media of communication;
- there are various tools used by professionals to convey information within a project, with the aim of channeling information to the right person at the right time;
- Because of a lack of familiarity among professional individuals in a construction project, professionals find themselves with little incentive to share knowledge or methodologies for effective communication.

2.2.4 Coordination

Coordination is defined as a process to control and link various parts of responsibilities together with an effort to accomplish a set of collective activities [17]. Coordination between professional team members fosters individuals to bring together their sets of responsibilities to develop collective sets of activities which can be controlled, managed and operated within a team. In simple terms, construction professionals combine their roles and responsibilities into a collective set of tasks, and a control mechanism is set to manage those tasks [17].

Coordination ensures active role of information sharing as it directs professional team members to be in one accord in terms of improving the quality of information and reducing duplicate information exchange [17]. In a professional team context, coordination functions to manage different activities of each professional and assume supervisory role on all professionals towards project success [17]. When the construction professionals are willing to coordinate by working

together and sharing information among themselves, their efforts enhance greater performance on project activities.

However, for the professional team to achieve greater integration, collaboration, communication and coordination, some researchers purposefully suggested BIM to be a solution to most industry-fragmented problems. BIM have changed construction industry from fragmented to an integrated industry [6] and [29]. One aspect of construction professional team is that the team requires effective collaboration and coordination and effective communication between all individuals who are to contribute to the success of the project [2]. The need to understand the use of BIM becomes inevitable as is it was declared a collaborative and communication tool for extensive integration of construction projects [2].

2.3 BIM developments and current applications

The use of BIM for construction life cycle can catalyse calcified processes brought by fragmentation and move the industry towards new approaches or paradigm shift of technological construction era [29]. The use of BIM in construction project is viewed as the appropriate digital and virtual technology that can provide integrated project solutions. It is suggested and considered the latest technology to maintain effective collaboration and coordination between stakeholders, curbing the interdisciplinary inefficiency of construction project caused by fragmentation [24].

With the ever increasing scope change of construction projects and emerging new trends in technology, the construction industry is faced with challenges to evolve project management techniques and tools that can fully exploit the potentials of BIM [23]. From BIM developers, vendors and researchers' perspectives, BIM tools have for some time now been made available, but there is a lack of urge for construction practitioners to take a step forward to adopt and implement BIM in their respective practices [36]. Observations made by [37] on the lack of BIM adoption within the construction industry goes as far as involving social and cultural implications which in Lorch's view, BIM does not seem to cater. Construction companies that have adopted and implemented BIM notably convey the issues associated with social and cultural implications of BIM [38].

Furthermore, (buildingSMART UK, 2010) expressed that ever since the construction industry adopted BIM, there were never clear methodologies developed to examine the potential contributions of BIM to construction projects. Moreover, the organisations practising in the construction industry consider BIM as not being clearly defined and analysed in terms of its desirable potential (buildingSMART UK, 2010). For the construction industry to realise the potential benefits of BIM, there must be mass proportion of organisations willing to participate in BIM investments [2].

The BIM oriented benefits and challenges as discussed in various research papers show a greater concern on the lack of in-depth knowledge on the adoption and implementation of BIM [9]. This brings about a lack of incentives to adopt BIM in many construction practices as practitioners perceive BIM as too demanding in terms of expert knowledge and investment [38].

The construction industry has to undergo a paradigm shift to be able to deal with more complex issues that not only caters for service delivery but also in the way the industry uptake evolving technologies that aim to sort out industry fragmented issues and to keep up with constant changes experienced in this rapid changing world.

On an organisational level, the paradigm shift requires companies to examine their operational and managerial business process to make BIM fit for adoption and implementation purposes. This is because the uptake of BIM presents a radical change as it creates a need for construction practices to improve on the capacity for greater integration, collaboration, effective business process, real time response and many more [38].

The purpose of BIM as a new technology trend is to transform the construction industry by enabling construction professionals to participate in virtual design and construction, with a clear mission of achieving abundant collaboration, coordination and communication during execution of construction projects [39]. Therefore, it is imperative to acquire more in-depth knowledge on the nature of BIM with regards to its adoption within the context of South African Construction Industry (SACI). In addition, there is an urge to look into the investment aspect of BIM with respect to construction professional practices. Observation made on the use of BIM suggests that BIM is beneficial to all professionals, contractors and suppliers for exchanging information of the proposed construction design, which results in accelerated communication amongst the project team [37].

If BIM is not well understood or rather its implementation cannot clearly address potential benefits of current and future projects in an investment context, the level of usage of BIM will remain low. Construction practices will find it difficult to invest in BIM while there is too much ambiguity on the potential benefits BIM can offer. Without proper advancements of adopting and implementing BIM for investment purposes, professional practices will be exposed to defective collaboration and coordination. Communication within the project participants will remain poor. Inevitably, professional team will be faced with challenges in developing proper communication systems to ensure timeous and appropriate generation, collection, distribution, storage, retrieval, and ultimate dissemination of project information [40].

If BIM can integrate the interdisciplinary inefficiency of construction process, then one should be able to answer and have an understanding of the following questions:

1. What really is BIM?
2. What is it about BIM that creates a paradigm shift for construction stakeholders to adopt and implement it?
3. How is BIM integrated by construction professionals' on construction project?
4. What are BIM limitations, prospects and challenges with regard to the existing approach methods of project delivery?
5. How is BIM being employed into the standard form of professionals' contractual arrangements?

The study will first attempt to answer these questions, before delving into other BIM related issues. BIM is reviewed in relation to its integrated characteristics, adoption and barriers to understand its use for alleviating fragmentation and its diffusion throughout organisational spectrum of construction professionals.

2.3.1 BIM Definition

BIM is a technology that is based on graphical information model [41], hence it is defined as a standardized machine and a readable information model which is able to portray and present visual processes concerning planning, design, construction, operation and maintenance of a facility [12]. It is a digital representation of the physical and functional characteristics of a facility; a shared knowledge resource for information about a facility, forming a reliable basis for decision making on pre and post construction [19].

In laymen terms, BIM can be described as a virtual model of a constructed facility, showing all functional elements of the facility as designed and integrated by the design team by consolidating all information of the project into one holistic model so that the stakeholders can query, simulate and make decisive actions of the facility. It gives an individual a clear picture of the end product before it is constructed.

BIM is fully exploited when it is shared amongst project participants so that designers can integrate their designs before converting them to 3D view through the use of BIM authoring tools [19]. BIM also requires project team to be expertise of BIM tools so that the project can be modelled in detail, scrapping out all ambiguities [33]. BIM becomes a collaborative approach of managing construction projects as it amalgamates the discrete process of construction activities in that it fosters the project team especially the designers to cooperate in designing construction model.

2.3.1.1 Evolution of Building Information Model

The need to create construction industry information value chain brought about the ultimate evolution of BIM. Figure 2.1 illustrates how BIM evolve from Computer Aided Design (CAD) systems to BIM tools.

2.3.1.2 Characteristics of BIM

The characteristics of BIM as stipulated by [10] are summarised in the following manner:

- Building components are represented with digital objects.
- Building components of carry computable graphic data, and can also exchange data to identify parametric rules and software applications.
- Building components include data that describe the behavioural components of objects for analysis and for work process
- Data is consistent and non-redundant, which represents the overall unchanged components and the changes to components in all views

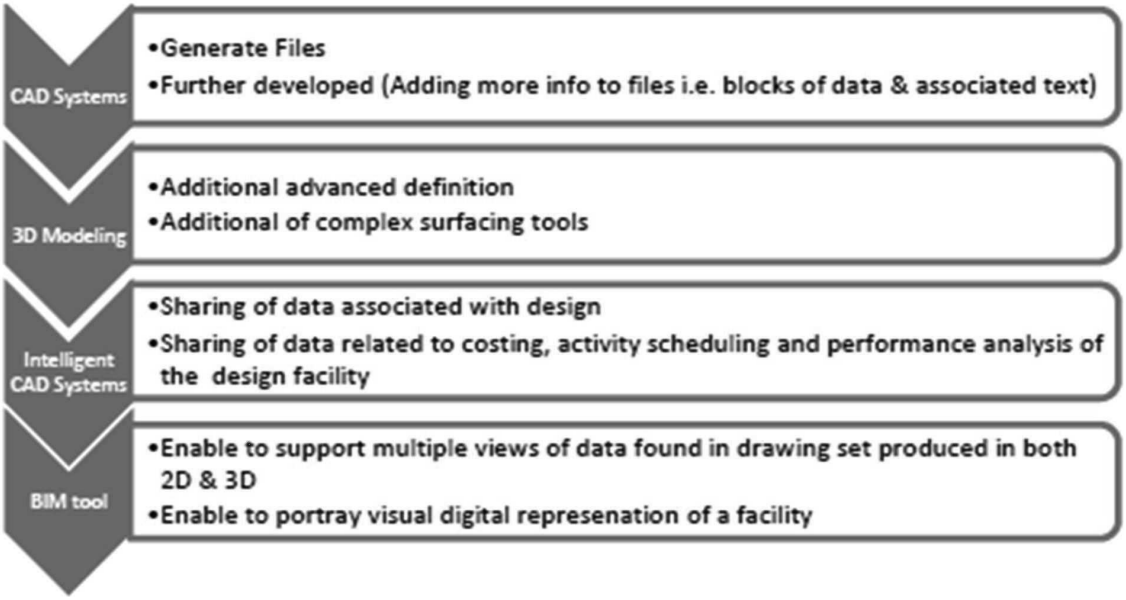


Figure 2.1: The evolution of BIM from CAD system

- The coordinated data is represented in all views in a coordinated way

2.3.1.3 Parametric objects

For BIM to represent and analyse the coordinated data of a building facility in 3D view, it makes use of parametric objects which gives BIM a distinct character from other 3D objects. [10] describes the parametric objects of BIM in the following manner:

- Consists of geometric definitions and associated data and rules
- Geometry is integrated non-redundantly; allows for no inconsistency (e.g. shape of object shown in 3D cannot be represented internally redundant) and always consistent: dimension cannot be fudged.
- Parametric rules for objects automatically modify associated geometries in that when changes are made to an associated object, there is an auto resize of the object itself.
- Objects can be defined at different level of aggregation and managed at any number of hierarchy levels (e.g. if weight of a wall sub-component changes, the weight of a wall should also change).
- Objects rules can identify when a particular change violates objects feasibility regarding size, manufacturability etc.
- Objects have the ability to link or receive, broadcast or exports sets of attributes (e.g. structural materials, acoustic data etc.).

Parametric design is the key feature of BIM and defines objects as parameters with relationships to other projects, automatically updating BIM model as parametric objects are being modified; BIM is largely limited in this regard depending on the level of geometry data detailed in the Industry Foundation Class (IFC) specification. This IFC specification forms the basis of BIM standards (Shen and Chuan, 2011).

2.3.1.4 BIM standards

BIM facilitates collaboration between individuals who are frequently involved in the same project but different geographic places and whom their common interest towards the project is the same [42]. BIM standard becomes a very important key feature of BIM, enabling all relevant data to be captured in the BIM model and to ensure a successful information transfer [43]. Parametric designs built-in within BIM model are defined by the Industry Foundation Class (IFC) specification [36]. The definition of BIM as a standardized readable machine model accounted BIM model to exhibit the interoperability role, thus making BIM model to be aware of other models by collectively, semantically and technically allowing BIM to interoperate with other models. The main objective of BIM standards is to improve productivity in project design and construction phases by incorporating, integrating and coordinating various professional designs, analysis tools etc., for construction project sake.

A BIM standard is centred on the implementation of IFC. The IFC is primarily used to exchange data between parametric modelling softwares. The IFC model came about implementing and testing specifications that were procedurally developed through the use of Information Delivery Model (IDM) and translating the specifications for software application through Model Viewer Definition (MVD) [43]. The impact of IDM, MVD and IFC processes in the construction of a project is the role the three processes play in the exchange of data. The level of details and the depth of exchange requirements to which IDM is required to generate MDV will dictate the level of standard and guideline on how IFC model will be shaped. In simple terms, IDM provides a descriptive foundation of the building construction process and requirements for information transfer which ultimately brings about the level of detail of IFC model [43].

There are some major challenges faced with the use of BIM standards in the application of BIM. Major findings emerged that IFC's standards are very complicated and not well understood and the lack of ability to understand IFC significance causes a delay in the deployment of BIM [36]. The main aim to discuss BIM characteristics and its parametric objects is to unravel other aspects of BIM which differentiate BIM from other construction models, making BIM a fact-base, repeatable and verifiable model that reduces construction life cycle risks and enhance the quality of construction process and building life cycle throughout industry-wide [10]. The definition of BIM, BIM characteristics and standards aim to give a contemporary view about BIM.

2.3.2 The notion of adopting and implementing BIM

The paradigm shift in the construction industry is brought about the need for the industry to offer efficient service for the delivery of infrastructure within outstanding quality, allowed budget

and constrains time frames. BIM aims to curb the construction professionals and end users' challenges by eradicating huge amount of life cycle costs, lead times, design duplications and inadequate information transfer throughout the project life cycle [38]. BIM project stakeholders are to derive real benefits of BIM by being offered high quality standard of 2D deliverables in that project professional team operates on a detailed 3D coordination to achieve 2D deliverables of high quality standard [33].

Also a need to move from paper-eccentric construction process (i.e. 2D and 3D CAD drawings) towards an integrated and interoperable work flow where construction project life cycle is coordinated in an intelligent digital way to maximise construction technology is another shift for the industry to uptake BIM [10]. The aim is to bring about sustainability of the end product offered, making BIM a new outlook of shaping construction processes through BIM objects oriented tools, functional capabilities and integrative process [36].

2.3.3 The integration of BIM with stages of construction life cycle

The integration of BIM with stages of construction life cycle is illustrated through MacLeamy's curve as cited by [33]. The assessment made on MacLeamy's curve addresses how the curve is been used to outline the benefits and effects of BIM in the building industry and how the curve received attention from various construction stakeholders of promoting the use of BIM. Figure 2.2 is a demonstration of how changes in time can impact the effort of professional team and how their effect will impact design and construction costs

The project timeline is shown on the horizontal axis, while effort/effect is shown on the vertical axis. In terms of the effort/effect axis, the traditional process put more effort on design when design changes are gradually increasing and becoming relatively costly. The preferred design process advocates greater design efforts in the early stage of design where the effect of design change on costs is minimal. This is depicted in the first dotted line which shows that the earlier pre and schematic design are done, the greater ability to impact costs and functional capabilities.

As time progress and the project is moving from one stage to another, preferred design process requires greater level of effort/effect from the design professionals to develop and finalise designs before construction documentation start as the cost to make changes become significantly high. This is illustrated in second dotted line that as other designs becomes more rigid, the costs rise significantly as the challenges become greater to alter the detailed designs. However, this is not the case for traditional process as depicted on the graph in that costs can gradually increase even when design changes continues within design development stage of construction process. In essence, as the project shifts from schematic design to design development, the level of effort form design professionals to finalise their design is still feeble.

For traditional design process, the ability to impact cost and cost of design changes is still the least until the procurement stage. During the preferred design process, the design team expels most of their efforts during early design stage. Under the traditional design process, the design team expels most of their efforts during consultation documentation. In these two scenarios, the cost for design changes is much greater for traditional design process as compared to preferred

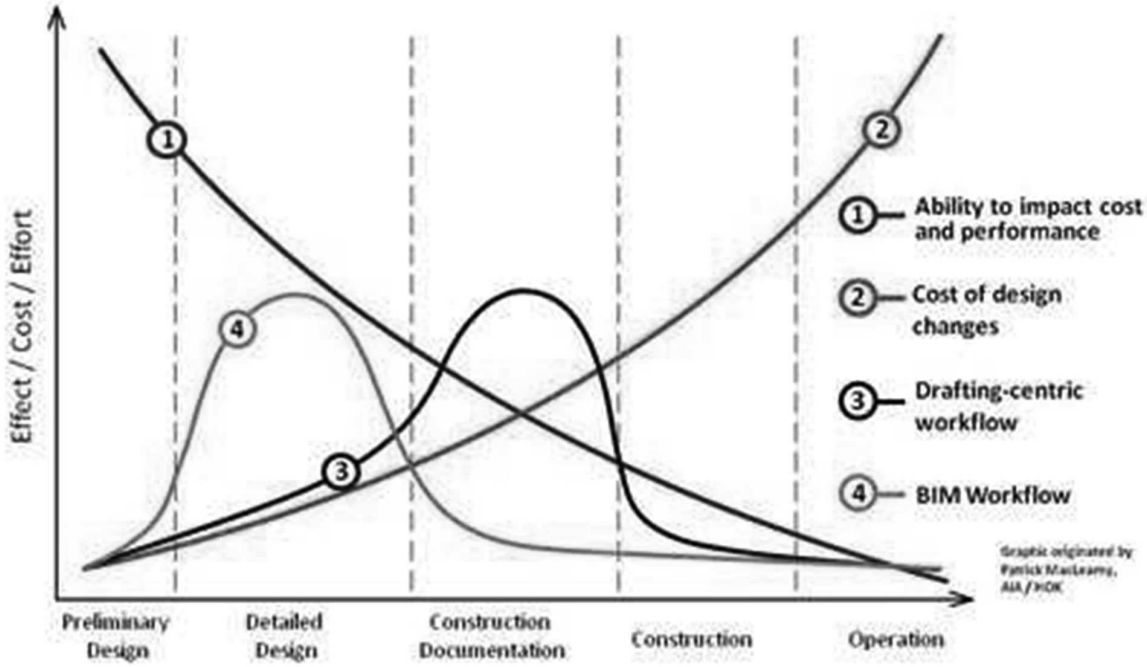


Figure 2.2: Effort/Effect over time. BIM versus traditional approach

design process.

By implementing BIM as a preferred design process during early stage of design, results with greater opportunities which add value to overall BIM model design. Consequently, this improves the level of design decisions amongst the design team. However, the cost to alter the BIM model design becomes significantly high once the project moves from design development to construction documentation. In retrospect, the effect to change BIM model, which is thoroughly developed in terms of design, has greater cost implications as compared to the traditional design process.

2.3.4 The use of BIM during stages of construction life cycle

For BIM to be fully realised in terms of maximising its potentials, it has to be applied throughout the project life cycle and by multi discipline professionals involved in a project [38]. The benefits of using BIM and its related tools to manage construction project processes become less significant in some other stages of construction if information is fostered to be conveyed in 2D [44].

[19] discussed the use of BIM in every construction project stage throughout project life cycle. During planning stage, BIM can be used for modelling existing conditions on site, cost estimates, phase planning, site analysis and programming.

During pre-design, schematic design and design development stage, BIM brings the design team in a collaborative manner which allows the integration of designs from various disciplines to test their designs and detect any errors that may implicate the costs [19].

BIM in the design stage allows the design team to use various BIM authoring tools to be able to interact with each BIM discipline to transfer and exchange information for collaboration purpose [45]. The design stage also allows the design team to starts 3D coordination with the design specialists and integrates specialist designs into BIM model. The client in the early stage of design also gets a visual idea of whether the design fits very well with his intentions [19].

During construction stage, the project team should have sorted out and verified all the designs because the means to influence the cost in this stage becomes minimal. Moreover, any alterations that are brought in this stage can result with not only re-designing but also de-constructing the facility which can be very costly [19]. BIM model at this stage would have reached the highest level of maturity in that it would have integrated all other design models into interdisciplinary model for various facility analyses during pre and post design stages. In addition, BIM would have modelled the design in 3D, modelled out the management of construction site in terms of sequencing and cost controlling etc. [46]. BIM in this stage would be more accurate in terms of advising the client on the budget.

During commissioning stage, BIM can be used for maintenance scheduling, building system analysis, asset management, space management, tracking and disaster planning [47]. A complete model of BIM during project life cycle can be used for visualisation, 3D coordination, cost estimating, planning and monitoring the life cycle of a facility [19]. The use of BIM through project process maximises the complete information integration throughout facility life cycle, which help to achieve real time information sharing from design phase throughout the operation

phase [48].

2.3.5 BIM and projects delivery methods

Project delivery approaches used in South Africa include Design Bid and Build (DBB), Design Build (DB), Construction Manager's at Risk (CM@R) and Integrated Project Delivery (IPD) to deliver [19]. The use of BIM is applied differently in all these approaches with an on-going perception that some approaches are BIM geared whereas some are anti-BIM [19].

Design Bid and Build (DBB)

DBB is mostly used in public projects as it is considered to be a more competitive bidding mechanism to achieve the lowest tender price possible and also less restraining in terms of tender processes involved in selecting a contractor [49]. As it is in the traditional sense, the setup of DBB model requires the professional team to have developed the model from conceptual design until contract documentation where a suitable contractor for the project is selected [10] and [19].

Major challenges faced in the use of DBB are in the procurement process in that the procurement of plants and materials freezes until the client approves the bid. This results in long lead periods especially on items that requires long period to be procured. Consequently, the project schedule becomes longer, resulting in extension of time [10]. More challenges can arise during the design alterations after tender stage as the contractor can create an opportunity to recoup any losses incurred from original bid [10].

Consequently, this matter leads to dispute resolutions. DBB is a slow project delivery method in that it does not allow early involvement of the contractor which compromises the design to have expert knowledge of the contractor during design stage [19]. Coordinated contract input from the entire project team during early design stage of BIM model when the ability to influence the cost is greatest is diminished in this regard.

Design Build (DB)

DB approach consolidates design responsibilities and construction into one entity, combining the contractor and the professional team into one entity [49]. In this occasion, the client enters into a contract with the design-build team, usually a contractor who has a design capacity to tailor design and develop project scope statement to meet the client's requirements [10].

The benefit of using DB is that it allows the design-build team to carry out modifications to the BIM model during early stages of design when the opportunity to influence the cost is the greatest. In addition the design-build team can eliminate extra costs and extra time needed to adjust changes made to the design [49]. Once the project reaches fixed design stage and the budget is set, the contractor assumes any responsibility that comes with design alterations [10].

Since the nature of DB requires the project to be collaborated and coordinated from the commencement of the project, it is suitable for use to BIM projects as it allows the project team to realises benefits BIM has to offer based on its collaboration and procurement principles that adhere to the spirit of teamwork.

Construction Manager's at Risk (CM@R)

In a CM@R method of approach, the client takes full responsibility as the designer and the

construction manager directly works for client [19]. In other terms, the designer will furnish the client with the designs, the construction manager will execute the management services for the client, and the two will have to collaborate and coordinate their work and report to the client about project progress. For BIM, the method is very beneficial as it supports the interoperability of softwares between the designer and the construction manager. However, challenges noted in the use of CM@R inter alia includes liability concerns, intellectual property rights during the exchange of information between the designer and the construction manager (Hergunsel, 2011).

