Information behaviour of construction project actors

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ABSTRACT

Construction is one of the largest industry sectors in terms of size and output in the United Kingdom (UK). The sector contributes about 10% directly to the UK’s Gross Domestic Product (GDP) and drives historical GDP growth. However, Construction projects and Organisations continue to underperform at significant levels which is underpinned by actors' Information Behaviours (IBs).

The pursuit of improvement has resulted in high-level research in information modelling, information flow, and integrated project delivery. This has highlighted the need for particular research and improvement strategies on information seeking, sharing and integrated working. Despite the significance of the underlying attributes to project failures and underperformance, not much attention has been devoted to actors’ IBs and/or Information-Seeking Behaviours (ISBs). As a result, insights into the information culture, the IBs and ISBs of actors in construction organisations remain elusive in extant literature. Similarly, research into the factors that influence actors’ information-seeking and information use/task performance behaviours remains hidden. Hence, this research empirically investigates the fundamental behaviours by which project actors' seek, share and use information, and the factors that influence such behaviours in Construction organizations.

The study employed qualitative and quantitative inquiries to investigate actors' in construction organisations and project environments to test the commonality of archetypical Information Seeking Behaviour Types (ISBTs) which were distilled from literature. This enabled assessments of the extent of actors' adoption of a particular ISBT and the key factors that influence their decision-making during task performance. Analysis of quantitative and qualitative data revealed five key ISBTs (such as Associate, Cognitive, Systematic, Serendipity/Fortuitous and Social Media ISBT) that actors' exhibit during task performance. In addition, the study found seven (7) key information-seeking behaviours factors (such as accessibility, collaboration, work condition, age, source/channels, trust and organisational setup) that predict actors' ISBTs. In addition, 10 key factors (such as accuracy, currency, context specific, efficiency, effectiveness, relevance, reliability, satisfaction, quality and useable) were found to influence actors' ISBTs. By way of consolidating the research findings, an ISBT model was developed. The model indicates the
relationship between the influencing information seeking and information use/task performance factors and the ISBTs.

In view of these findings, it is vital to plan construction project delivery and organisation management to integrate actors’ ISBTs into the Project Life Cycle (PLC) to enhance performance improvement. Similarly, organisation need to create avenues to support actors’ ISB preferences during the design development phases to facilitate effective information-seeking, information sharing and information use.

**Keywords:** Information Behaviour, Information-Seeking Behaviour Types, influencing information-seeking factors, information use/task performance factors, project actors, construction project organisation.
Acknowledgement

Father, I am grateful for your wonders, and thankful for what you continue to do in my life. Have your praise and adoration. Amen!

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My special thanks go to my wife, Mrs. Louise Charlotte Dzokoto and my wonderful son, Master Benjamin Edem Kofi Dzokoto for your patience, motivation and support throughout this journey. I am grateful to you.
Dedication
I dedicate this work to my family, friends and all loved ones who have been my sources of motivation throughout this PhD journey. Without your prayers, support and love, I would not be able to complete this thesis. I am very grateful. Father God, I am thankful for everything. Amen!
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List of Abbreviations

AEC - Architecture, Engineering, and Construction
AISBT - Associate Information-Seeking Behaviour Type
AMA - American Medical Association
ANOVA – Analysis of Variance
APM – Association of Project Managers
ARIST - Annual Review of Information Science and Technology
BIM - Building Information Modelling
CAD – Computer Aided Design
CDE - Common Data Environment
CIOB – Chartered Institute of Building
CISBT - Cognitive Information-Seeking Behaviour Type
COBie - Construction Operations Building Information Exchange
ERP - Enterprise Resource Planning
GDP - gross domestic product
GPS - Global Position Satellite
GVA - Gross Value Added
HCI - Human Computer Interaction
IB – Information Behaviour
IBM – International Business Machines
ICE – Institute of Civil Engineers
ICT - Information Communication Technology
IO – Information Overload
ISB - Information-Seeking Behaviour
ISBT - Information-Seeking Behaviour Type
ISO – International Standard Organisation
ISP - Information Search Process
IT - Information Technology
KMO - Kaiser-Meyer-Olkin
LIS – Library and Information Sciences
M & E - Mechanical and Information Sciences
nD – nDimensions
PCA - Principal Component Analysis
PDA – Personal Digital Assistant
PFI - Private Finance Initiative
PLC - Project Life Cycle
PPP - Public Private Partnership
PSWS - Project Specific Web Site
Q3 - Third Quarter
QS – Quantity Surveyor
RFI - Request For Information
RIBA – Royal Institute of British Architects
RICS – Royal Institution of Charted Surveyors
RSS - Rich Site Summary
SFC - Strategic Forum for Construction
SIC - Standard Industrial Classification
SISBT - Serendipitous/ Fortuitous-Seeking Behaviour Type
SISBT - Systematic Information-Seeking Behaviour Type
SMART – Specific Measureable Achievable Realistic and Timely
SMISBT - Social Media Information-Seeking Behaviour Type
SPSS – Statistical Package for the Social Sciences
TMO - Temporary Multi Organisation
CHAPTER 1 : INTRODUCTION TO THE THESIS