Nonetheless, CM@R method of approach is advantageous for BIM use for allowing early involvement of project team to work on the model design during early construction phase while the opportunity to influence the cost is still high. The value of CM@R delivery method stems from early involvement of the contractor and the reduced liability of the owner [10].

Integrated Project Delivery (IPD)

IPD is a relatively new procurement method that contractually requires the entire project stakeholders to share in the availability of risks [10]. The key theme about IPD is the effective collaboration of the client, designers and contractors in that the entire team shares the BIM model, share responsibilities and also share in decision-making [19]. The project team must effectively work together in coordinating the project and collaboratively use their BIM authoring tools for the benefit of the project [10].

The integration of IPD with BIM is perceived to be the best way to represent a clear break with current linear processes that are based on paper representation exchange of information. However, IPD has also faced some critiques from other researchers for making theoretical sense while in practice, it was hit by substantial road blocks for its implementation. The environment within which IPD is to be ready for implementation requires upfront resolution of design challenges and design delivery either be it political, cultural, legal or related organisational/business structure [33].

Based on the observation of the four delivery approach methods discussed, one can conclude that it is easier for BIM to fall short of collaborating and coordinating construction process and project team in a panache manner. This is based on the idea that BIM operates within a framework that requires early involvement of project participants from project inception to project commissioning.

Looking at the BIM application with the frequent methods of project delivery approach in the South African Construction Industry (SACI), this contrast the collaborative contractual agreements of BIM as most of the SACI procurement methods predominantly prompt competitive tendering through DBB [16]. Therefore, by comparing BIM framework with the likely procurement methods, it becomes inevitable that BIM framework will be inflexible to operate in the same basket as DBB.

2.3.6 BIM and Professional Contractual Arrangement

The development of BIM is also inclusive of BIM Addendum, which is designed to address the likely concerns of design professionals roles and other project team members. BIM Addendum is a type of arrangements emanated from BIM rider, which binds the key players within a

project to collaborate, coordinate and exchange information through the use of BIM tools [39]. It is issued by Consensus 301 to guide and stabilise the concerns of professional team in their professional roles and their involvement in the use of BIM [39]. BIM Addendum is not designed to confiscate or rather change the original obligations of professional team as in the contract. The general position of BIM Addendum states that:

> The BIM Addendum is an addendum, and is not intended to be used as a substitute for other standard form of agreements between owners, design professionals, and contractors.
>
> [39]

In fact, the contractual responsibilities of the parties to the project remain preserved and untouched. BIM Addendum has no link with any existing confidential matters from project participants. All that BIM Addendum does is to allocate certain BIM responsibilities among project team by providing a consensus mechanism which enables the project participants to share responsibilities and exchange information [39].

BIM Addendum curbs the discrete activities of project participants especially in a type of DBB approach. In this type of project delivery approach, BIM Addendum is integrated as a BIM rider to coordinate the project team. The project team in this instance is fostered to develop and implement BIM execution plan which identifies BIM needs and project functions and requirements and assign BIM related responsibilities to each project participant. Once BIM execution plan is implemented, this becomes an amendment to the BIM Addendum [39].

BIM Addendum seeks to cover all legal and contractual issues arising in the use of BIM. In every project where BIM is to be used, there is an attached form of arrangements which address concerns of designers' responsibilities and information exchange. The attached arrangements can be modified depending on the uniqueness of the project. However, considerations made from other studies postulated that even BIM Addendum fall short of support system to cater for contractual arrangement modifications. The implication goes far to reach modifications issues concerning design responsibilities and information exchange [45].

2.4 BIM adoption and construction professionals

This section reviews how some construction professionals adopted BIM including the barriers to its adoption. Much attention is drawn to detail out the process used by other construction professionals in the adoption of BIM. In the BIM related literatures, studies of BIM technology have broadened and taken various forms to contextualise BIM. Studies vary from studying BIM as a model [50], [51]; identifying BIM challenges, risks and benefits [52], [53]; integrating BIM with other technologies [54], [55] etc. In addition, studies related to the adoption and implementation of BIM has drawn heavily on innovative ways to upscale BIM use as the main domain. Much of BIM innovative studies are based on integrating BIM with other systems or technologies to advance BIM and increase its adoption success rate [43], [44].

Other studies underpin the methodological issues that impede on the success of adopting and implementing BIM technology [38], [42]. The premise from which BIM studies are framed

is because of fragmented nature of the construction industry where cooperative, collaboration and integration of construction process and stakeholders often become inefficient and difficult to achieve [38]. Central to BIM itself emanates other forms of studies that analyse the very nature of BIM in detail, with an attempt to make BIM technology a success [10], [33].

Whereas BIM literature is broadened in various forms to address different views of researchers across the globe, there seems to be limited research studies on the adoption of BIM within the South African Construction Industry (SACI). In fact, there was no success in tracing enough available academic published literature on BIM that address the concerns of SACI [13]. The reviewed literature on BIM cut across international countries such as USA, Norway, UK, Hong Kong, Korea, Singapore, Finland Sweden, Malaysia etc.

This is not to say BIM is not being used in South Africa, but its status quo is unknown with regards to adoption, implementation and application [13]. The status quo of BIM difussion in the SACI must be widely publicised, in order to promote the awareness of adopting and implementing BIM throughout construction industry spectrum, particularly the construction professionals. The reason to focus on the construction professionals is influenced by the idea that the construction professionals are involved in the project from project inception until commissioning with a full responsibility of ensuring that the project is delivered within the set project's parameters and that the client's needs and requirements are fulfilled.

2.5 BIM adoption: Cases for international studies

This section reviews relevant literature of BIM adoption cases across the globe to analyse how BIM was adopted despite its prevailing barriers.

Case 1: United Kingdom (UK)

It has been more than a decade since UK has embarked in the journey of using BIM for most of their construction projects. Various UK countries have, adopted BIM for their construction projects. In fact, recent studies of BIM in UK are now based on looking at various advanced ways of implementing BIM in construction projects or on an organisational level.

[56] conducted a study which focused on identifying current state of BIM realisation and the readiness to implement BIM in UK's construction industry. The researchers analysed BIM from other studies which facilitated the adoption of BIM in construction and reached a view that BIM in other studies was demonstrated for its capability to provide alternatives ways for providing more sustainable products. Sustainable products in their view implied to new technology tools that are BIM oriented, which improve technology in information management.

New technology tools provided the development of more technology programme which brought about the development of various BIM tools which considerably improved productivity for managing and maintaining information generated for facility life cycle. However, there was a need from an organisational level to change their current business process need in order to gain advantage of BIM [56].

The observation of changing business process to take advantage of BIM fostered [56] to review existing BIM projects by analysing benefits of such BIM projects. A review report on those projects postulated that BIM benefits were depended on the level of BIM implementation on an organisational level and the integration of BIM on an industry level.

[56] propose the implementation of BIM on organisational level by establishing BIM implementation best practice with an objective of identifying systematic approach of BIM implementation. Part of the best practice was to identify organisations that have implemented VIM or involved in research about VIM implementation. The identification of such organization was part of the researchers' methodology, which was conducted by arranging interviews with various companies.

The interviews were to capture organizations' uniqueness as well as commonalities in their VIM experience. The main objective of the interviews was to understand the organizations views and strategies in implementing and using VIM in their practice. Apparently, these interviews enabled the organizations to give their views about the experience they have in implementing and using VIM. Based on the responses received from conducting the interviews, the researchers formulated a questionnaire that reflected the views of the interviewees and distributed to the members of the UK's construction industry. Members who participated in the questionnaire were consciously selected based on their reasonable knowledge of VIM use.

The survey results of questionnaires were evaluated based on the VIM maturity levels and the underrating each industry members have on the use of VIM in different VIM maturity levels. [56] used findings made from both the interviews and the questionnaires to develop a roadmap to implement BIM. This roadmap indicated that a certain degree of intervention that reflects collaboration, construction sequencing, shareable database, and fully integrated project delivery is required from the researchers and the built environment professionals.

Case 2: Canada

A research study conducted by [45] with the institute of BIM for Canada suggested that one way to facilitate the BIM adoption for Canada is to make BIM a mandatory requirement for public projects. The suggestion was primarily based on the problem statement made by the researchers [45] which was affirmed by other research studies i.e. [18], that there is a lack of recognition by the public clients on the added value of BIM to construction projects. [45] envisaged that to adopt BIM that would cater for the needs of Canadian construction industry, this would require public projects to change existing work practices in order to realise maximum BIM benefits.

The researcher postulated this view, taking in consideration political sensitivities, financial and socio-economic backgrounds of the Canadian government. In an attempt to adopt BIM for the Canadian construction industry, [45] proposed a structured public procurement framework with an aim of encouraging widespread of BIM adoption. The proposed public procurement methodology aim to understand capabilities BIM tools have and to address the legal and procedural conflicts that are likely to emanate amongst project stakeholders in the uptake of BIM.

The researchers furthered their study with a case study to test the proposed BIM framework by making use of a funded public construction project that follow a traditional DBB service

delivery procurement method. The approach to the proposed public framework is framed around reviewed literature of BIM. Based on the report made to the Canadian construction industry, the analysis highlighted gaps that exist around functions and projects in the existing industry practices. Moreover, to those who are using BIM in the industry, require a significant adjustment to the current practices in the industry.

Moreover, on the basis of professional firms that have been requested by the construction industry to use BIM for tendering public construction projects, there have been implications associated with cost barriers for adopting and implementing BIM on an organisational level. Though [45] addressed the views of industry members on the undeniable benefits of BIM, the researchers have also alerted that the adoption of BIM is also accompanied by various technological barriers for BIM implementation, that relate to the organisational and business process changes in the requirement to uptake BIM. [45] elaborated the current state of BIM in the Canadian construction industry by discussing issues concerning BIM maturity levels.

The researchers indicated that for an organisation to reach BIM maturity level, there is an on-going continuous phase whereby BIM adopters will have to go through a managed process of change which affects how the firms operate and manage their organisations on a daily basis [45]. In fact, BIM adoption on an organisational level makes changes to be inevitable, as it requires financial and educational investment through organisational staffing, training, project team configuration and the re-adjustment of the entire organisational model or structure to cater for BIM technology [33].

In addition to the discussed BIM challenging issues, the Canadian industry mentioned BIM model definition, interoperability, legal and contractual issues that come with the extensive knowledge required to understand BIM technology [45]. However, in the review of existing procurement delivery method (DBB) used by the construction industry, the method was criticized for its fragmented style that causes obstruction between the project team and construction process. Nonetheless, DBB was considered to be re-looked at and adjusted by involving the contractor at an early stage to suit BIM requirements technology.

Structured public procurement framework

The development of public procurement framework for the Canadian construction industry is composed of two sessions, which are Early BIM partnering delivery method and early BIM partnering project delivery approach. In the first session of Early BIM partnering delivery method, there is planning and developing BIM model concepts. During planning phase, the construction industry develops a stakeholder analysis which is composed of the owner's project manager, owner's BIM consultants' and contractor's BIM design team including subcontractors. The next part of the planning is for the client's professional team to conceptualise BIM model from project inception until project commissioning phase.

Second session that is Early BIM partnering project delivery approach is to action the implementation plan of the conceptualised BIM model in a typical construction project process. Based on the developed conceptual BIM model, BIM phases have been classified in three categorised. The first category illustrated pre-design/contract documents and tender award. The second category illustrated BIM-partnering whereby the lowest bid contractor is selected from

category 1 to collaborate with the owner/client to develop an integrated full design model with the client's professional team.

Before the contractor can collaborate with the owner/client, the owner establishes a guaranteed maximum price for construction project. The guaranteed maximum price is deemed to be enforceable with no price adjustment unless the scope of work changes as per the owner's request. Once the construction budget/ price is agreed, the contractor then partners with the owner and the two teams that come from both the client's side. The teams together with the contractor develop a full integrated design BIM model. Once the integrated BIM model is fully designed, it is then checked for interoperability, facility analysis and any other model definition issues that may arise. The model is also analysed for construction lean principles.

BIM model then moves to category 3 of contract administration, which entails reviewing construction documents, technical inspections from both the contractor and the owner. Once BIM model is fully completed and the project is ready for construction, the rights of ownership becomes the sole responsibility of the owner/client. BIM model under category 3 of contract administration gives the contractor and the team an opportunity to execute the project as per the BIM model. In a case for Canadian construction industry, construction contract is a separate contract and the framework gives the owner the right to terminate the contract by paying the contractor the amount due and not enter into construction phase, which brings the whole process to the end of the proposed framework.

Immediately after the framework was completed, [45]made a follow up study by documenting a case study on public funded pilot project to test the framework. Findings made on the case study indicated the framework as the best strategy for the Canadian construction industry especially on a government level to facilitate the construction procurement process in an open, fairness and accounted manner. The method also proved to have achieved some of its objective of improving cost efficiency, value and carbon performance. Nevertheless, there were challenges concerning Consensus Docs for BIM addendum that had to do with contractual arrangements modifications.

The proposed framework was challenged in both sessions in terms of the allocation of risk to the owner's consultant team that was not clearly supported by the model under BIM addendum. In terms of a complete BIM model, any software malfunctioning was addressed to be the client's risk as much as a complete BIM model was concerned. A holistic analysis made to the proposed partnering framework suggested the framework as another way of increasing BIM adoption for the construction professional practices as it became an important tool used to evaluate organisational' capabilities in executing the state clients BIM projects.

Case 3: Malaysia

Malaysia is a late-comer in the adoption of BIM. The Malaysian construction industry is still hampered with challenges for adopting BIM as there is still a perception that both the public-private sector lack a clear clarity on the benefits of adopting BIM [57]. The industry also faced challenges relating to the development of codes of practices and policies to regulate the adoption of BIM and to maintain order within the industry. However, it has been envisaged by the Royal

Institutes of Quantity Surveying Malaysia (RIMS) to stand on the fore front and lead the first adoption of BIM especially for the quantity surveying body. Ideally, the adoption of BIM was to be for the entire spectrum of Built Environment professionals in Malaysia, but because the pilot test for BIM adoption was selected to be under the umbrella of the quantity surveying body, RIMS had an onus of creating an awareness of the importance and benefits of adopting BIM for the Malaysian construction industry.

Apparently, the Construction Industry Development Board (CIDB) of Malaysia showed no greater influence in the whole process of the industry to adopt BIM, which is noted to be the lack of knowledge of recent construction technologies. On other issues concerning BIM adoption, Malaysian Quantity Surveyors (MQS) were faced with greater challenges of sorting out and reviewing their standard codes of measuring as it was suggested to have bottlenecks relating to Malaysian system of coding to link BIM to specifications, standard method of measurement, approved material lists and etc.

Prior to the development of BIM adoption plan, MQS rated some of BIM benefits with an attempt to create a zeal for QS to be the first professionals to adopt BIM and give the Malaysian construction projects real value for money. Some of the benefits mentioned inter alia include elimination of non-budgeted changes, increase in cost estimation accuracy, and reduction in time to create cost estimates, clashes identification prior to build and greater project savings.

Malaysian Strategy to adopt BIM

MQS Division developed BIM technical committee with a core mandate of developing a framework for the adoption of BIM. The framework was divided onto two phases namely the development of BIM adoption framework and BIM adoption framework seminar. The framework covered BIM codes and BIM standards, BIM integrated project delivery and priority research for BIM studies. During the development of BIM codes and standard, the Malaysian Technical BIM Committee was guided by Hong Kong and Singapore codes and standard.

The essence of the seminar was to present BIM adoption framework to create BIM awareness and highlights other BIM experience across the globe with an aim to create a BIM acceptance to the audience. With regards to priority research for BIM studies, technical BIM committee developed about 10 BIM research areas that gave RIMS a way to invest in BIM studies and select the most priority areas for research. On issues related to integrated project delivery, technical BIM committee developed a framework for re-engineering systems and process for BIM adoption that covered all the Built Environment professional disciplines. The process and systems re-engineering in this instance pointed to the reviewing of existing processes in all the professional disciplines in order to reduce paper work. The reviewing also entailed assessing the applicability of foreign standards and codes related to BIM in some construction disciplines for adoption and adaptation purposes.

Based on BIM framework developed and presented in a seminar, BIM model has the potential to transform the Malaysian construction industry from being paper eccentric to a technology eccentric industry. The framework for BIM adoption has not yet being adopted but still in progress. The findings for its adoption are still unknown at this point.

The objectives of the three case studies discussed were to pave a way by giving the SACI,

construction professionals in particular to develop a clear view on how they can adopt BIM into their respective practices and implement BIM both at the project and organisational level .

2.6 Conclusion of Literature Review

The review of literature in this chapter focused on fragmentation phenomenon in the first section of the report. The second section of the literature focused on construction project processes that included integration, collaboration, coordination and communication. The third section covered BIM literature. Fragmentation in this literature is reviewed from the construction professionals' point of view. The first section of fragmentation is reviewed from the construction professional relationship context. The professionals face fragmentation challenges amongst each other as a professional team, with the contrator, with the client and on project processes. On the professional team, construction professionals face challenges of how to integrate their professional attributes in order to manage the project effectively. On the professional-contractor relationship, procurement project delivery method plays a big role especially on the procurement methods that do not require early involvement of the contractor for project planning and execution such as DBB.

Fragmentation is also noticed as a result of unavailability of specialised skills from the contractor's side, which tend to be time consuming to procure and manage such skills. Fragmentation exists between the professionals and the client and is mostly perpetuated by the client's instructions that does not consider time, scope and quality of project phases. The project-based fragmentation is noticed through project procurement methods and processes that do not exhibit integration processes. Professional activities during project execution follow sequential order whereby some professionals' activities follow one another with less integration and difficult coordination processes.

Despite fragmentation challenges experienced by construction professionals on a project, construction professionals' attributes ought to be integrated, collaborated, coordinated and communicated in order to achieve the project deliverables. Integration requires the professional team to amalgamate their attributes and methods with existing project process and activities into an integral whole to share, exchange and transfer information among team members in an open and efficient manner. Collaboration requires the professional team to cooperatively work together, to share responsibility, solve problems, propose solutions and make decisions on behalf of the project. Communication requires the professional team to convey the instructions, exchange or request information when it is needed or responding to project specific requests. Coordination requires the professional team to combine their roles and responsibilities into a collective set of tasks, and set a control mechanism to manage those tasks.

These four processes of integration, collaboration, coordination and communication explained the processes involved in sharing professional attributes by the construction professionals within a project team. However, as a result of existing fragmentation, the use of BIM becomes inevitable as it is an advanced 3D building model, digitally built to contain all aspects of building information into one holistic model. This model allows the stakeholders to query, simulate

and make informed decisions about the constructed facility

BIM literature is reviewed with regards to how it has evolved , its features, BIM usage and BIM adoption. The evolution of BIM started as a Computer Aided Devices (CAD), which was further developed to 3D modeling, then to intelligent CAD systems and recently developed further to digital intelligent model recently known as BIM. BIM features parametric objects that give BIM a distinct character from other 3D objects and define objects as parameters with relationships to other projects, automatically updating BIM model as parametric objects are being modified. BIM standard is a very important key feature of BIM, which exhibit the interoperability role, thus making BIM model to be aware of other models by collectively, semantically and technically allowing BIM to interoperate with other models. The use of BIM through project phases maximises greater integration throughout the facility life cycle that help to achieve real time information sharing from design phase throughout the operation phase.

In the adoption of BIM, construction professionals sign BIM Addendum, which binds the professionals with BIM contractual arrangements by allocating certain BIM responsibilities amongst project team members. International case studies on BIM adoption have been reviewed, which showed significant evidence of the importance of adopting BIM and taking into cognisance the cultural and socio-economic environment of implementing BIM around the globe. The case studies discussed BIM benefits, challenges, risks, opportunities and recommendation for BIM improvements. While the report discussed the potential benefits of adopting BIM, it also mentioned BIM barriers that prohibited many construction professionals to adopt BIM.

Chapter 3

Research Design and Methods

The literature review highlighted that fragmentation continues to be a challenge within the professional team. This might be partially attributed to the lack of standardised approach on how the construction professionals integrate, collaborate, coordinate and communicate their professional attributes in order to mitigate fragmentation challenges.

This study commenced by articulating the following research questions:

- What are the challenges brought by the fragmentation on construction professional team members regarding integration, collaboration, communication and coordination?
- Do the intrinsic properties of the construction projects i.e., project size, clients, project locations and project delivery method also contribute to fragmentation challenges experienced by the professional team?

This chapter articulates the research design and method followed in the study.

3.1 Research Philosophy

Prior to selecting the research philosophy, it is imperative to explore various research philosophies in line with the research questions above. In particular, two such philosophies are explored here.

Figure 3.1 outlines the research philosophy reviewed in the study in order to understand the way to approach the study and to explain and justify the methodological choice, strategy and data collection techniques used in the study.

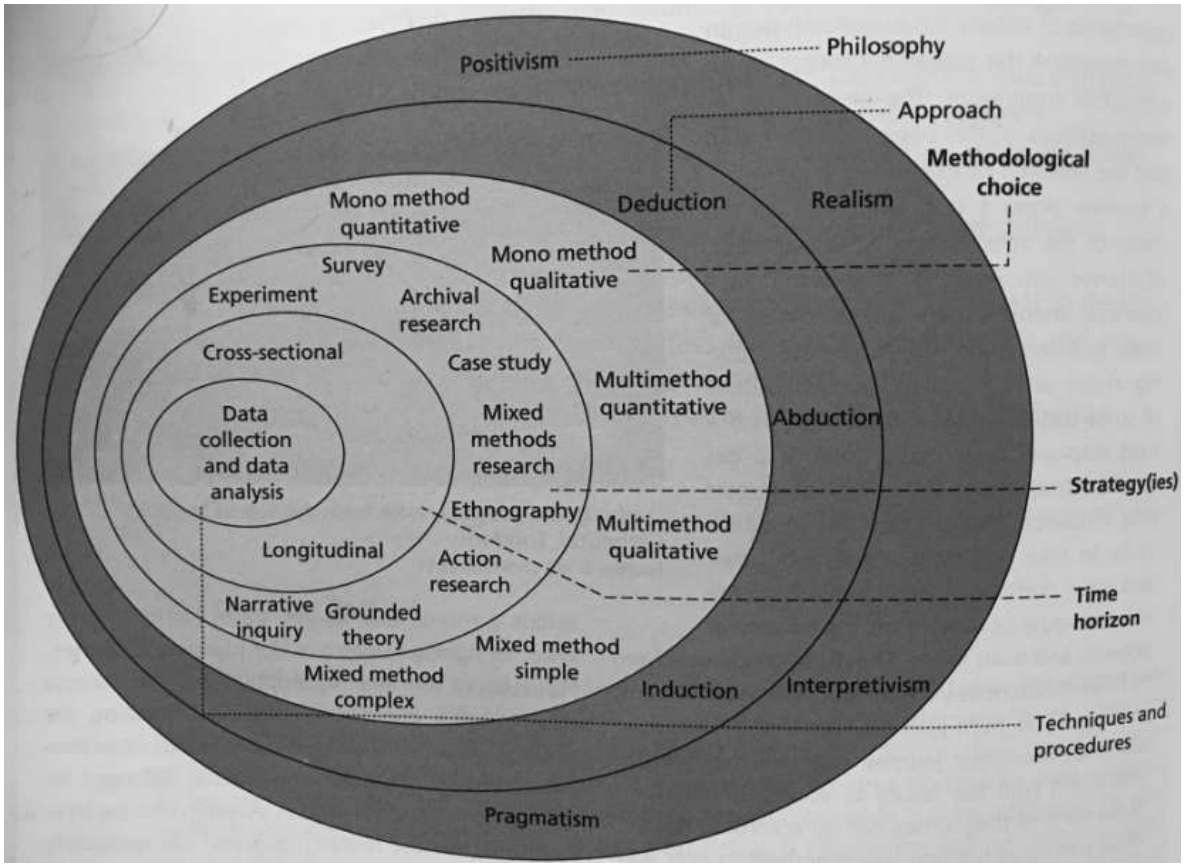


Figure 3.1: The research onion

The study uses the metaphor of research onion as depicted in Fig 3.1 to illustrate the genesis of research methodology employed in this study from the research philosophy down to data collection techniques and analysis procedures. Figure 3.1 covers the philosophical approach which underlies and informs the style of methodological choice, strategy and data collection techniques employed in the study. There are two philosophical positions or philosophical stances that can be adopted which is epistemology and ontology. Whereas epistemology is concerned with what constitutes an acceptable knowledge, in other words it is concerned with how the inquirer goes about in getting the information; ontology is concerned with the nature of reality. It focuses on the actual object of the research, what can be explored, or the object of the question to be explored [58]. Ontology has been argued that epistemology exists because of ontology since ontology studies the nature and its reality or the existence of nature in general [59].

Epistemology is underpinned by positivism and interpretivism philosophies as part of the develoment of knowledge.

Positivism Philosophy

Positivism philosophy normally adopts a natural scientist stance. It is a philosophy that one would traditionally looked at it as science, such as undertaking experiments or collecting data

about observable reality to provide a basis for hypothesis testing [58]. The positivist's view is that reality can be observed, studied and modelled [56]

Interpretivism Philosophy

Interpretivism philosophy advocates the necessity of conducting research by using humans to collect data as opposed to objects [58]. It advocates that reality can be interpreted and new theories can be developed that will result in new knowledge based on the interpretation [56].

This report attempts to apply the existing knowledge about fragmentation in the South African Construction Industry (SACI) by identifying fragmentation challenges concerning integration, collaboration, coordination and communication as encountered by the professional teams in a construction project. In addition, the report aims to describe a thematic framework emerging from the observed fragmentation challenges in line with the projects' intrinsic properties.

Therefore, the manner in which data was gathered and analysed and the application of existing knowledge on fragmentation reflects epistemological stance. The philosophical view embraced here is that of an interpretivist than a positivist philosophy. Interpretivism philosophy is applied by collecting data based on open-ended interview questions about fragmentation challenges. The collected data explores the professionals' views or their understanding on how they integrate, collaborate, communicate and coordinate their professional attributes and making inferences with the projects' intrinsic factors of project scope/budget, project location, project client (public/private), project type and project delivery method. The aim is to identify whether the project intrinsic factors have contributed to the fragmentation challenges faced by professionals.

3.2 Research approach

The research design employed in this study is mixed method research. It uses Qualitative Data Analysis (QDA) tool to capture the raw data from the participants and convert them into transcripts. However, the analysis of the results is quantitative.

Quantitative research is one in which the investigator primarily uses post positivist claims for developing knowledge [60]. This type of research is created from existing theories and therefore makes use of data collection that is numeric and it is analysed by means of statistical data [61]. Quantitative research is usually associated with deductive reasoning, focusing on testing a theory through the collected data [58].

Qualitative research is the one in which the inquirer often makes knowledge claims based primarily on constructivist perspectives [60]. Qualitative research is descriptive in nature and ought to make sense of the constructed meaning about the phenomenon being studied [58]. Qualitative approach as described by [62]is an approach whereby the researcher seeks to understand a situation by gathering information from participants.

The study used literature review to establish the context of fragmentation. This led to the identification of construction processes (integration, collaboration, coordination and communication), which formed four categories of fragmentation challenges. This paved a way forward for

conducting a geographic survey of construction projects in the Gauteng region and applied the construction processes as variables. It is envisaged that the big portion of infrastructure budget is within the Gauteng region which also carries rich data for infrastructure projects [27].

The research design is exploratory and it involves asking open-ended questions to gain insights about a topic of interests [63]. The exploratory research design has the potential to be useful because the study seeks to identify the fragmentation challenges the construction professionals face while sharing their professional attributes. The study uses unstructured open-ended interviews to collect the data and also to rely on the responses from participants with minimum bias. The collected data will be analysed through content analysis.

QDA is a qualitative content analysis software designed to analyse the data of the study. Content analysis can be perceived as establishing the existence and frequency of concepts that are often represented by words or phrases in a text [58]. Content analysis entails the identification of texts that can be coded into manageable contents by reducing the texts into categories [64]. In this study, the categories are selected from the reviewed literature and comprise of integration, collaboration, communication and coordination. The categories are coded for, by identifying the sets of phrases or patterns from the respondents' transcripts. The focus is to code the sets of phrases that aim to answer the research questions and achieve the project objectives. The content analysis is an appropriate tool to analyse qualitative data approach because the research questions are specifically addressing existing issues of fragmentation among a predesigned sample of construction professionals.

3.3 Research objectives

Objective one

To identify fragmentation challenges among construction professional team members concerning issues of integration, collaboration, coordination and communication during the execution of construction projects.

Objective two

To describe a thematic framework emerging from the observed fragmentation challenges among professional team members regarding integration, collaboration, communication and coordination during the construction projects.

3.4 Population

Population of the study covers construction professionals who are located and working on construction projects around the Gauteng region. The list of construction professionals was compiled from the list of construction projects done in-house by DDP quantity surveyors and other external business partners. See Appendix B for more details. The aim of compiling the list of construction projects was to understand the geographic dispersion of construction professionals members on construction projects. The construction project list was used to schedule appointments with the construction professionals involved in different projects. The partici-

pants included Architects, Quantity Surveyors, Project Managers, Civil/ Structural Engineers, Electrical/Mechanical Engineers, which form the construction professional team. The data was collected in the region of Gauteng Province due to its proximity and the greater scale of the Built Environment professionals as the province is the leading capital expenditure on infrastructure projects [27].

3.5 Sample and sampling method

The study sourced 26 construction professionals from the list of construction projects detailed in Appendix B. Construction professionals were either contacted through their office lines or mobile phones. In cases whereby some construction professionals have resigned from practices, their contacts were requested so that they could still be engaged.

3.6 Collection techniques and procedure

Pilot study was used to develop open-ended interview questions for data collection purposes.

3.6.1 Design and piloting of interview questions

A pilot study was conducted prior to the official data collection exercise among the construction professionals. The interview questions were developed from an analysis of fragmentation literature. The reason to conduct the pilot study was so that the researcher can explore the questions further to be able to gather relevant data and to explore and validate the relevancy of the questions. Answers were gathered from five participants. This exercise led to the restructuring and final validation of the interview questions.

3.6.2 Procedure

Open-ended questions were used to collect data as shown in the sample interview question in Appendix D. Fifty construction professionals were sourced and contacted for their availability to take part in the interview survey. Only 32 professionals were interviewed. The data collected on each interview was recorded through the use of audio recording device. Figure 3.2 shows the procedure undertaken to acquire the data.

3.7 Research Variables

While it is essential for the study to articulate how the variables of interest are measured in the study, [58] describes variables as characteristics or attributes that are of interest in a study. There are independent and dependent variables. Independent variable can be manipulated or change to measure its impact on the dependent variable whereas dependent variable may change in response to changes in other variable [58].

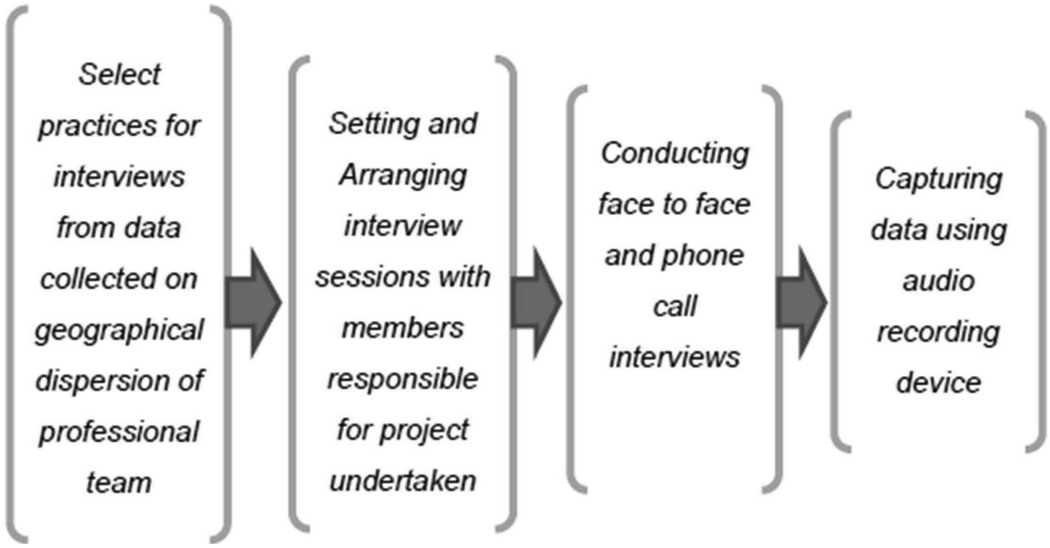


Figure 3.2: Procedure for data collection

For the purpose of this study, the independent variables comprise the project size (based on budget scale), clients, project locations and project delivery methods. The dependent variables are the measures of fragmentation, which include integration, collaboration, communication and coordination of professional attributes. Any other attributes other than the ones mentioned above will be overlooked in order to avoid any influence of external variables.

3.8 Validity and reliability

This section discusses and analyse the approximation of truth made to the conclusion or rather the quality made to the proposition [63]. The reason to analyse the validity and reliability of the study is that there might be threads that can compromise the conclusion made to the study. Therefore, there are appropriate steps that need to be taken to control all potential threads [63]. The study looked at concepts i.e., internal and external validity and reliability of the research.

3.8.1 Internal validity

Internal validity as defined by [58] refers to the ability to test the hypothesis being developed and ensuring that there are no external factors to rule out the hypothesis other than the one the study employs. Internal validity tries to establish a causal relationship of what is considered the cause and the effect to the cause [63]. Internal validity is associated with positivist and quantitative research. It can be applied to causal or explanatory studies, but not to exploratory or purely descriptive studies [58]. Since the study is exploratory in nature and did not need a hypothesis, the internal validity was not applicable.

3.8.2 External validity

External validity as defined by [58] is the ability to generalize results or research findings. The study was limited only to construction professional members

3.8.3 Reliability

Reliability as defined by [58] is the ability for the research to produce constant results under the same condition. In order to enhance reliability, the instrument was adopted using the research questions, peer review journals using similar studies from available sources. The study design was such that the data collection was conducted once, and therefore could not validate for any consistency with other findings of the study. However, all respondents were issued with the same interview questions. Some interviews were face-to-face interviews whereas some were done telephonically.

3.9 Ethical Issues

Prior to opening floor of questions, permission from the participants was obtained. Furthermore, it was agreed to keep identity of the participants anonymous. Audio recordings were used to collect the data from the participants. It was agreed with the participants that the audio recordings would be cleared off once the final research report is submitted.

Chapter 4

Data Analysis and Results

The aim of this chapter is to present the findings on fragmentation challenges of construction professional members. The results are discussed under integration, collaboration, communication and coordination as subtopics. The study also aims to find out whether the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

4.1 Data analysis procedure

This section of the results illustrates the processes involved in data collection i.e. collecting raw data from the participants until it is reduced to the descriptions of themes used for coding as per the Appendix A.1 to A.5. A total of 26 construction projects were selected from a list of construction projects compiled by DDP Quantity Surveyors as shown in Appendix B. The projects were carefully selected based on the cost bracket of the value of works as promulgated in the tariff of professional fees 2015, published by the South African Council for Quantity Surveying Profession [65]. The aim was to interview 50 professionals who participated in different construction projects of different budget scale, ranging from R 0.00 to over R1 000 000 000, to get their views on how they shared their attributes. At least 32 out of 50 construction professionals responded to the interview questions, achieving an response rate of 64%.

The results were analysed using a data mining software known as Qualitative Data Analysis (QDA). Data was collected through audio recordings and it was reduced into transcripts. The transcripts were organised into one retrievable spreadsheet and loaded into the QDA Miner for coding. Afterwards, the loaded transcripts were proof-read to check for any typographical errors. Four categories of integration, collaboration, communication and coordination were created along with the list of codes created for each category. These codes were considered helpful to analyse the data. To begin with coding, each transcript was read thoroughly and the texts required for coding were highlighted and linked to the preferred code of a particular category. Once all the texts were coded, the next step was to apply the coding frequency built within the software, which shows the number of times the texts were coded under a particular

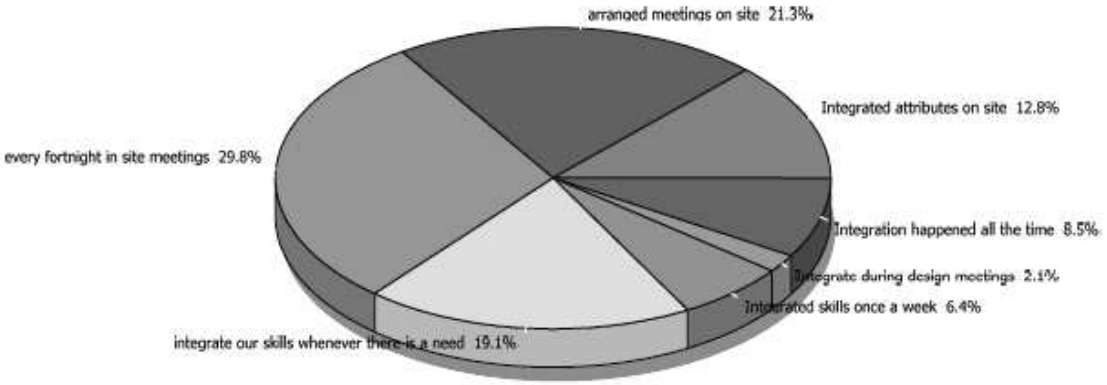


Figure 4.1: Integration challenges part 1

project or case. Qualitative Data Analysis (QDA) refers to each project as a case. Tables 4.1 to 4.4were developed based on the results shown in Appendix A.1 to A.5.

4.2 Results of the study

Table 4.1 presents a set of phrases used for coding integration challenges. The phrases used for coding collaboration, communication and coordination challenges are summarised in 4.2 to 4.4 respectively. Each table will be analysed based on the research questions of the study.

The respondents were given full descriptions of integration, collaboration, communication and coordination categories prior to posing any question. The aim was to simplify the terms used for categories, and making the processes of responding to the questions easy. In summary, the phrases shown in Tables 4.1 to 4.4 illustrate the frequency of themes that emerged from the transcripts on how the construction professionals integrated, collaborated, communicated and coordinated their professional attributes and the challenges they faced. The themes were explored further to identify any existing link with the intrinsic properties, i.e. the project size, type of client, project location and project delivery method of the construction projects that formed part of the study.

Tables 4.1 to 4.4 seek to address objective one of the study which is to identify the fragmentation challenges professional team encounters with respect to integration, collaboration, coordination and communication in construction projects.

4.2.1 Integration challenges

Table 4.1 illustrates how members of the professional team combine their attributes with each other. According to the professionals interviewed, integration of attributes occurs at different levels. The majority of professionals, 29.8% integrated their attributes every fortnight, about 21.3% integrated their attributes as per scheduled meetings and 12.8% integrated their attributes by attending to site issues without any scheduled meetings. At least 19.1% of professional inte-

Table 4.1: Integration challenges

Codes used to analyse no of times professional members integrate their attributes

Phrases	Frequency of occurrence	Percentage (%)
Every fortnight in site meeting	14	29.8
As per scheduled meetings	10	21.3
Integrate whenever there is a need	9	19.1
Integrate attributes on site	6	12.8
Integration happened all the time	4	8.5
Integrated skills once a week	3	6.4
During design meeting	1	2.1

Integration Codes used to analyse whether there is free and easy accessibility and availability of professional attributes

Phrases	Frequency of occurrence	Percentage (%)
Available on schedule meetings	13	44.8
Team members were available and accessible all the time	5	17.2
Skills available and accessible every fortnight	3	10.3
Professionals were available whenever there was a need	3	10.3
Professional attributes were accessible all the time	2	6.9
Team members were available and skills accessed once a week	2	6.9
Skills accessible on site	1	3.4

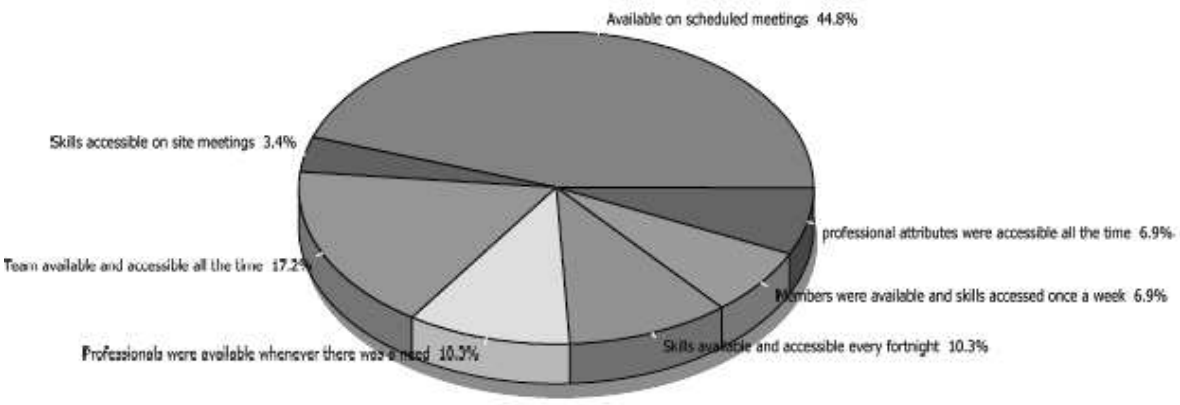


Figure 4.2: Integration challenges part 2

Table 4.2: Collaboration challenges

Codes used to analyse collaboration of familiarity, honesty, mutual trust and respect amongst team members

Phrases	Frequency of occurrence	Percentage (%)
Familiarise ourselves with one another	24	32.0
Trust each other	22	29.3
Professional respected each other	16	21.3
Honest with other members of team	13	17.3

Collaboration Codes used to analyse whether team member contribute, complement, pursue ideas, solve problems and propose solutions

Phrases	Frequency of occurrence	Percentage (%)
Contribute to suggestion	40	27.8
Pursue new ideas with other team members	23	16.0
Solve problems as a team	23	16.0
Propose solutions to each other	19	13.2
Knowledgeable about each other's work	19	13.2
Complement individual from their tasks	12	8.3
Make decisions with other team members	8	5.6

Table 4.3: Communication challenges

Codes used to analyse how information is communicated and transferred

Phrases	Frequency of occurrence	Percentage (%)
Verbal communication over meeting	28	38.4
Verbal communication through phone calls and messages	25	34.2
Communicate through emails	19	26.0
Communicate through team intranet and drop box	1	1.4

Communication Codes used to analyse challenges faced during communication

Phrases	Frequency of occurrence	Percentage (%)
Late responsiveness to information	16	42.1
Professionals not available	15	37.8
Project information delayed	3	7.9
Inability to adjust to new ideas	1	2.6
Improper language sometimes used	1	2.6
Lack of competency	1	2.6
Challenges of miscommunication	1	2.6

Table 4.4: Coordination challenges

Codes used to describe service offered by different discipline		
Phrases	Frequency of occurrence	Percentage (%)
Architectural design and coordination	7	21.9
Cost planning, monitoring and control	7	21.9
Supervision of professional team	6	18.8
Civil and structural design and coordination	6	18.8
Electrical design and coordination	4	12.5
Mechanical design and coordination	2	6.3
Coordination Codes used to describe frequency of managing and controlling construction activities and tasks		
Phrases	Frequency of occurrence	Percentage (%)
Activities managed and controlled only during coordination meetings	12	30.8
Activities managed and controlled during design and coordination meetings	7	17.9
Activities managed and controlled whenever there is a need for input	6	15.4
Activities managed and controlled within the work place	4	10.3
Mutual agreement with the team on every project phase	3	7.7
Activities managed and controlled all the time	3	7.7
Activities managed and controlled during site meeting	2	5.1
Activities managed and controlled daily	1	2.6
Activities managed and controlled once a week	1	2.6