1.1 OVERVIEW

This research investigates the Information Behaviours (IBs) of actors involved in construction organisation management and the project delivery process to identify their Information Seeking Behaviour (ISB) orientations and the factors that influence such behaviours. This research presents a model to guide the ISB preferences of actors involved in construction project organisations. The research focuses on actors’ ISB preferences, the key factors that influence such behaviours and the associations between the ISBs and the influencing factors.

1.2 RESEARCH BACKGROUND

The delivery of projects within the construction industry is very dependent on the provision and use of information. How actors make use of, or provide such information is described as their IB. Information Behaviour studies date back to the 1960s where the area of interest was on IBs and information practices of professionals such as scientists, social scientists, engineers, humanists and interdisciplinary, physicians, managers, journalists, lawyers, farmers, and non-professionals such as students and laypeople (Case, 2012). These studies focused on industry sectors and institutions such as engineering (manufacturing and aerospace), healthcare, academic, and Library and Information Sciences. They also provide a broad range of IB related phenomenon and information practices that rely on different approaches to methodological and theoretical issues. Similar studies in ‘Construction’ are limited to information flow measurement (Ndekugri and McCaffer, 1988; Tribelsky and Sacks, 2010, 2011), information technology and modelling (Eastman et al. 2011; Gu and London, 2010; Sebastian, 2011; Alshawi et al. 2010), and information and knowledge capture (East et al. 2009; Hari et al. 2005; Tan et al. 2006; Anumba et al., 2008). Although these contribute to heterogeneous technology/software applications and ontologies for information management in construction, they fall short of grasping actors’ information needs, information-seeking and information use.

At present, IB research focuses on specific occupational functions and relationships that exist with demographic factors (Kwasitsu, 2003; Leckie et al., 1996; Meho and Tibbo, 2003), where interests in task and non-task oriented ISB of individuals
continue to increase (Byström, 2002; Kuhlthau and Vakkari, 1999; Vakkari, 2008). Similarly, interests in IB of person-centred to person in context (Ford et al., 2002; Kuhlthau, 1999; Wilson, 1984), everyday life information-seeking (Savolainen, 1995), incidental information-seeking (Williamson, 1998), and information encountering (Erdelez, 1997) continue to advance.

Several IB studies have ignored profiling ISB preferences of actors in project centred organisations to insights into the area of personality traits (McCrae and Costa, 1997), information sharing (Talja, 2002; Choo et al., 2006; Hyldegård, 2009), and collaborative information-seeking (Choo et al., 2006; Hertzum and Pejtersen, 2000; Hyldegård, 2009). Similarly, areas such as information search process (Kuhlthau, 2005), serendipitous information-seeking process (Foster and Ford, 2003; Case, 2006; Erdelez, 1997; 2005), information foraging (Pirolli and Card, 1995, 1999; Pirolli, 2009), and other kinds of information-seeking process (Kuhlthau and Vakkari, 1999; Vakkari, 1999) continue to be investigated where conclusions are generalised. In addition, researchers in the Library and Information Science (LIS) and Knowledge Management Studies (KMS) traditionally use models to represent human IBs as a linear process (Byström and Järvelin, 1995; Ellis and Haugan, 1997; Krikelas, 1983; Leckie et al., 1996; Savolainen, 1995; Wilson, 1999).

The focus of IB research in recent years has shifted to task and non-task oriented studies where several pioneering theories and models are formulated to establish the nature of human IB practices in context (Byström and Järvelin, 1995; Greyson et al., 2012; Heinström, 2003; Krikelas, 1983; Leckie et al., 1996; Wilson, 1997). In the midst of the paradigm shift in the LIS study is the use of metaphors to describe the IBs of individuals (Agada, 1999; Merton, 1973; Pirolli and Card, 1995). Notable development in recent studies is the growing interest in identification of individuals’ ISB preferences (Fisher et al., 2005; Krikelas, 1983; Marchand et al., 2002; Vakkari, 2008).