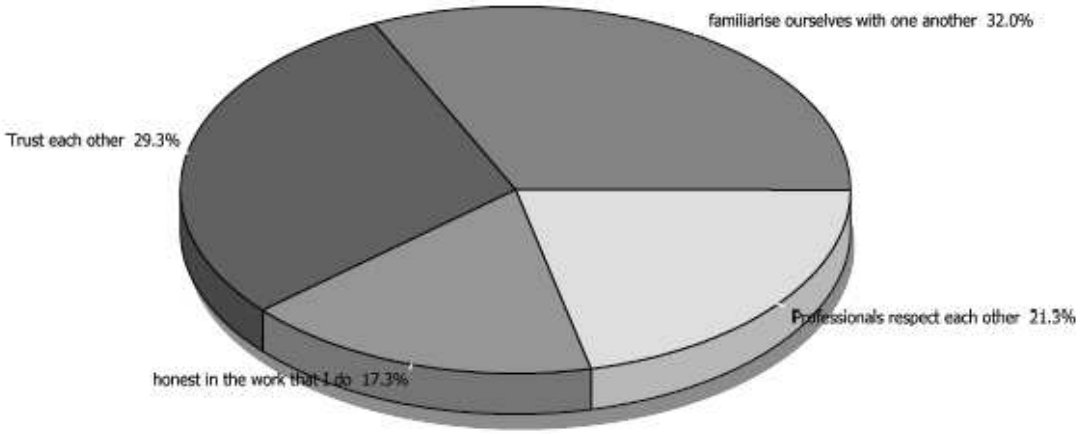


Figure 4.3: Collaboration challenges part 1

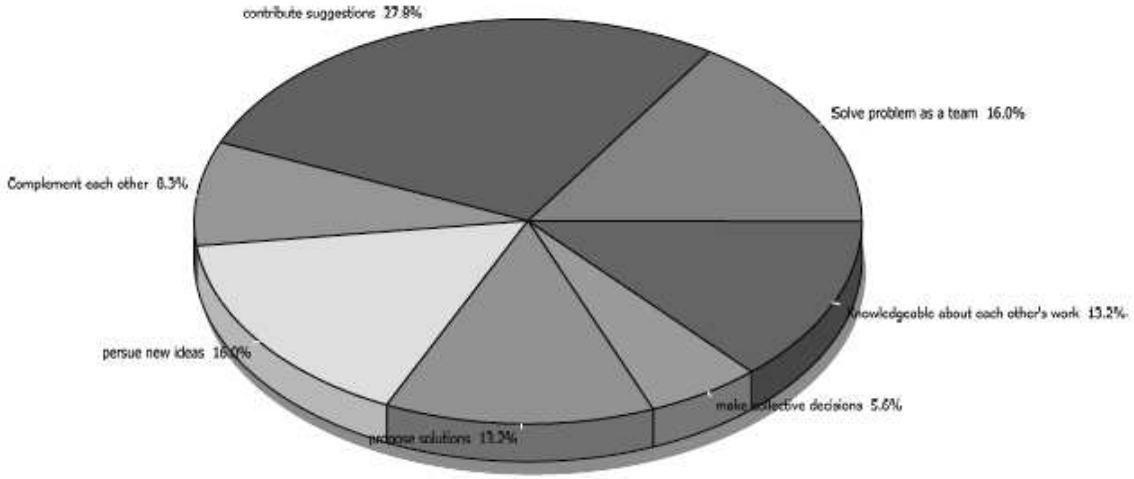


Figure 4.4: Collaboration challenges part 2

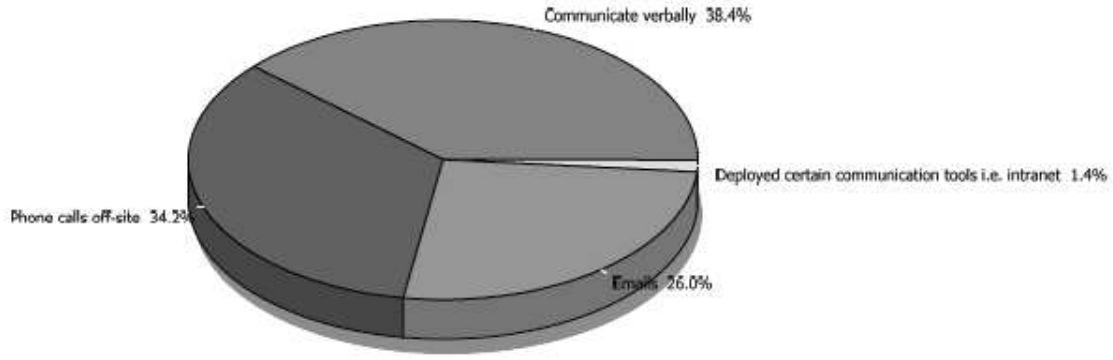


Figure 4.5: Communication challenges part 1

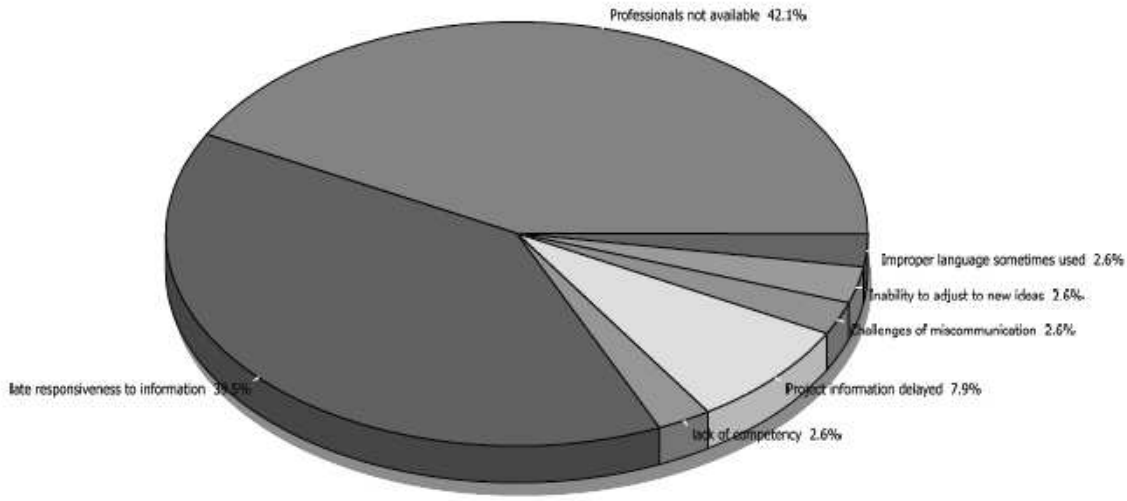


Figure 4.6: Communication challenges part 2

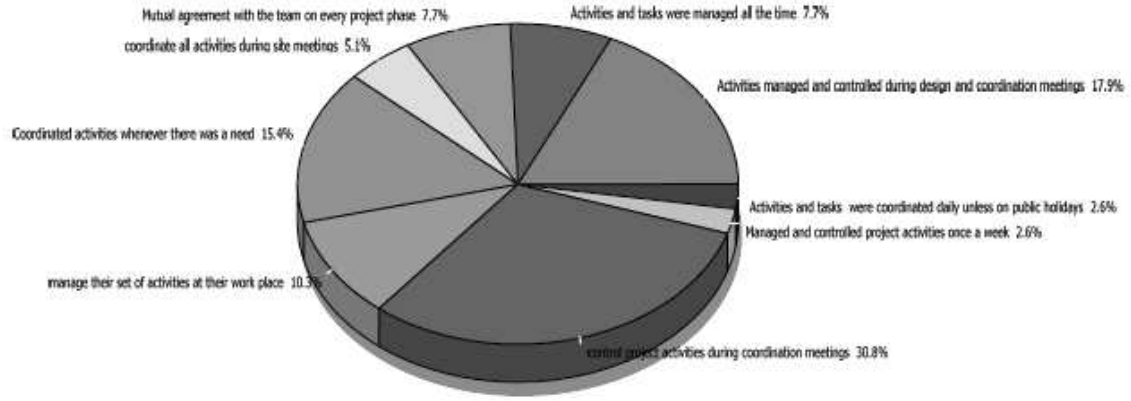


Figure 4.7: Coordination challenges part 1

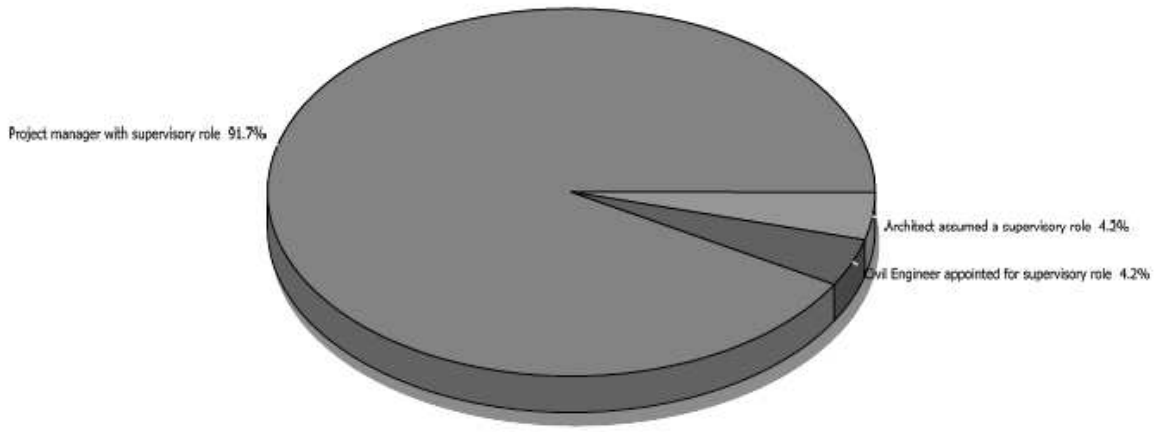


Figure 4.8: Coordination challenges part 2

grated their attributes whenever there was a need to do so and 8.5% of professionals integrated their professional attributes all the time throughout the project. Professionals who integrated their attributes once a week were 6.4% whereas only 2.1% of professionals integrated only on design meetings.

In view of professional attributes being easily and freely accessible and available, 44.8% of construction professionals availed their skills on scheduled meetings. At least 17.2% of the professionals were available and accessible all the time. Other professionals availed themselves and their skills whenever there was a need. Professionals who availed themselves whenever there was a need rated the same as the professionals who were available and accessible every fortnight at 10.3%. The professionals who were accessible all the time rated the same as those were accessible once a week at 6.9%. Only 3.4% of the professionals integrated on design meetings.

4.2.2 Collaboration challenges

Table 4.2 gives an overview of how the professionals contributed, complemented, perused new ideas, proposed new ideas and made honest project decisions, trusted and respected each other. Professionals showed high levels of collaborating their professional attributes. At least 32% of professionals have agreed to familiarize themselves which each other prior sharing and exchanging their ideas. An average 29.3% of the professionals stated that collaboration amongst team members had to be done in the spirit of mutual trust for each other whereas 21.3% of professionals believed respecting each other as professionals should be the first priority before all other facets of collaboration could be entertained. Whereas trust goes hand in hand with honesty, 17.3% of professionals suggested that honesty should be practiced amongst the team members in order to build trust within the professional team. However, some of the professionals suggested that trust requires professional competence on duties and responsibilities performed by each team player.

With views that related to the pursue of new ideas, problem solving, decision making and the acknowledging of other team members' roles in the project, most professionals collaborated well. In fact 27.8% pursued each others' ideas, 16% responded to contribute suggestion to value engineer the projects and to solve projects challenges as a team. Moreover, 13.2% of the professionals expressed to be knowledgeable about other team members' role on the projects and proposing solutions to members of the professional team. However, most professionals did not give their comments on whether they complement each other's work and made collective decisions with other team members. Only 8.3% and 5.6% of the construction professionals responded to be complementing each other's work and making collective decisions as a team respectively.

4.2.3 Communication challenges

Table 4.3 gives an overview of how professionals communicated amongst themselves and the challenges they encountered during their communication process.

According to the responses, professionals communicated verbally, through emails, phone calls, team intranet, Dropbox and project intranet. Professionals also transferred information

on hard copy drawings and also used fax machines. In all communication media used on site, verbal communication was used the most with 38.4%, followed by phone calls at 34.2% and emails at 26%. Only 1.4% of the professionals used intranet and fax machines to transfer information.

The communication challenges faced by the construction professionals included late responsiveness to information, unavailability of professionals, lack of competency by some professionals, project information being delayed and miscommunication. The most common communication challenges the professionals faced was the late responsiveness of information from the team members at 42.1% and the unavailability of the professionals at 37.8% respectively. This was followed by 7.9% of delayed information. The remaining communication challenges were below 5% and had to do with the lack of competency by other professionals, inability to adjust to new ideas, improper languages, and miscommunication of project information.

4.2.4 Coordination challenges

Table 4.4 gives an overview of professionals on how they linked together various parts of their responsibilities in an effort to accomplish a set of activities. The results show different functions as performed by various professionals and how those functions were controlled and managed by the professional team. Those that performed architectural services were about 21.8%. Quantity surveying services which encompass cost planning, monitoring and control also contributed 21.9%. Project management functions which included the supervisory role of professional team contributed 18.8%, so as the civil and structural engineering professionals. The electrical professionals performing electrical functions contributed to 12.5% and the mechanical professionals contributed to 6.3%.

Based on the type of functions the professionals performed in relation to their scope, different views expressed how professional tasks and activities were controlled and managed within a project. In all the professionals interviewed, 30.8% suggested that their sets of activities and responsibilities were controlled and managed during coordination meetings only. At least 17.9% of professionals managed and controlled their sets of tasks and activities during design and coordination meetings. On the other side, 15.4% of professionals suggested that their professional functions were better controlled and managed whenever there was a need for input. About 12.5% of respondents coordinated project tasks and activities based within the work place. The professionals who coordinated the project tasks and activities based on mutual agreement contributed to 7.7%. The same rate of 7.7% was also applicable to those professionals who controlled and managed their activities all the time. At least 5.1% of professionals managed and controlled their sets of tasks and activities during site meetings. The minority of professionals contributing to 2.6% coordinated tasks daily, including those that managed and controlled their tasks once a week.

4.3 Conclusion

This chapter has presented how the raw data was collected and processed to give the results of the study. These results and their implications have not been discussed yet. This is the purpose of the next chapter.

Chapter 5

Discussion and Recommendations

Chapter 4 presented the processed results of the survey, but did not discuss the findings. This chapter discusses these results and makes some recommendations. There are some subtle, but enlightening points from the survey, that are not captured in the results in Chapter 4. The discussion highlights some of these.

In some cases, the discussion leads to natural solutions to some of the challenges that are exposed. These solutions are captured throughout Section 5.1.

There appears to be one grand solution to many of the fragmentation challenges presented. This solution is discussed in Section 5.3.

5.1 Discussion of the Results

A list of construction projects was compiled which shows the geographic locations of the construction professional members as shown in Appendix B. A total of 26 construction projects accompanied by the professional teams were selected from this list. The aim was to reach at least 50 professionals-2 from each project-to participate in the interview session for data collection. Appendix E shows the project intrinsic properties from project size (budget), project type, project delivery method, project location and the type of client.

From the 50 participants that were projected, only 32 construction professionals participated in the study which gave a response rate of 64%. The participants have been involved in different types of projects namely restoratives and repairs, renovations and additions and new construction developments. In the 26 projects executed, 42% projects were for restoratives and repairs, followed by 35% projects of renovations and additions. The remaining 23% projects were for the new construction development. Geographically, 38% of the projects were executed in the greater city of Johannesburg, 23% of the projects were executed in Ekurhuleni municipal region, 19% of the projects were executed in the greater city of Tshwane, 8% of each projects were executed in Randfontein and Midvaal region and only 4% of the projects were executed in Merafong municipal region. Apparently 92% of the projects were procured and delivered through Design Bid and Built (DBB) and 8% of the projects were procured and delivered through Design Built (DB).

The public sector financed 81% of the projects with a budget of R410,4 million whereas the private sector client financed 9% of the projects with a budget of R1,224 billion . In retrospect, most of the project executed were from the public sector clients but a big portion of the budget was invested in the private sector projects.

The study uses these intrinsic properties of the projects to find out whether they contributed to fragmentation challenges experienced by the construction professionals. These challenges are categorised into integration, collaboration, communication and coordination based on the presentation of the results in Chapter 4.

5.1.1 Integration challenges

Most of the professionals met on site every fortnight to integrate their attributes. These professionals were mostly involved in the restoratives and repairs projects. The projects were for the purpose of restoring and repairing existing facilities that were damaged. The challenges with the restoratives and repairs projects were that there were no as-built drawings given to the professionals. [1]Therefore, professionals could not verify the specific details of the work to be executed. Hence, the professionals integrated by meeting on site to assess the scope of the work. Some of the professionals who were involved in the restoratives and repairs projects met weekly, others once a month as per the arranged meetings to integrate their attributes. Even though some professionals stated to meet whenever there was a need, that was because the projects' scope were small and the budgets of restoratives and repairs projects were relatively smaller than other types of projects.

With regards to new construction developments, the construction professionals stated that they integrated their attributes all the time or even daily through design and coordination meetings. The reason to integrate their skills more frequently was the demanding nature of the projects. Other professionals described their projects as being more complex with limited time of execution.

On renovations-and-additions projects, some professionals integrated every fortnight while some agreed on the ongoing future dates of site and coordination meetings everytime they met. Some professionals integrated their attributes whenever there was a need. Other professionals integrated weekly and on a fortnight basis.

It is clear from the results that the manner in which the professionals met to integrate their attributes is directly related to the type of the projects executed. Most of the professionals who were involved in the study executed restoratives and repairs projects and renovations and additions projects. These are the professionals who met every fortnight, some on arranged meetings and others met whenever there was a need in order to integrate their attributes. The few professionals who integrated daily and some once a week through design and coordination meetings were involved in projects of big budget scale, and the projects were considered to be complex.

It appears that the construction professionals availed themselves and made their skills accessible on different time slots depending on the needs and requirements of the projects. In

[1]Maybe the city council needs to improve its record-keeping procedure of the approved building design.

essence, the professionals integrated their attributes by way of scheduling meetings in order to share, exchange and transfer information among team members. There was not a trace of any mentioned methods or tools that were brought forward and amalgamated with existing project processes and activities to form an integral whole system that shares, exchanges and transfers information among team members as espoused by [14]. Only the tools or systems that the professionals used to provide their professional services were left behind their work practices. With the information shared and exchanged in the meetings, the professionals were able to integrate it using their office software tools i.e. Computer Aided Software (CAD), winQS etc., in order to amalgamate some of the project processes and activities.

Integration requires the professionals to come together under an umbrella of oneness and merge their organisational culture, goals and needs into a single unified supporting unit [32]. Based on the findings of the study, the construction professionals did not have a standardised approach such as "integral whole system" or "single unified supporting unit" from which their attributes were integrated. This view does not seem to promote a unified working environment where sharing, access to and exchange of information is free and available to all the disciplines involved in the project as espoused by [32].

By virtue of professionals solely residing within their own organisations and having to integrate at the same time, professionals were forced to make means of occasionally scheduling time slots to integrate their attributes. Through separate organisational boundaries, professionals wanted to maintain their own individual identities, which assisted in giving them recognition and recommendation for future business. This contrasts the same view iterated by [32] that the construction professionals ought to come together under one umbrella in sharing their attributes and have one defined culture, goals and recognition in order to achieve integrated project goals.

In view of professional attributes being easily and freely accessible and available, the majority of professional individuals (44.8%) agreed to avail their attributes as per scheduled meetings. Only few professionals (6.9%) availed themselves and made their attributes accessible all the time. Some of the professionals (10.3%) availed their attributes to be accessible every fortnight while some of the skills were accessible as and and when required. Since most of the professionals could only avail their attributes on scheduled meetings, this suggests that the methods used by the professionals to avail and access their attributes were limited to scheduled meetings.

As highlighted previously, the professionals availed their skills to be accessible depending on the needs of the projects. Therefore, construction professionals could not have achieved greater integration as envisaged by [32] that for a project to achieve greater integration, there should be collaborative working practices, methods and behaviors for free accessibility and availability of information amongst professional team members.

By looking on the integration results holistically, there seems to be a pattern on the frequency of meetings the professionals integrate. With regards to the types of projects executed, most professionals who were involved in the restoratives and repairs projects used to integrate every fortnight, as per scheduled meetings or whenever there was a need. The same pattern occurred with the professionals that were involved in the renovations-and-additions type of projects. The professionals that were involved in the new construction developments highlighted a different

pattern that suggested they met once a week to integrate their attributes and they indicated that their attributes were integrated all the time. Those professionals who integrated all the time described their project scope as being more complex with huge expenditure and therefore required full time professionals dedicated to the project.

In light of the procurement delivery method of the project, most restoratives and repairs projects were procured under DBB, which did not require the early involvement of the contractor. Therefore, the construction professionals integrated their attributes from the planning stage to the procurement stage without early involvement of the contractor. This was done through site assessment for scope verification. Only two projects, the new construction developments were procured using DB. From the scope and the budget point of view, the projects carried huge budgets (R200 million and R600 million) and the project's scopes were of a complex nature. The clients were also from the private sector whereas on the restoratives and repairs and renovations and additions, the clients were from the public sector namely, Department of Infrastructure Development (DID) and the Independent Development Trust (IDT).

The type of procurement method seems to have contributed in the manner the professionals have integrated their attributes. Based on the integration results, the construction professionals indicated that professionals skills were not freely and easily accessible as they were constrained geographically. However, they were willing to avail themselves as and when they were required. Some professionals agreed to avail their skills as per scheduled meetings whereas other professionals stated clearly that they could not avail themselves all the time as they had other projects to manage. The professionals who procured the projects through the use of Design Bid and Build (DBB) raised concerns on the lack of professional expertise for self supporting roof designs, echo slabs, etc., on the project that were deemed necessary for tender purposes. These expertise were only procured after the tender processes, which came at high costs, post main contractor tender selection. The costs could have been avoided by choosing the Design Build (DB) procurement process.

Most of the projects executed were located in the Gauteng region, particularly in Johannesburg, which gave some professionals a ground advantage of not having to travel long distances. Hence, it was easy for them to decide to meet once a week in other instances.

Integration in this report requires that:

- the professionals must come together under an umbrella of oneness and merge their organisational culture, goals and needs into a single unified supporting unit [32].
- the professionals must promote a unified working environment where sharing, access and exchange of information is free and available to all the disciplines involved in the project [32].
- there should be collaborative working practices, methods and behavior for free accessibility and availability of information amongst professional team members.

Based on the findings of the study, the construction professionals did not have a standardised approach such as "integral whole system" or "single unified supporting unit" from which their attributes were integrated. Only the tools or systems that the professionals used to provide

their professional services were left behind their work practices for office use. The construction professionals occasionally scheduled time slots to integrate their attributes depending on the needs of the project. Moreover, the professionals are geographically dispersed and stated to have other project commitments, which fostered them to spread their time and resources sparingly. There are some existing organisational boundaries within the professionals' practices on which the professionals derive recognition and recommendation for future business. These organisational boundaries foster the construction professionals to maintain their own individual identities, as opposed to unify them, and in the processes the professionals do not fully exploit the integration process and become fragmented.

5.1.2 Collaboration challenges

Based on the 4.3, most professionals indicated that they collaborated well as most team members were familiar with each other. They also trusted each other to share their professional attributes. Some professionals stated that respecting each other as professionals should remain first priority before all other facets of collaboration can be entertained. Professional team members believed that honesty, trust and respect should be the basic principles of working in a team in order to collaborate their professional attributes. Construction professionals collaborated in all types of projects. By looking at the intrinsic properties of the project, the process of collaboration was not affected by whether the project was DBB or DB, neither was it affected by the type of client.

The manner in which the construction professionals have collaborated is supported by [15] that suggests that the construction team members are expected to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honesty, trust, and mutual respect. However, this does not seem to measure fragmentation except to demonstrate the atmosphere within which the professional members collaborated.

The professionals shared suggestions amongst each other, followed by pursuing each other's ideas and solving project challenges. The professionals also proposed solutions as a team as well as being informed of each other's tasks despite the project scope or budget. While the professional members showed levels of collaboration by ways of sharing suggestions, pursuing each other's tasks and the likes, this does not mean that collaboration is fragmented, but to demonstrate the levels of collaboration from the most to the least task. This manner of collaborating is consistent with the view of [35] which states that during collaboration, professional team members should become aware of each other's type of knowledge and skills and exploit such knowledge and skills for better decision-making.

A view expressed by some of the professionals pointed out that some team members need to move from being buried to their own ideas and accommodate other professionals' ideas as this hampers project progress, making it pointless for other professionals to collaborate. Decent communication and soft skills need to be emphasised during training as well as on the workplace.

The collaboration results were not able to measure fragmentation quantitatively. Therefore, one cannot deduce whether the professional members were/not fragmented during collaboration process. It is required that the future study develops collaboration methods or ways that can

measure fragmentation on collaboration

5.1.3 Communication challenges

The communication results showed that the construction professionals communicated verbally, others used phone calls or emails as their means to communicate more often than any other medium. The geographic locations were the determining factor as professionals were segregated in their practices while aiming to interact with each other in an effort to transfer information [18]. The media of communication used cut across all types of project spheres. In addition, the communication media were not affected by the project type, neither were they affected by the type of client or the project scope.

The construction professionals encountered challenges related to late responsiveness to information from other professionals and their unavailability. The professional members were bound by contracts which guided them when to respond to information. However, it remains questionable whether those contracts were effective. The issue regarding the response to information should be dealt with the moment it arises, since certain project information may require immediate attention from the professional members. It is recommendable for professional members to face disciplinary action for their late responses to information. It is also imperative for the professional team members not to be overloaded with many projects, but to be allocated enough time to focus on every project in order to deliver the required information at the required time. Concerning the unavailability of professionals, be it planned or unplanned leave, it was requested on other projects for the professionals to have representatives so that the transfer and sharing of information can be maintained.

Construction projects by nature are temporary and unique in their form, with a new set of professional team members per project. Already, that exhibits unfamiliarity of professional individuals. As a result, communication tends to be complex and even difficult to maintain as individuals find themselves with little incentive to share knowledge or methodologies [18].

Other challenges that were raised were the lack of professional competency caused by misinterpretation of project information and miscommunication by some construction professionals. In other instances, it was stated that some professionals delegated work to incompetent or rather inexperienced individuals who could not communicate designs or cost models properly. While an incompetent professional can either be experienced or inexperienced, the professional practices must ensure that those delegated to manage the projects are properly trained and supervised.

On the other hand, professional members raised concerns about specialist professionals who did not entirely communicate special items of work during coordination meetings. This made it difficult for the project manager to coordinate such special items of work with the entire project tasks and activities.

Some professionals viewed the project procurement method of DBB as having a negative impact on communication due to its sequential nature as it caused delays in receiving certain project information from other consultant. [6] confirmed the process of issuing hard copy drawings or discs to be fragmented in nature especially if such drawings require an input of other design professionals. For instance, the architect being the main designer has to design and finish

the facility first before handing over the designs to engineers to fill engineering gaps and the estimator is left last to cost the project. The process has proven to be time consuming and costly because by the time the project cost is determined, there might be a need to adjust architectural or structural changes on the design drawings which may result in cost overruns of the project. Again, the idea is supported by [10] by confirming that DBB faces major challenges when it comes to the procurement processes, be it professional or supplying services. The challenges faced by the professionals suggests the communication process to be fragmented.

5.1.4 Coordination challenges

The professional team members that took part in the survey were architects, quantity surveyors, project managers, structural and civil engineers, electrical and mechanical engineers. An observance made on the professional team is that there is an overlap of most professionals in the project because they tend to play more than one role whereby the architect is the project manager at the same time. The same applies to the the quantity surveyors who also act as project managers on other projects. Some civil engineers were appointed as the structural engineers of the projects. The electrical discipline also showed the same results whereby an individual is both an electrical and a mechanical engineer. However, this is not to say there were no multi-skilled individuals in one discipline but to recognise that most team members play more than one role in a project.

Most construction professionals preferred to control and manage their tasks and activities during coordination meetings or on an as-and-when-required basis. However, most project tasks and activities were prepared within the professionals' practices. The challenge with this is that the construction professionals will not be working together as a team in sharing information among themselves. The important aspect on coordination is that all members of the professional team must come together to manage different sets of tasks and activities. In cases whereby some of the professionals prefer to manage their activities and tasks on their own within their work places, the process of coordination becomes distorted. When the construction professionals are willing to coordinate by working together and sharing information among themselves, their efforts enhance greater performance on project activities. Therefore, it is important for the construction professionals to manage their sets of activities and tasks as a team, within an environment that allows them to come together so that their efforts can enhance greater information sharing.

To some professionals, the activities and tasks were coordinated either on site meetings or during design off-site meetings. Depending on the project type, the needs and requirements of the project, the construction professionals coordinated their attributes either weekly, fortnightly or even monthly. These construction professionals coordinated their attributes as envisaged by [17] in that they fostered individuals to bring together their sets of responsibilities to develop a collective set of activities that can be controlled, managed and operated within a team. In most of the projects, the project manager was appointed to play a supervisory role that leads the professional team.

A major coordination challenge arose whenever professionals missed coordination meetings.

In some professional teams, it was requested that each discipline should have two representatives in order to deal with the non-attendance of coordination meetings and also to ensure that information is shared on time. All the projects procured through DB required at least two representatives per discipline. The scope of these projects was considered complex and as such, the professionals were required to avail themselves all the time. The challenges the construction professionals faced with regards to the coordination process reflect an element of fragmentation amongst the construction professionals.

5.2 The grand solution (BIM)

The recommendations of the results follow the same sub-topics under which the results were discussed in Section 5.1.

BIM use to mitigate integration challenges

Based on the findings of the study, the construction professionals did not have a standardised approach such as "integral whole system" or "single unified supporting unit" from which their attributes were integrated. In fact, there was not a trace of any mentioned methods or tools that were brought forward and amalgamated with existing project processes and activities to form an integral whole system that shares, exchanges and transfers information among team members as espoused by [14]. Apparently, the type of projects like restoratives-and-repairs and renovations-and-additions projects did not have as-built drawings. Therefore, professionals could not verify the specific details of the work to be executed except by going to the construction site to inspect the ongoing challenges. Through Building Information Modelling (BIM) use, the construction professional members will have an "integral whole system" and/or "single unified supporting unit" to integrate their professional attributes. The construction professionals will not have to go to the site whenever there are challenges on the facilities, but use BIM to portray and present visual processes concerning planning, design, construction, operation and maintenance of facilities since BIM comes handy as a standardized readable machine information model [12].

On the other hand, the construction professionals occasionally scheduled time slots to integrate their attributes depending on the needs of the project. The construction professionals are geographically dispersed and stated to have other project commitments, which fostered them to spread their time and resources sparingly. Moreover, the integration results stated that the construction professionals were not freely and easily accessible as they were constrained geographically. BIM facilitates collaboration between individuals who are frequently involved in the same project but residing on different geographic places and those sharing common interests towards the project is the same [42]. BIM exhibits the interoperability role, thus making BIM model to be aware of other models by collectively, semantically and technically allowing BIM to interoperate with other models. It does so through the use of BIM standards which are primarily used to exchange data between parametric modelling softwares. BIM understands that the professionals will not always be available at all times. By using BIM tools to manage projects, professional attributes become available and accessible in that once the model is

built, it remains as a shared knowledge resource for information about the built facility. The professionals that utilise BIM model must ensure that prior to the execution of the project, the model is provided with the required data and information in order to portray and present visual processes concerning planning, design, construction, operation and maintenance of the facility [19].

By using BIM, The construction professionals will fully exploit the integration process and alleviate the fragmented processes. BIM has characteristics of attaining greater integration in that it can enable construction professionals to participate in a virtual design and construction [39], as it digitally presents the physical and functional characteristics of the facility. During integration, BIM integrates digital descriptions or designs of the project from all design individuals and their relationship to each other in a precise manner, ensuring that professionals afford to query, simulate and estimate activities and their effects on the life cycle of the facility [19]. As a shared knowledge resource center, BIM cut across the organisational boundaries that seem to entangle professionals practices by unifying the professional team.

BIM use to mitigate collaboration challenges

Collaboration results were not able to measure fragmentation quantitatively. Therefore, one could not weigh the fragmentation of the construction professionals during collaboration process. The professionals shared suggestions amongst each other, followed by pursuing each other's ideas and solving project challenges. The professionals also proposed solutions as a team as well as being informed of each other's tasks. However, during the process of collaboration, professional team members will not only contribute and complement each other whenever there is a need but by using BIM, professionals will continuously work together as a team towards developing a successful project by bringing the contribution of project designers and building professionals into a single synchronised building model rich of information [19]. Professionals will benefit from collaboration opportunities provided by BIM, which allows the integration of designs from various disciplines to be tested and to detect any errors that may implicate the construction costs.

BIM requires professional competencies as it requires expert knowledge in the development of the model. On issues related to trust, honesty and respect, BIM as a tool does not cater for human relationships but has distinct parametric features which define objects as parameters with relationships to other projects, automatically updating BIM model as parametric objects are being modified [10].

BIM use to mitigate communication challenges

The construction professionals encountered communication challenges related to late responsiveness to information from other professionals and their unavailability. Through the use of BIM, professional members stand a good chance to eradicate issues concerning late responsiveness because BIM as a standardized readable machine exhibit the interoperability role, thus making BIM model to be aware of other models by collectively, semantically and technically allowing BIM to interoperate with other models [10].

Construction projects by their nature are temporary and unique in their form, with a new set of professional team members per project. Already that exhibits unfamiliarity of professional individuals. As a result, communication tends to be complex and even difficult to maintain as individuals find themselves with little incentive to share knowledge or methodologies. Professional team members will have to ensure that their operative models have BIM features to enable them to communicate with each other. BIM provides opportunities to deal with communication challenges in that it uses BIM authoring tools to be able to interact with each BIM discipline member to transfer and exchange information [45]. Within BIM model there are built-in features such as BIM standards, which enable all relevant data that are captured in the BIM model to be transferred and exchanged successfully amongst team members [43].

Other challenges that were raised were the lack of professional competency caused by misinterpretation of project information and miscommunication by some construction professionals. In other instances, it was stated that some professionals delegated work to incompetent or rather inexperienced individuals who could not communicate designs or cost models properly. The construction professional members also raised concerns about specialist professionals who did not entirely communicate special items of work during coordination meetings. This made it difficult for the project manager to coordinate such special items of work with the entire project tasks and activities. On the issue concerning professional competency to communicate design, BIM allows the design team to starts the 3D coordination with the design specialists and integrates specialist designs into the BIM model. The professional team members in the early stage of design also get a visual idea of whether the design fits very well with the client's intentions [19]. BIM is a good communication model, in that it communicates all the information that is built into it and requires project team to be experts of BIM tools so that the project can be modelled in detail, scrapping out all ambiguities [33].

The construction professional members using BIM will benefit in terms of being able to access information instantly, undertake their filing management tasks through online document collaboration session, manage electronic tracking of the activity and automatic reference file detection for effective communication despite being geographically separated [19].

BIM use to mitigate coordination challenges

A major coordination challenge arose whenever professionals missed coordination meetings. In some professional teams, it was requested that each discipline should have two representatives in order to deal with the non-attendance of coordination meetings and also to ensure that information is shared on time.

As iterated in Setion 5.1 under collaboration discussion, most construction professionals preferred to control and manage their tasks and activities during coordination meetings or on an as-and-when-required basis. Most of the project tasks and activities were prepared within the professionals' practices. BIM as a virtual model of a constructed facility provides the virtuals of all functional elements of the facility as designed and integrated by the design team. The virtual model serves as a coordination tool by consolidating all information of the project into one holistic model, allowing professionals' sets of activities to be managed and controlled through

the model and ensuring the active role of information sharing within the professional team [19].

Whereas BIM supports professionals' views on coordination, BIM boundaries in terms of scope of work must be clearly defined from the inception of the project. The project team must engage on how the model is to be built by being able to define BIM functional capabilities and the individual to oversee the model. In addition, the professional team must thoroughly consider the type of relevant information required, the manner in which the model is to be shared, including the agreed tools to manage the model's interoperability issues [33].

Since the professional team members view the project manager to have a supervisory role on the professional responsibility in most projects, BIM is silent in terms of the individual who will have a supervisory role to oversee the model. The study suggests that to be left to the professional team to decide on a suitable BIM expert candidate amongst members of the team, to oversee the model and play a supervisory role in terms of detailing the model even further. Should the professional views select the project manager as a suitable candidate to coordinate project tasks and activities, BIM will assist the project manager to control and manage activities of professional team efficiently. BIM would have modelled the design in 3D, modelled out the management of construction site in terms of sequencing and cost controlling etc [46].

BIM Addendum seems to be the best feature to address the likely concerns of design professional roles and responsibilities. BIM Addendum is a type of arrangement emanated from BIM rider, which binds the key players within a project to collaborate, coordinate and exchange information using BIM tools. It is issued by Consensus 301 to guide and stabilise the concerns of the professional team in their professional roles and their involvement in the use of BIM [39].

Chapter 6

Conclusion

Construction professionals tend to face some major fragmentation challenges during the execution of construction projects. The aim of this study is two-fold. First, it endeavors to identify the fragmentation challenges encountered by the construction professionals. Second, it investigates the dependence of the fragmentation challenges on the intrinsic properties of the construction projects such as project size, client type, project location and project delivery methods. Because the subject of fragmentation is very broad, this study deliberately focuses on its manifestation in four categories, namely integration, collaboration, communication and coordination.

The data was collected from the construction professionals mainly from Gauteng in South Africa, using open-ended interview questions. Qualitative Data Analysis (QDA) software was then used to analyse the collected data. This generated the quantitative results reported in Chapter 4. It turned out that these numerical results did not translate to a quantitative measure of fragmentation for each sector. As an example, under integration, various teams met with varying frequencies, yet there is no direct indication of how much each of these teams was fragmented by[1]. However, there are some subtle, but enlightening points from the survey that suggest that the construction professionals are indeed fragmented.

6.1 Summary of the results

This section summarises the results of the study by capturing the main points on integration, collaboration, communication and coordination.

6.1.1 Integration

The construction professionals integrated their attributes in various ways and were not limited to one method of integration. Regarding the manner on which the construction professionals integrated their attributes, fortnight meetings ranked first, followed by on site inspection meetings. Some professionals preferred to integrate their attributes whenever there was a need. The manner in which the construction professionals integrated was affected by the type of project

[1] This is what is has been summarised as weighted fragmentation in the text.

executed. The professionals who integrated their attributes by attending scheduled site meetings were mostly involved in renovations and additions projects and restorative and repairs projects. Most of these site meetings were scheduled every fortnight and some of the meetings were scheduled monthly. Only few of the professionals integrated their attributes during design meetings, some integrated once a week while others integrated all the time throughout the project. This was because the projects were new construction developments, with big project scope and were considered complex.

The level of integration was largely perpetuated by the geographical dispersion of professional team members which fostered them to spread their time and resources sparingly. The construction professionals were also found to be physically constrained to make their professional attributes easily and freely accessible on a daily basis as they were having other project commitments. These challenges have led many professional teams to resort to scheduled meetings in order to integrate their professional attributes.

Based on the findings of the study, there was not a trace of any mentioned methods or tools that were brought forward and amalgamated with existing project processes and activities to form a "single unified supporting unit" that shares, exchanges and transfers information amongst the team members. Only the tools or systems that the professionals used to provide their professional services were left behind their work practices for office use. There were some existing organisational boundaries within the professionals' practices on which the professionals derive recognition and recommendation for future business. These organisational boundaries foster the construction professionals to maintain their own individual identities, as opposed to unifying them. In the process, the professionals do not fully exploit the integration process and become fragmented.

6.1.2 Collaboration

With regards to collaboration, the construction professionals firstly ensured that they familiarised themselves with one another. This helped them to trust each other and respect each other's professional duties. In the process of collaborating, they became open and honest to one another in their professional duties. On issues concerning pursuing new ideas, solving problems, proposing solutions and making decisions with other team members, professionals acted mostly on contributing suggestions as a team. The professionals regarded pursuing new ideas the same as solving problems as a team. This was also applicable to proposing solutions to each other and being knowledgeable about each other's work. However, only few professionals made collective decisions as a team. The construction professionals seemed to have collaborated well despite the project size. Their way of collaborating was not even affected by whether the project was for the public or private client, neither was it affected by the type of delivery method chosen for the project.

6.1.3 Communication

Construction professionals transferred information amongst themselves by communicating verbally, through phone calls, emails and using intranet. These communication media were used

despite the project size. They were also not affected by whether the client was a public sector or a private sector one, nor the project location. In essence, verbal communication was mostly used, followed by phone calls and emails respectively. Only few individuals used intranet as a way of communicating. The high usage of verbal communication made sense since most of the attributes were integrated on site. While phone calls and emails follow each other in their usage respectively, this is because the professionals spent most of the time managing their activities and tasks in their respective offices. On communication challenges, the professionals struggled with late responsiveness to information, followed by the unavailability of some team members when information was communicated or required. In addition, the lack of competency by some professionals to be able to communicate professional attributes contributed to communication challenges. On other cases, some of the professionals found it difficult to adjust to new ideas that were brought in the project.

6.1.4 Coordination

Coordination between the professional team members fosters individuals to bring together their sets of responsibilities to develop collective sets of activities which can be controlled, managed and operated within a team. The construction professionals coordinated their attributes in various ways. Though coordination meetings ranked highest in terms of their use on how construction professionals manage and control their sets of activities, some professionals preferred to manage their sets of activities in their work place while some coordinated the activities whenever there was a need. A major coordination challenge arose whenever professionals missed coordination meetings. In some professional teams, it was requested that each discipline should have two representatives in order to deal with the non-attendance of coordination meetings and also to ensure that information is shared on time. Certain coordination methods that were preferred by the professionals such as managing project tasks and activities in the work places are not in accordance with the principle of coordination process as they discourage the professional team to come together to merge their activities and tasks into one unit.

6.2 The proposed solution

It appears implementing Building Information Modelling (BIM), as was done in other markets globally, may solve most of the fragmentation challenges. BIM is a virtual model of a constructed facility, showing all functional elements of the facility as they are designed and integrated by the construction professional team. The use of BIM as an “integral whole system” or “single unified supporting unit” will enable the construction professionals to amalgamate both new and existing project processes with their activities. BIM will also be used to portray and present visual processes concerning planning, design, construction, operation and maintenance of facilities. BIM comes handy as a standardized machine and a readable information model, rich in project data and knowledge, as built-in by the professional team members. This resource center of information will allow the project stakeholders to make informed decisions as they will have a clear picture of the end product before it is constructed.

6.3 Short-falls of the study

The study itself is not perfect. This section discusses some of the shortfalls.

It seems that there are loop-holes in the data collection and analysis because the results do not tell the level of fragmentation therein. To measure fragmentation on the results, it will require to prove that the manner in which the construction professionals demonstrated to share their attributes is indeed fragmented. The results of the study demonstrated how the construction professionals integrated, collaborated, communicated and coordinated their professional attributes amongst themselves and the challenges they faced. While the results are derived quantitatively, one could not quantitatively measure fragmentation on integration, collaboration, communication and coordination. The results did not translate to weighted fragmentation.

The tool used to collect the data had limitations and did not address the socioeconomic characteristics such as age and the level of experience the construction professionals have. This is important as it would have assisted to analyse the professionals on their understanding of fragmentation and the project processes of integration, collaboration, communication and coordination. It was discussed in the study that some of the professionals answered the interview questions anyhow and at times, their answers did not relate to the questions asked. However, based on the discussion of the results, it is clear that the construction professionals were to some extent fragmented in the way they shared their professional attributes.

6.4 Outlook

The limitations contained in this research report provide a natural guide to future research. Typically, the research methodology employed in this study has flaws that were addressed in Section 6.3. These short-falls map out avenues for future work, which inter alia include the following:

Since the study used open-ended interview questions as a tool for data collection, the challenge with this method is that the responses received from the participants of the study did not measure a definite understanding of the concept of fragmentation. Despite the concepts of integration, collaboration, communication and coordination being defined to the participants prior to the question and answer sessions, the level of understanding on these concepts varies from one member to another. The use of open-ended interview questions allowed the participants the liberty to answer the questions anyhow, but also made it difficult to get the correct answers that relate to the concepts of integration, collaboration, communication and coordination. One contributing factor that was not factored into the study is the years of experience by the professionals. This is salient because the professionals who appeared more experienced had a better understanding of the concepts of integration, collaboration, communication and coordination than the newly graduated construction professionals. By repeating the same study with structured questions and developing a numerical measure of fragmentation, the shortfalls mentioned in the study can be addressed. The literature review on BIM owes most of its citations to the international BIM literature as there was not enough local literature. Therefore, it makes sense to review BIM within the South African context to understand its status quo in South Africa.

6.5 Conclusion

This study has unearthed a number of fragmentation challenges as proposed in the introduction. The intrinsic properties of the construction projects do contribute to fragmentation, but only in certain cases. However, it turns out that there are various avenues to improve the study of fragmentation in the construction industry in South Africa.

Appendix A

Description of themes coded

Appendix A.1 to A.5 tabulates the results from the interview questions on construction fragmentation. Every participant was asked to give an appropriate open answers to the questions asked. The interview questions were categorised into integration, collaboration, communication and coordination. Before questions were asked, the participants were given a definition of integration, collaboration, communication and coordination so that they could answer in relation to the context of the study. About 3-4 questions were asked per category which allowed the respondents to answer according to their satisfaction. Below is the description of themes that were coded from the answers given by the respondents.