Primarily, construction activities depend on information produced by actors. However, all indications show the lack of research in human IBs, and reliable instruments for assessing human information-seeking, sharing, and use behaviours.
**Composition of the Construction Sector**

Construction is composed of Architecture, Engineering, and Construction (AEC), which embodies the most dynamic and complex sector in industrial terms. The nature of AEC is such that different sizes (large, medium and small, including temporary multi-organisations) of diverse organisations and professional partnerships rely on teams and/or individuals with different skills, experiences and knowledge to execute a project. These actors are usually drawn together from different professional backgrounds, cultures, communicating different languages (i.e. technical and social), often using different tools, technology and processes.

Construction projects vary from a few thousands of pounds undertaken by small jobbing builders to major schemes of projects worth billions (Harvey and Ashworth, 1993). The composition of a project organisation depends on factors such as the size and complexity of the project. The more complex a project is, the higher the need for large number of people and/or organisations to execute, and the higher the level of fragmentation in the organisation (Eastman et al., 2011; Halpin, 2010; Harty et al., 2007; Morton and Ross, 2002). Although the fundamental principles of project organising, execution and delivery may be similar, the size and complexity vary enormously. Essentially, the industry is well accustomed to fragmentation from both geographical and functional perspectives (Eastman et al., 2011; Halpin, 2010; Morton and Ross, 2002). Fragmentation is regarded in construction as a strength and a weakness (Egan, 1998). Fragmentation as a strength provides the flexibility for different actors (including surveyors, engineers, architects and designers) involved in the construction process to operate from both inside and outside of construction sites and construction firms as independent consultants, businesses and vendors (Egan, 1998). In contrast, actors in industries such as manufacturing and aerospace operate from within the same organisation (Morton and Ross, 2002). Fragmentation as a weakness impact on the extensive use of subcontracting and contractual relations which prevents continuity of actors (Egan, 1998).

According to Emmitt and Gorse (2009), the construction process rely on professional interaction across organisational boundaries to develop and implement projects. This result in creation of vital information, critical to the success of projects and organisations. The information created by these actors flows through multiple
channels and sources where context specific information is extracted to develop and execute project designs (Austin and Telford, 2001). However, actors’ exposure to multiple information sources and channels results in numerous problems including information overload (IO) (Allen and Wilson, 2003; Edmunds and Morris, 2000; Eppler and Mengis, 2003; 2004; Grisé and Gallupe, 1999). The consequences of IO culminate in suboptimal ISBs. This results in poor and inadequate information capture which leads to information burden (Edmunds and Morris, 2000). Decision makers such as project managers, surveyors, architects and designers use the poor information. Edmunds and Morris (2000) posit that information burdens (including personal, organisational and customer loadings) can have negative impact (low productivity and stress) on individuals and organisations which leads to “information fatigue syndrome” (Lewis, 1996; Oppenheim, 1997).

It is widely acknowledged that actors in project organisations are constantly overwhelmed with large volumes of information through multiple channels and sources (Allen and Wilson, 2003; Edmunds and Morris, 2000; Eppler and Mengis, 2003; 2004; Grisé and Gallupe, 1999; Yuyang et al., 2008). This subsequently impacts on the amount of time actors spend information IB activities (Bawden and Robinson, 2008; King, 1994; Robinson, 2010). The delay in the capture of appropriate information is considered to impact on project delivery costs and performance (Hertzum and Pejtersen, 2000; KPMG, 2013), whereas “too” much information affects individuals and organisations (Eppler and Mengis, 2004).

The desire to obtain the right level of information is essential to successful project delivery. Actors generally seek appropriate information through trusted sources and channels by neglecting source quality in favour of convenience. However, the amount of time they spend to actively or passively seek information is evidently found to take longer, and cognitively demanding than when using non-human sources (Robinson, 2010). It is argued that different information sources and channels actually help to capture relevant information (Tang et al., 2006). However, source quality is vital to information use (Aurisicchio et al., 2009; Robinson, 2010; Kwasitsu, 2004). Tang et al. (2006), posits that the composition of construction organisations makes it easier for actors to spend more time to capture all kinds of irrelevant information. This is affirmed in a recent research that engineers spend 40%
to 66% of working time seeking, processing, sharing and communicating information (Bawden and Robinson, 2008; King, 1994; Robinson, 2010). A similar study suggests that 80% of information filed by professionals is never used (Inc Staff, 2003). Feather (1998) posits that increase in IO is a result of growth in technological developments. Other research indicates that performance are negatively affected by too much information (Butcher 1995;Eppler and Mengis, 2004), and exposure to technologies. Organisations are aware of the IO problem and its impacts on performance (both individuals and the business). However, efforts to alleviate the intensity of the problem continue to fail (Gerstberger and Allen, 1968; McMahon et al., 2004). Majority of construction organisations continue to implement Computer-Supported Collaborative Work (CSCW) systems (Ellis et al. 1991; Grudin, 1994; Hansen and Järvelin, 2005) and other software tools and concepts to mitigate the social and economic burdens of IO. Others have resorted to “push” technology (Edmunds and Morris, 2000; Hertzum, 2008; McMahon et al., 2004). However, these technologies continue to compound the problem on actors.