Table A.1: Description of themes coded for integration

CODE	DESCRIPTION	COUNT	%CODES	CASES	%CASES
Integrated attributes on site	meet on site and deal with the problems	6	1.3	4	14.3
arranged meetings on site	come to side on arranged meetings and thats how they become accessible and available	10	2.1	9	32.1
every fortnight in site meetings	every fortnight	14	3.0	11	39.3
Available on scheduled meetings	availing ourselves as per scheduled meetings	13	2.8	10	35.7
integrate our skills whenever there is a need	integrate our skills whenever there is a need	9	1.9	6	21.4
Skills accessible on site meetings	Our skills were accessible everytime on site meetings	1	0.2	1	3.6
Integrated skills once a week	integrate our skills more often and that was done once a week	2	0.4	2	7.1
Team was available and accessible all the time	Team was available and accessible all the time	5	1.1	5	17.9
Professionals were available whenever there was a need	Professionals were available whenever there was a need	3	0.6	2	7.1
Integrate during design meetings	Integrate during meetings for design error detections	1	0.2	1	3.6
Skills available and accessible every fortnight	so as our availability and the accessibility	3	0.6	3	10.7
Integrated once a week	Sometimes once a week	1	0.2	1	3.6
Members were available and skills accessed once a week	Professionals avail themselves once a week and so as the accessibility of their skills.	2	0.4	1	3.6
Integration happened all the time	Integration happened all the time because this was a fast track project	4	0.9	4	14.3
professional attributes were accessible all the time	Accessibility of professional attributes all the time due to the nature of the fast track project.	2	0.4	2	7.1

Table A.2: Description of themes coded for collaboration

CODE	DESCRIPTION	COUNT	%CODES	CASES	%CASES
familiarise ourselves with one another	construction professionals familiarise ourselves with one another	24	5.1	21	75.0
Solve problem as a team	solve problems with the rest of the team	13	2.8	13	46.4
contribute suggestions	we do contribute and give each others suggestions	18	3.8	18	64.3
Complement each other	complement each and persue one other's ideas	12	2.6	12	42.9
Develop suggestion as a team	work as a team by developing suggestion where needed	16	3.4	16	57.1
persue new ideas	persue new ideas with team members	23	4.9	23	82.1
Trust each other	trust is more important	22	4.7	20	71.4
honest in the work that I do	I believe to be honest in the work that I do	13	2.8	10	35.7
contribute on each other's task	we contribute and develop suggestions for each other's tasks	3	0.6	3	10.7
Develop suggestion on each other's tasks	we contribute and develop suggestions for each other's tasks	3	0.6	3	10.7
propose solutions to each other	proposing solutions	19	4.1	19	67.9
make collective decisions	make collective decisions where required	8	1.7	8	28.6
Knowledgeable about each other's work	All professionals are knowledgeable about each other's role or tasks	19	4.1	19	67.9
Professionals respect each other	We respect one another as professionals	7	1.5	7	25.0

Table A.3: Description of themes coded for communication

CODE	DESCRIPTION	COUNT	%CODES	CASES	%CASES
Members familiar to one another	My team members were familiar to one another	1	0.2	1	3.6
Respected each other	we respected each other	9	1.9	9	32.1
Collectively solved project challenges	Collectively solved project challenges	10	2.1	9	32.1
Communicate verbally	communicate verbally in the meetings	28	6.0	26	92.9
Phone calls off-site	Phone calls	25	5.3	25	89.3
Emails	Emails	19	4.1	19	67.9
Professionals not available	professionals tend not to be available at times when contacted	15	3.2	15	53.6
late responsiveness to information	late responsiveness from professional members due to their unavailability and project info could not be approved on time	15	3.2	15	53.6
lack of competency	lack of competency to relay certain project information	1	0.2	1	3.6
Project information delayed	Some design details not shown and no proper go ahead to carry certain aspects of works	4	0.9	4	14.3
Challenges of miscommunication	Challenges of miscommunication at times	1	0.2	1	3.6
communicated whenever there was a need	communicated whenever there was a need	1	0.2	1	3.6

Table A.4: Description of themes coded for coordination part 1

CODE	DESCRIPTION	COUNT	%CODES	CASES	%CASES
Members available whenever there was a need	Members available whenever there was a need	1	0.2	1	3.6
Improper language sometimes used	Improper language was sometimes used	1	0.2	1	3.6
Deployed certain communication tools i.e. intranet	Deployed certain communication tools such as intranet	1	0.2	1	3.6
Activities managed and controlled during design and coordination meetings	Professionals manage their set of activities	7	1.5	7	25.0
Project manager with supervisory role	project manager was appointed to have a supervisory role on the project	20	4.3	20	71.4
Activities and tasks were managed all the time	Activities and tasks were managed all the time whenever there were meetings	1	0.2	1	3.6
Mutual agreement with the team on every project phase	Mutual agreement with the team on every project phase	3	0.6	3	10.7
coordinate all activities during site meetings	coordinate all activities during site meetings	1	0.2	1	3.6
Coordinated activities whenever there was a need	Coordinated activities whenever there was a need	6	1.3	6	21.4
manage their set of activities at their work place	All professional members manage their set of activities at their work place	4	0.9	4	14.3
control project activities during coordination meetings	control project activities during coordination meetings	3	0.6	3	10.7
Site meetings coordination	only get to manage and control project activities during site meetings	1	0.2	1	3.6
Manage project activities as per scheduled meetings	manage and control project activities and tasks as per scheduled meetings	4	0.9	4	14.3
Fortnight site meetings manage activities and tasks	control our set of activities and tasks every fortnight during site meetings	4	0.9	3	10.7
Fortnight meeting to manage project tasks	Managed and control our set of activities and tasks every fortnight during site meetings	1	0.2	1	3.6

Table A.5: Description of themes coded for coordination part 2

CODE	DESCRIPTION	COUNT	%CODES	CASES	%CASES
Civil Engineer appointed for supervisory role	Civil engineer was also appointed as the project manager with a supervisory role	1	0.2	1	3.6
Architect assumed a supervisory role	Architect assumed a supervisory role	1	0.2	1	3.6
Managed and controlled project activities once a week	Managed and controlled project activities once a week through coordination meetings	1	0.2	1	3.6
Two PM firms occupied supervisory role	Appointed two project management firms to oversee every project activity and also occupied a supervisory role	2	0.4	2	7.1
Activities and tasks were coordinated daily unless on public holidays	Activities and tasks associated with the professional team were coordinated daily	1	0.2	1	3.6

Appendix B

Geographical Locations of the Professional Team

The information of the geographical locations of the professional team is attached in the unnumbered pages that follow.

Item	Title and Type of Building	Project Location	Client/Developer	Project Manager	Architect	Quantity Surveyor	Civil Engineer	Structural Engineer	Electrical Engineer	Mechanical Engineer
1	Restorations and repairs to Orlando West Secondary School	Orlando West	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Façade Design Architects(Morning Side)	XCF Consultant CC (Rissik Street Surrey House, Joburg)	Onke Consultant (Glen Vista, Joburg South)	Onke Consultant (Glen Vista, Joburg South)	Transelectrical(Midrand)	Transelectrical(Midrand)
2	Restorations and repairs to Madume Primary School	Orange Farm	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Mwelase Architect (Queens wood Pretoria)	XCF Consultant CC (Rissik Street Surrey House, Joburg)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Aluwani Consulting Engineers (Randburg)	Aluwani Consulting Engineers (Randburg)
3	Restorations and repairs to Prinshof Primary	Pretoria Central	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Sabelo Sithole Architect (Auckland Park)	Lethola Cost Associates (Midrand)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Sisqo Engineering (Westonaria, Gauteng)	Sisqo Engineering (Westonaria, Gauteng)
4	Restorations and repairs to Edenpark Primary	Tokoza, Alberton	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Lemaseya Design (Saxonwald, Johannesburg)	IVM Quantity Surveyor (Fourways)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Raphal Consultant (Glenvista)	Raphal Consultant (Glenvista)
5	Restorations and repairs to Matshediso Primary	Katlehong, Eastrand	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Gps Architect cc	IVM Quantity Surveyor (Fourways)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Raphal Consultant (Glenvista)	Raphal Consultant (Glenvista)
6	Restorations and repairs to Lenasia secondary	Lenasia	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Mwelase Architect (Queens wood Pretoria)	DDP Quantity Surveyor (Parktown)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Aluwani Consulting Engineers (Randburg)	Aluwani Consulting Engineers (Randburg)
7	Restorations and repairs to Mohlakeng Primary	Mohlakeng, Randfontein	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Mwelase Architect (Queens wood Pretoria)	DDP Quantity Surveyor (Parktown)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Aluwani Consulting Engineers (Randburg)	Aluwani Consulting Engineers (Randburg)
8	Restorations and repairs to Endicott Primary School	Springs	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Edifice Architect	IVM Quantity Surveyor (Fourways)	SIDO Engineering (Crest Rd, Joburg)	SIDO Engineering (Crest Rd, Joburg)	Ikusasa Engineering (Midrand)	Ikusasa Engineering (Midrand)
9	Restorations and repairs to Enkangala Primary School	Benoni	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Façade Design Architects(Morning Side)	Moteko Cost Consultant (Bryanston)	Onke Consultant (Glen Vista, Joburg South)	Onke Consultant (Glen Vista, Joburg South)	Goni Technical services PTY(Ltd) (Midrand)	Goni Technical services PTY(Ltd) (Midrand)
10	Restorations and repairs to Mamellong Secondary School	Tsakane, Brakpan	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Amanda Architects (Rivonia)	Lethola Cost Associates (Midrand)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Raphal Consultant (Glenvista)	Raphal Consultant (Glenvista)

11	Restorations and repairs to Thutolore Secondary School	Soweto	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Façade Design Architects(Morning Side)	Nkonki Cost Associates	KOCO Engineering (Sandton)	KOCO Engineering (Pretoria)	Raphal Consultant (Glenvista)	Raphal Consultant (Glenvista)
12	Restorations and repairs to Ditau Primary School	Soweto	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Amanda Architects (Rivonia)	Nkonki Cost Associates	Kanybake Enineering	Kanybake Enineering	Goni Technical services PTY(Ltd)	Goni Technical services PTY(Ltd)
13	Renovations and Additions to Baxoxele Primary School	Soshanguvhe, PTA	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Sabelo Sithole Architect (Auckland Park)	DDP Quantity Surveyor (Parktown)	Adiholdings (Pretoria)	Adiholdings (Pretoria)	Raphal Consultant (Glenvista)	Raphal Consultant (Glenvista)
14	Renovations and Additions to MC Weiler Primary School	Alexanda, Johannesburg	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Sabelo Sithole Architect (Auckland Park)	DDP Quantity Surveyor (Parktown)	Adiholdings (Pretoria)	Adiholdings (Pretoria)	Raphal Consultant (Glenvista)	Raphal Consultant (Glenvista)
15	Construction of Sokhulumi Community Centre	Bronkorspruit	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	MMA Architects	DDP Quantity Surveyor (Parktown)	Onke Consultant (Glen Vista, Joburg South)	Onke Consultant (Glen Vista, Joburg South)	Lidwala Consulting Engineers PTY(Ltd)	Lidwala Consulting Engineers PTY(Ltd)
16	Construction of Randgate Clinic	Randfontein	Gauteng Department of Infrustructure Development (Johannesburg)	Alchemy Architects (Bedfordview)	Alchemy Architects (Bedfordview)	DDP Quantity Surveyor (Parktown)	Zitholele Consulting Engineers (Midrand)	Shaweni Consulting Engineers (Northwold,)	Plantech Electrical & Mechanical Engineers (Pretoria)	Izazi Consulting Engineers (Randburg)
17	Upgrading of Far East Rand Hospital to Folateng	Springs	Gauteng Department of Infrustructure Development (Johannesburg)	Design Corazon Architects (Bedfordview)	Design Corazon Architects (Bedfordview)	DDP Quantity Surveyor (Parktown)	Denshe Engineers (Brooklyn, PTA)	Denshe Engineers (Brooklyn, PTA)	Raphal Consultant (Glenvista)	Raphal Consultant (Glenvista)
18	Centurion Gate - Retail & Offices	Centurion	PCN (Pretoria)	ADO Architects (Erasmusrand, Pretoria)	Paul Boshoff Architects (Erasmusrand, Pretoria)	Schoombie Hartmann Pretoria,(PTA)	EDS (Pretoria)	EDS (Pretoria)	Ingplan (Eldoraigne, Pretoria)	Ingplan (Eldoraigne, Pretoria)
19	Mooikloof Shopping Centre	Pretoria East	PCN (Pretoria)	n/a	Boogertmann Architects(Pretoria)	Schoombie Hartmann Pretoria,(PTA)	EDS (Pretoria)	EDS (Pretoria)	Ingplan (Eldoraigne, Pretoria)	Ingplan (Eldoraigne, Pretoria)
20	Heineken Brewery	Sedibeng, Gauteng	Heineken			De leeuw (Johannesburg)	BKS Engineering (Pretoria)	BKS Engineering (Pretoria)	BKS Engineering (Pretoria)	BKS Engineering (Pretoria)
21	GF Hostel Upgrade Phase 4	Carletonville	Gold Fields (Carletonville)	De leeuw (Johannesburg)	n/a	De leeuw (Johannesburg)	Pro-North	Pro-North	Consius	n/a
22	Wits Student Housing	Parktown	Wits(Braamfontein)	Focus Project Manager (Rivonia)	Boogertmann	DDP Quantity Surveyor (Parktown)	PD Naidoo (Illovo)	PD Naidoo (Illovo)	PD Naidoo (Illovo)	PD Naidoo (Illovo)
23	Panorama Alterations		University of Johannesburg (Auckland park)	De leeuw (Johannesburg)		DDP Quantity Surveyor (Parktown)				
24	Aegis call centre	Midrand	Atterbury (Pretoria)	n/a		De leeuw (Johannesburg)				

25	Rosebank Lanes Apartments	Rosebank				De leeuw (Johannesburg)				
26	Adcock Ingram Warehouse	Aeroton	Adcock			De leeuw (Johannesburg)				
27	Alterations to Executive offices	Carletonville	Gold Fields (Carletonville)	De leeuw (Johannesburg)		De leeuw (Johannesburg)				
28	ECSA - Office refurbishment	Midrand	ECSA (Midrand)			De leeuw (Johannesburg)				
29	KDC East - Guesthouses Tsepong (Phase 1)	Carletonville	Gold Fields (Carletonville)	De leeuw (Johannesburg)		De leeuw (Johannesburg)	Pro-North	Pro-North		
30	Comair - Simulator Building	Kempton Park	Comair (Kempton Park)		MEG Architects	Schoombie Hartmann Pretoria,(PTA)				
31	Restorations and Repairs Seipone Primary School	Orange Farm	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Mwelase Architect (Queens wood Pretoria)	DDP Quantity Surveyor (Parktown)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Aluwani Consulting Engineers (Randburg)	Aluwani Consulting Engineers (Randburg)
32	Restorations and Repairs Mahlasedi Primary School	Kagiso, Krugersdorp	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Mwelase Architect (Queens wood Pretoria)	DDP Quantity Surveyor (Parktown)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Aluwani Consulting Engineers (Randburg)	Aluwani Consulting Engineers (Randburg)
33	Restorations and Repairs Willowmead Secondary School	Lenasia	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Mwelase Architect (Queens wood Pretoria)	DDP Quantity Surveyor (Parktown)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Aluwani Consulting Engineers (Randburg)	Aluwani Consulting Engineers (Randburg)
34	Restorations and Repairs Dukathole Primary School	Katlehong	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Mwelase Architect (Queens wood Pretoria)	DDP Quantity Surveyor (Parktown)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Aluwani Consulting Engineers (Randburg)	Aluwani Consulting Engineers (Randburg)
35	Restorations and Repairs Lakeview Primary School	Soweto	Gauteng Department of Infrustructure Development (Johannesburg)	Tau Pride Moteko Project Manager (Bryanston)	Mwelase Architect (Queens wood Pretoria)	DDP Quantity Surveyor (Parktown)	Abaziyo Consultant (Midrand)	Abaziyo Consultant (Midrand)	Aluwani Consulting Engineers (Randburg)	Aluwani Consulting Engineers (Randburg)
36	Impala Court - Flat/Offices	JHB	University of Johannesburg (Auckland park)		De leeuw (Saxonwald)	DDP Quantity Surveyor (Parktown)				
37	American Axles & Manufacturing	JHB			De leeuw (Saxonwald)	DDP Quantity Surveyor (Parktown)				
38	Upgrade of the lecture venues on DFC	JHB	University of Johannesburg (Auckland park)		De leeuw (Saxonwald)	De leeuw (Saxonwald)				
39	Sedibeng Cider Production Plant	Sedibeng	Sesibeng Breweries			De leeuw (Saxonwald)				
40	Kings College Additions	JHB				De leeuw (Saxonwald)				
41	MTN Campus Development	Fairlands JHB	RMB Properties	Bagale Consulting (Midrand)	Boogertman & Krige	Pentad	Aurecon	Aurecon	Claasen Auret	Spoormaker

42	Princess Plot Housing Mixed Development	Roodepoort	Gauteng Human Settlements	Bagale Consulting (Midrand)	Michael Hart Architects	Faller Properties	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering	Electroplan	
43	Slovo Park/Crosby Housing Mixed Development	Crosby Jhb	Gauteng Human Setterments	Bagale Consulting (Midrand)	Michael Hart Architects		PH Bagale (Fairland, Johannesburg)		Batseta Engineering Pty Ltd	
44	Klipspruit/Holomisa Housing Mixed Development	Soweto	Gauteng Human Settlements	Bagale Consulting (Midrand)	Michael Hart Architects		PH Bagale (Fairland, Johannesburg)		Batseta Engineering Pty Ltd	
45	Lawley Ext 3 & 4 Township Establishment	Lawley (South of JHB)	Gauteng Human Settlements	Bagale Consulting (Midrand)						
46	JPC Informal Trading Stalls Upgrade	Around JHB & Soweto	JPC	Bagale Consulting (Midrand)						
47	Drieziek Ext 1 Township Establishment	JHB South	Gauteng Human Settlements	Bagale Consulting (Midrand)						
48	Drieziek Ext 4 Township Establishment	JHB South	Gauteng Human Settlements	Bagale Consulting (Midrand)						
49	Lady Selbourne (phase 1 - 8) Mixed House Development	Lady Selbourne: Pretoria	Gauteng Department of Human Settlement	Bagale Consulting (Midrand)	LACA/ Klerch Architects	Joe Faller	Zitholele consulting/ PH Bagale	PDS	Electroplan	N/A
50	New, Upgrade and rehabilitation of Schools programme in Limpopo Province	Limpopo	Independent Development Trust	Bagale Consulting (Midrand)			Bagale Consulting (Midrand)	Bagale Consulting (Midrand)		
51	Construction of Sewer and Water Reticulation in Lawley Ext 3	Johannesburg South	Gauteng Department of Human Settlement	Bagale Consulting (Midrand)			Bagale Consulting (Midrand)			
52	Construction of Sewer and Water Reticulation in Drieziek Ext 1	Johannesburg South	Gauteng Department of Human Settlement	Bagale Consulting (Midrand)			Bagale Consulting (Midrand)			
53	Lady Selbourne (phase 1 - 8) Mixed House Development	Lady Selbourne: Pretoria	Gauteng Department of Human Settlement	Bagale Consulting (Midrand)	LACA/ Klerch Architects (Lynnwood, Pretoria)	Joe Faller Quantity Surveyor (Pretoria)	Zitholele consulting/ PH Bagale(Midrand)	PDS (Randburg, Johannesburg)	Electroplan	N/A
54	Osizweni School	Newcastle		Motsepe Architects 130 Fox str,Johannesburg	Motsepe Architects 130 Fox str,Johannesburg	BTKM (Emmarentia,Johannesburg)	Bagale Consulting (Midrand)	Bagale Consulting (Midrand)	PDNA (Waverley, Johannesburg)	PDNA (Waverley, Johannesburg)
55	PAN AFRICAN PARLIAMENT	Midrand JHB	National DPW	Bagale Consulting (Midrand)	Earthlab Architects (Johannesburg)	LDM (Midrand, Johannesburg)	Aurecon (Rivonia, Johannesburg)	Aurecon (Rivonia, Johannesburg)	Kwezi V3 (Germiston, Johannesburg)	Kwezi V3 (Germiston, Johannesburg)
56	Mabopane DLTC	Mabopane	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	Archcor(Fourways North, Johannesburg)	DDP Quantity Surveyor (Parktown)	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Buvhezi Engineering (Orange groove, Johannesburg)	Buvhezi Engineering (Orange groove, Johannesburg)
57	Mabopane DLTC	Temba	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	Archcor(Fourways North, Johannesburg)	DDP Quantity Surveyor (Parktown)	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Buvhezi Engineering (Orange groove, Johannesburg)	Buvhezi Engineering (Orange groove, Johannesburg)

58	Bonalesedi Nursing College	Kagiso	Gauteng Department of Infrustructure Development (Johannesburg)	Akisa Architects (Polokwane)	Akisa Architects (Polokwane)	Gosiame Development Consultants	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Raphal Consultant (Glenvista)	Raphal Consultant (Glenvista)
59	Weskoppies Psychiatric Hospital	Pretoria	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	Osmond Lange Architects	DDP Quantity Surveyor (Parktown)	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Buvhezi Engineering (Orange groove, Johannesburg)	Buvhezi Engineering (Orange groove, Johannesburg)
60	Makgake Primary School	Hammanskraal	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	N/A	N/A	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	N/A	N/A
61	Hoerskool Alberton	Alberton	Gauteng Department of Infrustructure Development (Johannesburg)	Sisonke Facilities Management	Creative Axis Architects	Sisonke Facilities Management	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Buvhezi Engineering (Orange groove, Johannesburg)	Buvhezi Engineering (Orange groove, Johannesburg)
62	Julius Sebolai Primary School	Soweto	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	N/A	N/A	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	N/A	N/A
63	Eureka High School	Springs	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	Osmond Lange Architects (Melrose Blv, Johannesburg)	DDP Quantity Surveyor (Parktown)	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Buvhezi Engineering (Orange groove, Johannesburg)	Buvhezi Engineering (Orange groove, Johannesburg)
64	Itumeleng LSEN School	Westonaria	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	N/A	N/A	N/A	N/A	N/A	N/A
65	Siphiwe Primary School	Thembisa	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	Motse LMI (Marshaltown, Johannesburg)	Kiwango QS (Johannesburg)	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	N/A	N/A
66	Jabulani Technical High School	Soweto	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	Motse LMI (Marshaltown, Johannesburg)	IVM Quantity Surveyor (Fourways)	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Buvhezi Engineering (Orange groove, Johannesburg)	Buvhezi Engineering (Orange groove, Johannesburg)
67	Randfontein High School	Randfontein	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	Archcor(Fourways North, Johannesburg)	Kiwango QS (Johannesburg)	PH Bagale (Fairland, Johannesburg)	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Buvhezi Engineering (Orange groove, Johannesburg)	Buvhezi Engineering (Orange groove, Johannesburg)
68	Motsweding Primary School	Pretoria	Gauteng Department of Infrustructure Development (Johannesburg)	Impande Engineers (Menlo Park, Pretoria)	Impande Engineers (Menlo Park, Pretoria)	Impande Engineers (Menlo Park, Pretoria)	N/A	Sisimo Engineering (Vanderbijlpark,Vereeniging)	Impande Engineers (Menlo Park, Pretoria)	Impande Engineers (Menlo Park, Pretoria)

69	Suikerbosrand Nature Reserve	Heidelberg	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	Archcor(Fourways North, Johannesburg)	Kiwango QS (Johannesburg)	PH Bagale (Fairland, Johannesburg)	Bagale Consulting (Midrand)	Buvhezi Engineering (Orange groove, Johannesburg)	Buvhezi Engineering (Orange groove, Johannesburg)
70	Zitholele LSEN School	Katlehong	Gauteng Department of Infrustructure Development (Johannesburg)	Bagale Consulting (Midrand)	N/A	N/A	N/A	N/A	N/A	N/A
71	Diepkloof Crime Combating Unit	Diepkloof	Department of Public Works (Johannesburg)	Isago Arcitecture (Sandton, Johannesburg)	Isago Arcitecture (Sandton, Johannesburg)	R&M QS (Houghton, Johannesburg)	Ntsu Engineering (Midrand, Johannesburg)	Bagale Consulting (Midrand)	Usizo Engineering (Steelendale, Johannesburg)	Secelec (Surrey Ave, Johannesburg)
72	Mondeor Police Station	Mondeor	Department of Public Works (Johannesburg)	Ngonyama Okpanum & Associates (16 Clyde St, East London)	Ngonyama Okpanum & Associates (16 Clyde St, East London)	Mahlatsi Tumelo Cost Consultants (Northgate office park, Johannesburg)	N/A	Bagale Consulting (Midrand)	Hambisa Engineering (Kempton Park, Johannesburg)	

Appendix C

Project Intrinsic Factors

Project Category	Project Budget	Project Type	Project Delivery Method	Project Location	Client	Professionals Interviewed
Category A (R2m-R4m)	R4 million	Restorations and repairs to Madume Primary School	Design, Bid and Build	Orange Farm,	Gauteng Department of Infrus-tructure Development (DID)	1
	R4 million	Renovations and Additions to MC Weiler Primary School	Design, Bid and Build	Alexanda Johannes-burg	Gauteng Department of Infrus-tructure Development (DID)	1
Category B (R4m - R8m)	R5 million	Restorations and repairs to Edenpark Primary	Design, Bid and Build	Tokoza, Alberton	Gauteng Department of Infrus-tructure Development (DID)	1
	R5.1 million	Restorations and repairs to Mohlakeng Primary	Design, Bid and Build	Mohlakeng, Randfontein	Gauteng Department of Infrus-tructure Development (DID)	1

R6 million	Restorations and Repairs Dukathole Primary School	Design, Bid and Build	Katlehong, Springs	Gauteng Department of Infrastructure Development (DID)	1
R6.6 million	Restorations and Repairs Dukathole Primary School	Design, Bid and Build	Tsakane, Brakpan	Gauteng Department of Infrastructure Development (DID)	1
R7 million	Restorations and repairs to Endicott Primary School	Design, Bid and Build	Springs	Gauteng Department of Infrastructure Development (DID)	1
R7.2 million	Restorations and repairs to Lenasia secondary	Design, Bid and Build	Lenasia	Gauteng Department of Infrastructure Development (DID)	1
R8 million	Restorations and repairs to Orlando West Secondary School	Design, Bid and Build	Orlando West, Soweto	Gauteng Department of Infrastructure Development (DID)	1
R8 million	Restorations and Repairs Seipone Primary School	Design, Bid and Build	Orange Farm	Gauteng Department of Infrastructure Development (DID)	1

	R8 million	Restorations and Repairs Willowmead Secondary School	Design, Bid and Build	Lenasia	Gauteng Department of Infrastructure Development (DID)	1
Category C (R8m - R16m)	R9 million	Restorations and repairs to Matshediso Primary School	Design, Bid and Build	Katlehong, Eastrand	Gauteng Department of Infrastructure Development (DID)	1
	R11.5 million	Renovations and Additions to Baxoxele Primary School	Design, Bid and Build	Soshanguvhe, PTA	Gauteng Department of Infrastructure Development (DID)	1
	R12 million	Renovations and Additions Lakeview Primary School	Design, Bid and Build	Dobsonville, Soweto	Gauteng Department of Infrastructure Development (DID)	1
Category D (R16m - R32m)	R17 miliion	Renovations and Additions Mabopane DLTC	Design, Bid and Build	Mabopane	Gauteng Department of Infrastructure Development (DID)	1
	R20 million	Renovations and Additions Temba DLTC	Design, Bid and Build	Temba	Gauteng Department of Infrastructure Development (DID)	1

	R25 million	Renovations and Additions to Eureka High School	Design, Bid and Build	Springs	Gauteng Department of Infrastructure Development (DID)	1
	R27 million	Upgrading of Far East Rand Hospital to Folateng	Design, Bid and Build	Springs	Gauteng Department of Infrastructure Development (DID)	2
Category E (R32m-R64m)	R38 million	Construction of Sokhulumi Community Centre	Design, Bid and Build	Sokhulumi, Bronkorspruit	Gauteng Department of Infrastructure Development (DID)	1
	R42 million	KDC East - Guesthouses Tsepong (Phase 1)	Design, Bid and Build	Carletonville	Gauteng Department of Infrastructure Development (DID)	1
	R54 million	Construction of Randgate Clinic	Design, Bid and Build	Randfontein	Gauteng Department of Infrastructure Development (DID)	2
Category F (R64m-R128m)	R128 million	Weskoppies Psychiatric Hospital	Design, Bid and Build	Pretoria	Gauteng Department of Infrastructure Development (DID)	2

Category H (R128m-R256m)	R186 million	Wits Student Housing	Design, Bid and Build	Parktown, Johannesburg	Gauteng Department of Infrustructure Development (DID)	1
	R214 million	Heineken Brewery	Design, Bid and Build	Midvaal	Heineken Company	2
	R202 million	Upgrade of Gold Reef City	Design and Build	Mondeor	Tsogo Sun	2
Category I (R256m-R500m)						
Category J (R500m-R1500m)	R600 million	Sedibeng Cider Production Plant	Design and Build	Midvaal	Sedibeng Breweries	2

Appendix D

Interview Questions

These interview questions aim to identify problems associated with fragmentation within construction projects executed by the professional team and suggesting the use of Building Information Model (BIM) as one of the solution to promote integration, collaboration, communication and coordination between construction professionals to increase efficiency and productivity in the construction industry Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Architect (A)

Quantity Surveyor (QS)

Construction Project Manager (CPM)

Civil Engineer (CE)

Structural Engineer (SE)

Electrical Engineer (EE)

Mechanical Engineer (ME)

Other (O)

Integration Integration is a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit

1. Indicate from above other professionals you get to interact with on a project. _____

2. How often do you combine your attributes with other professional members of a professional team? _____

3. Are various professional attributes or expertise easily and freely accessible and available in a project? _____

Collaboration Collaboration is a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

4. Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other _____

5. Do you contribute, complement and develop suggestions from each other's' tasks _____

6. Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team? _____

7. Are you knowledgeable about other roles or tasks of members in the project _____

Communication Communication is a means through which information is transferred from one person to another.

8. How do you communicate with each other on a project? _____

9. Are there any medium of communication through which information is conveyed? _____

10. What challenges do you experience when communicating with other team members?

_____

Coordination Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

11. What kind of functions do you perform in relation to your job? _____

12. How often do you submit your set of activities to be controlled and managed by the team?

_____

13. Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

_____

14. Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

_____

_____ Date of Interview

Appendix E

Transcripts

Participant 1

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Paraticipant 1: I am the electrical and mechanical engineer of this project but my background is electrical.

Mpho Papo: oh okay. So you do both electrical and mechanical services?

Paraticipant 1: Yes

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each section before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you.

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 1: I normally work with Architect, QS, CPM, CE, SE because myself I work both as electrical and mechanical engineer on building projects. Remember the scope of my work is barely huge where one will need a separate electrical and mechanical engineer. So I do both services.

Mpho Papo: Okay.

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 1: Yes I got that. Very much often, it is on-we combine our attributes all the time

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 1: Yes, our attributes are easily available all the time

Mpho Papo: Okay, we are done with integration. the next is collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 1: Yes, normally after working with the professional team, relationships continues after even the project is done because sometimes I recommend or get to be recommended by one of the professionals I worked with in the previous project to a new project. I know most of professionals and have a relationship with them because of recommending each other and working with each other in various projects. So we very familiar with each other

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 1: Yes, by just working on a project you would be interested from what other professionals do. I also look at what best work for me and other members of the team. With completion, I could say there are two angles; one is to complement what other person do, which is of my benefit and second to complement good ideas not necessarily benefit me but the other individual

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 1: Yes, in a way to say that one will welcome suggestions or input from others and it then gets applied

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 1: Yes, progress knowledge that exposes you to other professional team roles experience over period adds to knowledge of other team members tasks. Almost every time learn something new about other members.

Mpho Papo: Next discussion is on communication. Ready?

Participant 1: Yes

Mpho Papo: Communication is a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 1: On projects we communicate in three spheres. First, sitting around a table mostly for meetings and coordination. Secondly, we use electronic devices for communication to transfer information. However, it depends on the urgency of the information or to clarify some notes. And thirdly we use emails mostly for correspondence purposes

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 1: Just emails and phones

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 1: The period to give respond turns to be very minimal. There is lack of connection as a result of poor signal or network connectivity especially when trying to communicate a project while you are busy on another project that is in remote area. Also technology become too much mobile but disadvantageous when have to communicate while driving.

Mpho Papo: Okay, now we going to discuss how you coordinate your attributes. Can we start with coordination now?

Participant 1: Yes

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 1: Planning of electrical service for a project. Do preliminary designs which includes electrical and mechanical costs. Once preliminary designs and costs are approved, start with electrical design and when we get to construction, starts monitoring and advice the contractor on how to deal with electrical issues and execute the works

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 1: It is done per stages, Issue as-built drawings and COC and submit other activities for control purposes by mutual agreement

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 1: Yes, it does

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 1: Yes, all it requires is the professional team to be well experienced in the coordination process. Project Manager assumes a supervisory role. A well experienced professional team is required for a well coordination process.

20/02/2014

Date of Interview

Participant 2

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 2: I do Landscape architect and fire architect

Mpho Papo: oh okay. So you not involved in buildings?

Participant 2: I am but not as hectic as landscape and fire. This is an area where in most projects it is outsourced and the market is big and quite open.

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout right in front of you.

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 2: I normally work with Electrical engineers, quantity surveyors, construction project manager, civil engineers, structural engineer..

Mpho Papo: Okay.

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 2: Depends on the situation, if there is an issue to be resolved, I will combine knowledge to solve this

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 2: Yes, depending on how open and approachable someone is. Sometimes there is poor project coordination

Mpho Papo: Okay, we are done with integration. we will now move to collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 2: I certainly try to do that. I mean to familiarize myself with other team members and respect them as I also expect to be respected by them.

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 2: Yes, just working on a project you would be interested from what other professionals do, look at what best work for me and other members of the team. With complement,

I could say there are two angles; one is to complement what other person do of which is of my benefit and second to complement good ideas not necessarily benefit me but the other individual

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 2: Yes

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 2: Yes

Mpho Papo: Next discussion is on communication. Ready?

Participant 2: Yes

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 2: Verbal, drawings, plan, email

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 2: We only use the ones that I have just mentioned

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 2: Most of the time information is received late

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Ready?

Participant 2: Yes

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 2: I do design planning and provide drawings for the project and liaise with other design team members to coordinate design drawings. I also do supervisory role on design. This is one thing most project managers who are not architects are not best at.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 2: In some of my project we have weekly meeting and that's when we get to manage all activities together.

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 2: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 2: Architect, lest a separate project manager is appointed

20/03/2014

Date of Interview

Participant 3

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 3: I play quantity surveying role

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout right in front of you.

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 3: I normally work with Electrical engineers, architects, construction project manager, civil engineers, structural engineer..

Mpho Papo: Alright.

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 3: Once a week on average

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 3: Yes

Mpho Papo: Okay, we are done with integration. the next questions are based on collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 3: Yes, the first few meetings form the basis of a working relationship

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 3: Yes

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 3: Yes, project team meeting weekly solves many problems. I remember there was a time a meeting was postpone and issues accumulated which could have been solved by a way of making correspondence on electronic devises. However, my principle is to attend issues at hand than to wait for the worse. It always helps me

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 3: Yes, even though I believe the project manager must outline all the responsibilities

Mpho Papo: Next discussion is on communication. Ready?

Participant 3: Yes

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 3: Emails but primarily and cell phones

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 3: Most of the time information is conveyed through emails or minutes

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 3: Professionals are hardly available

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Ready?

Participant 3: Yes

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 3: Every kind of action that affects and involve the costs of the project but mostly I do cost control and monitoring

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 3: Once a week in a meeting

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 3: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 3: If the project manager is good, the different activities will run smoothly

24/03/2014

Date of Interview

Participant 4

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 4: I am an architect by profession

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handoutgiven to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 4: I normally work with quantity surveyor, electrical and mechanical engineer, construction project manager, civil engineers, structural engineer..

Mpho Papo: Alright.

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 4: All the time through meetings and correspondences

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 4: Yes, they are freely and easily accessible. Clients are well informed

Mpho Papo: Okay, we are done with integration. the next questions are based on collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 4: Yes, to keep a good relationship for even future projects

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 4: Yes, I sometimes advice and commend on other professional task and they do same to mine. It is part of being in a team.

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 4: Yes, in a way to say that one will welcome suggestions or input from others and it then gets applied

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 4: Yes, I understand their boundaries in relation to my boundaries, their mandate and what they are contracted to do. It is important to be able to set how far I can require from them in terms of their scope

Mpho Papo: Next discussion is on communication. Ready?

Participant 4: Yes

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 4: Person-person in a meeting, communicating telephonically, telephonically via emails. We normally correspond through detailed documentation, drawings and also giving instructions

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 4: Emails, meeting, telephone, internet based communication such as conference calls

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 4: First, information gets delayed in that information is received not at the expected time. Lack of understanding-language barriers

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Ready?

Participant 4: Yes

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 4: Coordination of information from various professional team. Administering whether info given to contractor is applied as intended and make sure that the intended design is value engineered before bringing to practicality

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 4: Whenever there is an issue contractually, have to go back and check the activities to understand the responsible party. There are always some discrepancies and activities get reviewed and submitted when such discrepancies arise. Whenever there are contractual

issues, activities get reviewed and the required information is submitted

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 4: Yes, we coordinate to make sure that the team is moving in one direction

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 4: Yes, professionals make sure that work is well managed. PM assumes supervisory role. Supervisory happens at different level and professional scale, professionals supervise their own work

20/03/2014

Date of Interview

Participant 5

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 5: I do electrical engineering

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handoutgiven to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 5: I normally work with architect, quantity surveyor, construction project manager, civil engineers, structural engineer..

Mpho Papo: Alright.

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 5: Two times a month depending whether the scope have not changed

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 5: Its not always the case

Mpho Papo: Okay, we are done with integration. the next questions relates to collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 5: It's important to understand your team members, So yes, I do familiarize myself with other members of the team

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 5: Every tasks is discussed before and after is completed, So yes, I contribute

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 5: Sometimes as a team we do collaborate with new proposals and ideas

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 5: Because of regular meetings, yes I am knowledgeable

Mpho Papo: The next discussion is on communication. Let me know when you ready to begin

Participant 5: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 5: We use electronic mails, instant messages and team intranet.

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 5: Through project intranet and emails

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 5: Members being offline for hours and even for days.

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 5: Lets continue

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 5: I do electrical design and coordination mostly

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 5: As soon as the tasks are done which is normally ones in 2 weeks

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 5: Yes, coordination result in active roles and better performance for the team

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 5: Team leader (Project Manager) makes sure that all activities are well managed and supervised

19/03/2014

Date of Interview

Participant 6

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 6: I oversee the electrical scope of the project. I am an electric engineer by profession

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handoutgiven to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 6: I work with the architect, quantity surveyor, construction project manager, civil engineers, structural engineer..

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 6: Often as possible as long as the need arises

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 6: Yes because we also expect professionals to indicate their assistance for in

case they are not available

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 6: Yes because in a project team we have to know each other and what each other do so that we can ask the right questions and require the right information from the right person

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 6: Yes

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 6: Yes, especially when you are a project manager, you always require other professionals to support or respond to their scope of work always.

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 6: Yes, as a project manager you are forced to understand all members of the professional team and what they do

Mpho Papo: The next discussion is on communication. Let me know when you ready to begin

Participant 6: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 6: We communicate verbally through meetings and calling each other but I prefer meetings as information gets minuted

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 6: We still expect individuals to respond using emails and phone calls which is something I do mostly because we don't get to meet every day, so electronic devices are also applicable as a medium of communication

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 6: When the project is in a mess no one wants to take responsibility and play a blame-blame game. We had those instances

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 6: Lets continue

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of

professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 6: I manage the project process and do supervisory role on everybody in the project

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 6: I try to do that every day as long as I am busy on the project

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 6: Yes, because it is through project coordination that project process and the team becomes manageable, so yes, coordination ensures individuals to be active and share in the required information

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 6: Yes, so long as professional team is accountable on their professional responsibility. And with the supervisory role, mostly the qs or architect can be assigned as a project manager, so it really depends on whom the client want to serve as a supervisor for the project

19/03/2014

Date of Interview

Participant 7

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 7: I do architectural services

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 7: I work with the quantity surveyor, construction project manager, civil engineers, structural engineer, electrical and mechanical engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 7: We set consistent time slots on all projects all the time. Normally in this one we meeat as per scheduled meeting

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 7: Not always as there are always issues that needs immediate time and not always all individuals available 24/7 in one projects. Have other projects to do. Hence I always set for 48hrs period of responding to project issues

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 7: Yes, especially the design team because I expect them to coordinate their designs with mine and therefore I have a responsibility to know who is responsible for what. However, I don't always do it with everybody

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 7: Not always unless requested to

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 7: Yes, especially when you are a project manager, you always require other professionals to support or respond to their scope of work always.

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 7: Yes, as long as they affect my scope of work as an architect

Mpho Papo: The next discussion is on communication. Let me know when you ready to begin

Participant 7: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 7: Through emails, voice calls and text messages

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 7: It is only those that have been mentioned in the last previous question

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 7: When there is no response from other team members but I do understand them, since I also have other project to run so I cannot always be available on one project

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 7: Yes, I am

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 7: I perform full architectural services and principal agent of which some people prefer it project manager

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 7: I am not sure you mean transferring my architectural responsibility because that one I cannot transfer them. However if you mean when the activities are coordinated, normally we coordinate activities whenever there is a need

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 7: Yes, because the success of the project depends on it

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 7: Yes, and Architect assumes supervisory rolect

24/03/2014

Date of Interview

Participant 8

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 8: I do all the quantity surveying services

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 8: I mostly work with the architect, construction project manager, civil engineers, structural engineer, electrical and mechanical engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 8: Every fort night on site meetings

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 8: Not all the times and not all professionals. So it varies from project to project

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 8: Yes

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 8: Yes, when that case arises

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 8: Yes, where I can help and fully understand the details

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 8: Not all of them but some yes

Mpho Papo: The next discussion is on communication. Let me know when you ready to begin

Participant 8: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 8: Verbal at site meetings, telephonically and using emails

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 8: Yes, internet via emails, telephones and cell phones

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 8: Sometimes professionals are not easily available

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 8: Yes, I am

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 8: I control the project budget and do cost monitoring and the list can go on.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 8: I would say monthly

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 8: Yes, as we all end up being on the same page with the project

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 8: Yes, even though it's not always the case as some cannot deliver on time. The project manager or principal agent assumes a supervisory role

25/03/2014

Date of Interview

Participant 9

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 9: I do all the quantity surveying services

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity.

We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 9: I work with the architect, construction project manager, civil engineers, structural engineer, electrical and mechanical engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 9: Mostly during documentation stage, attributes from professional team are combined all the time. Once the project moves to construction stage, attributes are combined whenever there is such a requirement

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 9: Yes as long the professional team is competent

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 9: Yes, so that I can know who is responsible for what scope of work. In my project, we are being honest to each other and possess mutual trust because of the competency that is required to execute the project

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 9: Yes, as part of the team member, scope of work tend to overlap and all the team members have to contribute to develop suggestions so as to direct the project

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 9: Yes, because one problem arising in scope of one member of the professional team tend to impact on another member, so the whole professional team always come together to pursue new ideas

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 9: Yes, because I have to prepare cost models, do valuations, and payment certificate of the overall scope of work which in turn has to involve all tasks of the members of the project

Mpho Papo: The next discussion is on communication. Let me know when you ready to begin

Participant 9: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 9: We communicate verbally through meetings and telephonically

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 9: Emails, mouth to mouth conversation

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 9: Late responses

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 9: Yes, I am

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 9: Payment certificates, Cost report, Cash flows

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 9: Most submission done prior approval of tender documentation and few submissions during construction as when they are required

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 9: Yes, that is why there are coordination meeting in order to coordinate all active roles for information sharing and avoid discrepancies from team members

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 9: Yes, Project Manager assumes a supervisory role

23/03/2014

Date of Interview

Participant 10

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside

solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 10: I am the mechanical engineer

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 10: I work with the architect, construction project manager, civil engineers, structural engineer, electrical and quantity surveyors

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 10: As often as it needs to be done

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 10: Yes, all professionals make time for their project tasks

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 10: Yes, I familiarize myself with those members which their scope of work is directly linked to mine

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 10: Yes, to complete a task very well, one needs to contribute and develop suggestions with other team members

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 10: Yes, especially when you are a project manager, you always require other professionals to support or respond to their scope of work always.

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 10: Yes, there are times in the project where we have to solve problems and propose solutions

Mpho Papo: The next discussion is on communication. Let me know when you ready to begin

Participant 10: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 10: We use emails and verbal communication

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 10: Emails and project folder in the server

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 10: I am not experiencing any challenges

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 10: Yes, I am

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 10: Mechanical designs and installation

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 10: Every professional meeting which is once a week

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 10: Yes, coordination and cooperation is the strength of our team

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 10: Yes, all activities are well managed from the project manager

21/03/2014

Date of Interview

Participant 11

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as

required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 11: I am the mechanical engineer but under a category of fire specialist

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 11: I work with the architect, construction project manager, civil engineers, structural engineer, electrical and quantity surveyors

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 11: Whenever the need for fire designs arises and I am requested

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 11: The professional attributes are freely accessible but not always available

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 11: Yes, I familiarize myself with those members which their scope of work is directly linked to mine

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks r

Participant 11: Yes

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 11: Yes

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 11: Yes, the scope of mechanical and electrical work interact. I myself am mechanical engineer by profession and decided to specialize in fire design

Mpho Papo: The next discussion is on communication. Let me know when you ready to begin

Participant 11: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 11: Emails and instant messages and if necessary we meet for verbal discussion

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 11: Yes, through project intranet and emails

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 11: Members of the team do not respond to their emails on time or daily

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 11: Yes, I am

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 11: I do fire design and installation

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 11: As per the scheduled time once the task is completed

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 11: Yes, the team has been performing well in coordinating their activities

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 11: Yes, I supervise the electrical and mechanical on a fire related building project

19/03/2014

Date of Interview

Participant 12

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 12: I am the construction project manager

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 12: I work with the architect, mechanical engineer, civil engineers, structural engineer, electrical and quantity surveyors

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 12: Most of the time we meet during design meeting for documentation stage and also during construction stage

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 12: Professional attributes easily and freely accessible on site and difficult to access if professional off site

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 12: Always strive to familiarize myself with other professionals. I do respect one other's professional but trust depend on the level of competence of a professional

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 12: Yes, I do complement and develop suggestion

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 12: Yes, whenever there is a need

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 12: Yes, as a project manager it is a compulsory to be knowledgeable about each other's tasks

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 12: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 12: I communicate through minutes on meetings and also exchange calls when there is a need

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 12: I mostly communicate with emails when am off site and also telephonically

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 12: Sometimes there is unavailability of professionals and their late responses

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 12: Yes, I am

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 12: Supervise professional team, prepare and coordinate minutes, advice clients and keep the clients updated on project status

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 12: During site meetings I circulate my activities and also on emails. Helps to keep everybody in the loop

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 12: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 12: I the project manager assume a supervisory role and yes the team is well managed

23/03/2014

Date of Interview

Participant 13

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim

to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 13: I do civil engineering service

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 13: I work with the architect, mechanical engineer, construction project manager, structural engineer, electrical and quantity surveyors

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 13: During design meetings and site meetings when civil engineer attributes are requested and also through correspondence

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 13: I was only available on request or during meetings of professional team

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 13: Yes, I familiarize myself with other members and honest with each other and do trust that the service offered by various individuals of the professional team is trustworthy and should be criticized if not

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 13: Yes, that's part of working in a team

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and

make decisions with other members of the team?

Participant 13: Yes, I do that as part of value engineering

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 13: Yes, as a civil engineering, have to understand tasks of architecture and other design engineers and how they interact with my tasks

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 13: Yes, I am

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 13: I use verbal communication on site with the team and also communicate by issuing drawings

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 13: Yes, email and telephone

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 13: Lack of competency from other team members to read and interpret designs and late responsiveness

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 13: Yes, I am

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 13: I do concept designs of civil drawings, prepare civil work bills of quantities, certify evaluations on civil, advice and issue instructions on civil scope of work and prepare civil claims

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 13: All the time after the release of drawings and revisions

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 13: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 13: Activities are better managed and the Principal Agent (Project Manager) assumes supervisory role

20/03/2014

Date of Interview

Participant 14

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 14: I do electrical engineering service

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 14: I work with the architect, civil engineer, mechanical engineer, construction project manager, structural engineer and quantity surveyors

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 14: Mostly during tender stage and concept stage when such attributes are required

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 14: Not all the time, sometimes difficult to reach out all discipline

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 14: Yes, I familiarize myself and I am honest with other team members

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 14: Yes, I do contribute my ideas and develop suggestions with other team members

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 14: Yes, that comes with working as a team

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 14: Yes, as an electrical I have to understand how other professionals interact with my profession

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 14: We can start

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 14: I communicate with other professionals through phone calls and verbally when we meet through meetings. I also use emails for correspondence

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 14: Also uses telephone like the office line

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 14: Some professionals are brought in the project inexperienced, which brings forth the of lack of competancy on the project

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 14: Lets start madam

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 14: I do electrical designs, claims and certify contractor's claim, prepare electrical documentation and advice contractor on electrical responsibilities

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 14: Whenever it is required or whenever I think it is important to submit

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 14: Yes, unless if it is not properly implemented

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 14: Activities are well managed if there is proper coordination, so it is not all the time

20/03/2014

Date of Interview

Participant 15

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 15: I render full quantity surveying services

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 15: I work with the architect, civil engineer, mechanical engineer, construction project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 15: Our skills get combined mostly during meetings, either on or off site as long as it suits the needs of the project

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 15: Its easy to avail our skills the same time we have meetings because that is when they become easily accessible

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 15: Yes, I try to familiarize myself even though sometimes members of the professional team change more often, making it difficult to keep up with familiarity. I try to stay honest with the service I provide and do respect other's professional as well.

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 15: Yes, but from the cost point of view in order to stay within budget

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 15: Yes, there are always cost related problems which need to be resolved in light of the whole team

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 15: Yes, I have a reasonable knowledge

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 15: Sure, I am ready

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 15: Verbally-when meeting with the professional team and also through electronic media such as email

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 15: Yes, emails, phone calls

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 15: Sometimes professional team not available which results with late response in some of the required information

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 15: Lets start madam

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 15: Prepare tender documentation, project budgets, do cost reports, prepare projected cash flows, payment certificate and final accounts of the project

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 15: During project phases when activities are prepared and submitted and also on interim cases when activities are required such as monthly cash flows, monthly cost report

and monthly payment certificate

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 15: Yes, though I send all my information to the project manager who then distribute it to the rest of the team

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 15: Not all the time activities are been well controlled and managed. In some of the project there is proper management and in some there is not. Project Manager gets appointed to perform a supervisory role unlike in previous cases where the architect automatically became the project manager

20/03/2014

Date of Interview

Participant 16

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 16: My role is in the structural designs of facilities

Mpho Papo: Alright

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 16: I work with the architect, civil engineer, mechanical engineer, construction project manager, quantity surveyors and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 16: Whenever we are brought together by the project manager to attend professional team meetings and also when other professionals require my input

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 16: Not all the time professionals are available and accessible, it depends whether you are fortunate enough to get hold of them or not. We mostly avail ourselves as per scheduled meeting

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 16: Yes, However professionals have a tendency of bringing their subordinates because the big guys who were initially part of the project were only there to get it going and afterwards they go seek for more projects. Its sometimes difficult when you have to relate to new members all the time

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 16: Yes, I do. In fact we all do

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 16: Oh yes.

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 16: Yes, especially civil engineering as sometimes I get appointed to do both structural and civil engineering in other projects

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 16: Okay

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 16: Verbal communication is used mostly on site meetings and phone calls whenever off site

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 16: Yes, emails, phone calls and fax

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 16: The professionals' unavailability and lack of quick response on the information required

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 16: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 16: I do structural designs, value engineering on structural design, do certification of structural work, advice and issue instruction to the contractor

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 16: We often use hard copies to submit drawings to the relevant team members and keep drawing register for design submission. This happens whenever there are design variations

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 16: Yes, especially on design coordination meeting when the CPM coordinate all the info received from professional team

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 16: Sometimes it is difficult to manage all activities and the CPM assumes a supervisory role

20/03/2014

Date of Interview

Participant 17

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 17: I am a quantity surveyor by qualification and do quantity surveying serivice

Mpho Papo: Thats good

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 17: I work with the architect, civil engineer, mechanical engineer, construction project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 17: We normally met two times in a month for the duration of the project

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 17: Yes, project information and periodical date for the accessibility of the professional team is made available to the team via emails and/or drop box

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 17: Yes, each team has a role and responsibilities to ensure that the project materializes with set targets and goals i.e. time cost and budget, hence each team member must acquaint himself with the roles of each member

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 17: It is always encouraged that each team member contribute over and above his set of roles in order to successfully achieve and avert risks that may otherwise jeopardise successful completion of the project. So yes I do contribute.

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 17: Yes, atleast twice a month the project team meets to evaluate the rate of the project progress and seek alternative methods or steps that may help fast track the completion of the project within set goals

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 17: Yes, each members role and responsibility are clearly stated in the conditions of contract and made available to all team players

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 17: Okay

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 17: I communicate through emails and tele-coms

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 17: Yes, as stated above, emails and telephones are the main means of communication amongst the members.

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 17: Communication challenges are rarely experienced unless in a case where a team member is on leave or unavailable due to unknown reasons, this hampers progress if no one is delegated to carry out his role

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 17: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 17: I prepare project cash flow, interim payment certificates, variation orders and advice on cost effective methods

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 17: On a monthly basis in coordination meeting

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 17: Yes, I believe each member has to be familiar with the financial status of the project and its viability through its cycle.

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 17: Although there is always a black sheep in the team, all members must always give their ultimate best to ensure the successful completion of the project. Depending on the conditions of the contract, the engineer is usually the chair leader of the pack

21/03/2014

Date of Interview

Participant 18

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as

required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 18: I have been appointed both as a quantity surveyor and the project manager but my background is quantity surveying

Mpho Papo: Wow, two roles. Thats good

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 18: I work with the architect, civil engineer, mechanical engineer, construction project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 18: Every fortnight. However, should there be any additional information, I respond as when it is required

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 18: Not always, unless enforced

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 18: I assume they are honest people; hence there is mutual trust to win the team. And we do respect each other's profession

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 18: We do because it is in the best interest of working as a team to complete the project

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 18: I always discuss with team members and based on that, I make final decision

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 18: Yes, I possess reasonable knowledge

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 18: Okay

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 18: We communicate verbally by using telephones and face to face on site. And electronically by using emails

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 18: By using minutes and emails

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 18: Late responses or when professionals say nothing in areas where they supposed to reply

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 18: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 18: I prepare minutes, payment certificate, cost reports and conduct site meetings

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 18: Submit payment certificate monthly and manage project activities every fort night

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 18: Yes, it does

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 18: Not always. The principal agent or project manager depending on the type of contract assumes supervisory role

21/03/2014

Date of Interview

Participant 19

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges

experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 19: My role is simply to provide an architecural service

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 19: I work with the quantity surveyor, civil engineer, mechanical engineer, construction project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 19: We combine as and when is necessary and also depends on the size of a project

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 19: Easily accessible if we meet as a team but very rare in terms of availability because sometimes it takes time to get hold of other professionals

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 19: Yes, I respect other professionals to be competent. On trust it depends on the experience of a professional member

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 19: Yes, I do. I somebody comes up with a good idea, I am open to suggestion, cannot be a master of all

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 19: Yes, because that is a creative way to go about anything

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 19: I have done three years of structure and three years of electricity. Yes, I have been trained to have an extensive knowledge of other professionals

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 19: Okay

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 19: We communicate face to face discussion in meetings, phone calls

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 19: For design drawings, we issue hard copies or soft copies through emails

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 19: Level of competence of other professionals is quite low. I think some professionals are newly graduates and should not only be by themselves in the daily management of the project.

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 19: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 19: I do the entire architectural serivces as in the government gazette

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 19: Very often, when it is necessary. Sets dates for project milestone to let everybody know where they should be at a particular time

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 19: Yes, it does

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 19: Yes, the activities are well managed. The architect assumes a supervisory role on professional responsibility

20/03/2014

Date of Interview

Participant 20

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 20: I do construction project management

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 20: I work with the quantity surveyor, civil engineer, mechanical engineer, architect, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 20: Very often, as long as the project demands that and especially when we appointed as project managers

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 20: Often not, careful coordination by the project manager is critical to ensure information flow and integration and sometimes its difficult to find the professionals freely available

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 20: Yes, but this requires strong and decisive leadership from the project manager

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 20: Yes, very often

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 20: Yes, very often

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 20: Yes, as a project manager I have to be more knowledgeable than any members of the team

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 20: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 20: We communicate by arranging the design and coordination meetings. Its a better way to communicate when we all gathered together

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 20: Yes, we also communicate through phone calls and emails.

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 20: Mmmmh... I can't think of any right now.

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 20: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 20: Do you know project management body of knowlegde

Mpho Papo: Yes

Participant 20: My functions are summed up in there.

Mpho Papo: Oh okay. I shall revisit them

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 20: As often as necessary or dictated to by mutual agreement with the team

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 20: No, sometimes information does not flow in one direction. I think there is a need for central coordination and bilateral where necessary

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 20: Not always. The project manager assumes a supervisory role

22/03/2014

Date of Interview

Participant 21

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 21: I am an Architect

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 21: I work with the quantity surveyor, civil engineer, mechanical engineer, project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 21: It depends on project phase, we can have more meetings during design phase and scheduled meetings usually on a fortnight during construction

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 21: Yes

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 21: Yes, there is a lot of interact which happens among professional team which in turn become familiar to each other. Respect each other and trust other's professional competence

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 21: Yes

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 21: Yes

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 21: Yes, I have a very good understanding of what other members ought to do. This helps me as an architect to require information from relevant individuals.

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 21: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 21: Through meeting and sending of emails

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 21: We also send pdf information through emails and deliver hard copy files

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 21: Time management to respond to queries. Usually late responsiveness

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 21: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 21: Design and details, coordination of contract document

Mpho Papo: Oh okay. I shall revisit them

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 21: Depend on whether scope of work is clearly defined but information is submitted whenever it is required

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 21: Yes, and it helps to alleviate any chance of conflict information

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 21: Activities are well managed and problems arise when activities are not well managed. CPM oversees the supervisory role

23/03/2014

Date of Interview

Participant 22

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 22: I do civil engineering service

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 22: I work with the quantity surveyor, architect, mechanical engineer, project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 22: Normally as a team we always combine our skills

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 22: Yes, but not all the time

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 22: Yes, it is imperative to do that

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 22: Yes

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 22: Yes, sometimes harsh decisions need to be made for the project to progress

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 22: Yes

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 22: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 22: Emails, phone calls and face to face meeting

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 22: We use phones, emails etc

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 22: Competency is a challenge sometimes

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 22: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 22: Design documentation of civil work and supervision

Mpho Papo: Oh okay.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 22: As per the request of if changes arise

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 22: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 22: Not all the time. Project manager manages the project

21/03/2014

Date of Interview

Participant 23

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 23: I am a plumber specialist

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 23: I work with the quantity surveyor, architect, mechanical engineer, project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 23: 5 times a week

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 23: Yes

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 23: Yes, especially the architect and the mechanical engineer as I normally sit around with them to do plumbing designs and the scope of work overlaps

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 23: Yes, for the good of the project though not easy sometimes

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 23: Yes, but consensus is sometimes hard to reach

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 23: Yes, one has to be acknowledgeable in order to have a full picture of the project

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 23: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 23: I normally have monthly meeting to communicate with the architect and the mechanical engineer and sometimes with the rest of the professional team if I have been requested to attend the entire professional team meeting

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 23: Phones, emails etc

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 23: There's some incompentency of during project

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 23: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 23: I do health and safety files and supervision

Mpho Papo: Oh okay.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 23: Monthly

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 23: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 23: Yes, the principal agent assumes the supervisory role

23/03/2014

Date of Interview

Participant 24

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 24: I am an Architect

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 24: I work with the quantity surveyor, civil engineer, mechanical engineer, project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 24: Often times especially during consultant meetings

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 24: Not easily accessible and not easily available unless during site meetings

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 24: Yes, we do try hard to familiarize ourselves with each other and respect other profession as well

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 24: Yes, contribute to build a strong project team

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 24: Yes

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 24: Yes

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 24: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 24: Through progress and site meeting

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 24: Phones, emails, sms

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 24: Late response and unavailability of professionals

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 24: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 24: Architectural service-design drawings, conceptual design, issue instruction for architectural work and do quality control of the executed works

Mpho Papo: Oh okay.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 24: All the time after every revision

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 24: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 24: Yes, activities are well managed. Architect assumes supervisory role unless there is a Project Manager

23/03/2014

Date of Interview

Participant 25

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 25: I do mechanical engineering

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 25: I work with the quantity surveyor, civil engineer, architect, project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 25: Under normal circumstances, must have design coordination meeting which depends on the state of design development process. Only meet less because of preparation of documentation. There are more coordination meetings before tender. Once the project is on site, meeting are few, perhaps twice in a month

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 25: Most of the time professional attributes are available and accessible

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 25: Yes, we do try hard to familiarize ourselves with each other and respect other profession as well.

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 25: Yes, mostly electrical and mechanical

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 25: Yes, to avoid collision or repetitive work

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 25: Yes

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 25: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 25: Mostly is verbal communication. Drawings are communicated by formatting them into readable files so that other team members can accessed

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 25: CAD software mostly used among design team to convey information and emails to all professional team. Also used phone calls

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 25: Lack of competence in understanding mechanical work. Its almost as if the party understanding mechanical work is the electrical engineer followed by the contractor

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 25: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 25: Mechanical design and documentation, advice and instruct the contractor on how to carry mechanical work, certify claims of mechanical work and request information if necessary

Mpho Papo: Oh okay.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 25: All the time and when such activities are required

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 25: Not all the time as on some projects there are always changes of professional individuals which impact coordination process due to lack of experience in implementing a

proper coordination system

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 25: Not always the case depends on the management style employed. Usually CPM assumes supervisory role

20/03/2014

Date of Interview

Participant 26

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 26: I am a structural engineer and my collegue is civil engineer

by profession

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 26: I work with the quantity surveyor, mechanical engieer, architect, project manager and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 26: All the time, there is an element or overlaps of other professional like Architect who is involved in my decision, With other professionals, I combine my attributes whenever I have to. There is also a lot of interaction with the quantity surveyor (qs)as the qs must price and value structural work. Always review structural design with the qs to control structural costs

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and

available in a project?

Participant 26: Most of the time available but not always. A sequential process of professional team in preparing their tasks make some information to be available at a late stage. Though it does not happen all the time, it does happen sometimes

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 26: Yes, a good working relationship requires one to know his team and how it operates

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 26: Yes, when there is a need

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 26: Yes, especially those activities that have much influence on the structure of the design

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 26: Yes, it is very important to know who does what so that we can address issues respectively.

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 26: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 26: Mainly telephonically and follow up with email to have track record of information

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 26: Emails, though have software like rivets and autoCAD and convert information form these softwares into pdf files and sent it to the team through internet web base sources

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 26: Late information because of clients changes in the last hour

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 26: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of

professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 26: Make sure whatever the architect envisage in his design is structurally sound and effective. Check whether structural boq fits well with structural design

Mpho Papo: Oh okay.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 26: Most of the time especially if any reviews from the architect

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 26: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 26: It depends from project to project. Architect gets to manage design information from design team and the project manager liaises between the team and client, supervising entire professional responsibility. Some of the projects are not well managed due to client interruptions.

20/03/2014

Date of Interview

Participant 27

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 27: I am an Architect

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 27: I work with the quantity surveyor, civil engineer, mechanical engineering, project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 27: Almost once a week in a month

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 27: Yes, they are available

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 27: Yes, its good for the project if team members are open and respectful

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 27: Yes, it is important to discuss and come up with solutions to project challenges

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 27: Yes, it is essential to solve matters pertaining to the project that might hinder progress

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 27: Yes, and the project benefits from various knowledge brought by the professional team

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 27: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 27: Cell phones, emails, fax and meetings

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 27: Same as above

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 27: Vague or unclear communication

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 27: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 27: Prepare construction drawings and supervise the team

Mpho Papo: Oh okay.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 27: As often as there are changes

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 27: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 27: Architect assumes the supervisory role. And it is not all the time project activities being well managed

20/03/2014

Date of Interview

Participant 28

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 28: We do architectural and project management services

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 28: I work with the quantity surveyor, civil engineer, mechanical engineering, project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 28: All the time

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 28: No, its not always the case as we all have other projects to manage

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 28: Yes, professional trust for other's abilities of utmost importance

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 28: Yes

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 28: Yes

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 28: Yes

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 28: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 28: Emails and drawings

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 28: We normally have face to face discussions during meetings

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 28: Other professional designs which are not compatible with companies software

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 28: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of

professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 28: Team leader and facilitator for coordination of all professionals

Mpho Papo: Oh okay.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 28: Weekly

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 28: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 28: Architect here assumes the supervisory role as a project manager

20/03/2014

Date of Interview

Participant 29

Mpho Papo: This interview questions aim to identify the challenges associated with fragmentation within construction projects as experienced by the professional team. It also aim to find out whether the the intrinsic properties of the construction projects i.e project size, clients, project locations and project delivery methods contributed to fragmentation challenges experienced by the construction professionals.

Mpho Papo: Fragmentation as explained refers to a condition whereby professional disciplines involved in the project solely have overall control and ownership of their functions as required in the project to fulfil construction project processes. These functions services reside solely within each professional practice with different management style set for each practice. The services provided by various professional teams are rendered as discrete processes

Mpho Papo: What professional role do you play in this project?

Participant 29: I do Architectural service

Mpho Papo: Okay

Mpho Papo: I have defined the concepts that I will be asking questions on so that you have a clear idea of what this interview process entails. We will go through the definition of each concept before I start asking you the questions. You are allowed to ask any question for clarity. We will start with integration. You can also read the for yourself on the handout given to you

Integration in this context refers to a process whereby various disciplines from all over different geographic locations come together to merge their attributes, methods into a single cohesive unit 1.

Mpho Papo: What other professionals do you get to interact with on a project?

Participant 29: I work with the quantity surveyor, civil engineer, mechanical engineering, project manager, structural engineer and electircal engineer

Mpho Papo: Okay

Mpho Papo: How often do you combine your attributes with other professional members of a professional team? By attributes I mean your professional skills.

Participant 29: Two times a month

Mpho Papo: Are various professional attributes or expertise easily and freely accessible and available in a project?

Participant 29: Yes, they are freely and easily accessible

Mpho Papo: Okay, we are done with integration. the next questions are for collaboration

Mpho Papo: Collaboration is defined as a creative and collective process undertaken by more than one individual to share their attributes, expertise, knowledge and understanding in an atmosphere which reflects openness, honest, trust and mutual respect.

Mpho Papo: Do you as a member of the team familiarize yourself with other members, honest and possess mutual trust and respect each other

Participant 29: Yes, as a team, we do interact a lot

Mpho Papo: Do you contribute, complement and develop suggestions from each other's tasks

Participant 29: Yes, we advise and discuss tasks at hand

Mpho Papo: Do you collectively pursue new ideas, solve problems, propose solutions and make decisions with other members of the team?

Participant 29: Yes

Mpho Papo: Are you knowledgeable about other roles or tasks of members in the project

Participant 29: Yes, but to a certain extent

Mpho Papo: The next discussion is on communication. Let me know when you ready

Participant 29: Okay, no problem

Mpho Papo: Communication is defined as a means through which information is transferred from one person to another.

Mpho Papo: How do you communicate with each other on a project?

Participant 29: Emails, Phone call, instant messages

Mpho Papo: Are there other medium of communication through which information is conveyed?

Participant 29: Through servers and clouding

Mpho Papo: What challenges do you experience when communicating with other team members?

Participant 29: Members responding late or not at all

Mpho Papo: Okay, now we going to discuss the coordination of attributes. Let me know when you ready

Participant 29: Okay

Mpho Papo: Coordination is defined as a process to control and link together various parts of responsibilities with an effort to accomplish a set of collective activities. Each member of professional team is fostered to bring together set of responsibilities so as to develop collective sets of activities which can be controlled, managed and operated within a team

Mpho Papo: What kind of functions do you perform in relation to your job?

Participant 29: I do designs and management

Mpho Papo: Oh okay.

Mpho Papo: How often do you submit your set of activities to be controlled and managed by the team?

Participant 29: Once every week during meeting

Mpho Papo: Does coordination in your case ensures active role of information sharing and leading members of the team in one direction?

Participant 29: Yes

Mpho Papo: Are different activities of professional team well managed and who assumes a supervisory role on professional responsibilities?

Participant 29: Sometimes they are well managed. Construction Project Manager assumes supervisory role on professional responsibilities

18/03/2014

Date of Interview

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