1.2.1 Nature of Information in Construction

Information is implicit in the construction process; however, IB research in construction is limited to Information Communication Technology (ICT) and the systems that run or manage the information (Behzadan et al., 2008; Cerovsek, 2011; Eastman et al., 2011; Ruikar and Emmitt, 2009). The use of ICT dominates the entire construction design and development process where computer aided design has taken over the traditional manual drawing methods (Dainty et al., 2007; Peansupap and Walker, 2005). Moreover, since the main cause of project failures are attributed to human behaviour factors (KPMG, 2013); one might think that the primary focus of research in construction would be on human IBs. However, this area is scarcely researched in the sector. Some researchers and academicians (including Anumba et al., 2013; Demian and Balatsoukas, 2012; Edum-Fotwe and Price, 2009; Emmitt and Gorse, 2009; Runeson and Loosemore, 1999; Thorpe, 1992) who have tried to research the information aspect of the construction process focus on information flow, the supply chain, and some aspect of communication and/or knowledge management. In the UK, successive government reports (Emmerson 1962, Banell 1964, Latham 1994, Egan 1998, 2002 and 2007) have emphasised the need for performance improvement, process integration and other
arrangements. However, these reports have fallen short of highlighting the importance of actors’ IBs and ISBs, the value of information and information management in the construction sector.

According to Glazer (1993), information has both implicit (the information itself) and explicit (the information environment) attributes with which the quality of information is regarded as implicit. Some explicit factors including quality, usability, currency, context, accuracy, availability, relevance, and accessibility influence the value of information (Zhao et al., 2008) and information quality (Eppler, 2006). Gerstberger and Allen (1968), assert that engineers will simply not be attracted to information sources and channels by improving the quantity or quality of information library, but by pushing the library to them. This implies there is a strong need to disseminate information to actors according to their ISB preferences. They emphasised that channel quality and accessibility are the most important determinants of the overall extent to which information is used. Gerstberger and Allen (1968) posits that experience in the use of a familiar channel enhances its accessibility. This underpins the push technology, where information is pushed to the user according to their information needs/requirement profile.

A study by KPMG (2013), identified eight main factors that cause construction projects to underperform. These factors include delays, poor estimation process, and failed risks management processes. In addition, organisations suffer from poor subcontractor performance, design errors and omissions. The study indicate that 51% of underperforming projects are due to delays, 50% is due to poor estimates, and 47% is due to failed risk management processes. Approximately 37% results from poor subcontractor performance, 20% is due to unavailable resources, 17% results from change impact on management teams and 16% is due to poor client relations. All these factors emanate from interactions between actors involved in the project delivery and the result of poor information management process.

There are number of challenges associated with managing information in engineering organisations particularly in construction industries. For example, the complex nature of construction suggests large volumes of information creation, use and transfer between different project actors. Project actors require context specific
information (such as design specifications, status report, planning details, as-built information and performance report) to make critical decisions. Similarly, a stakeholder may require specific information about project progress. In addition, an effective project manager requires a good knowledge and information about the technical aspects of the project. Hence, considerable amount of information is generated during the project delivery process; however, only a fraction of the information is captured and used. This is attributed to the fragmentation of the sector (Tan et al., 2009). Essentially, when the captured information is presented in a well-structured and timely manner, it is evident that effective decisions are made against the project (Hanka and Fuka, 2000). This implies the creation of avenues to seek to understand user information needs in order channel appropriate information. Hence, this research is conducted on the premise:

- the need to understand project actors’ IB in order to establish their ISB preferences to facilitate effective seeking and dissemination of context specific information,
- the need to establish an IB/ISB culture in construction organisations and project environment to establish a common understanding of its importance to performance.

This implies, by defining actors’ information-seeking preferences, appropriate systems and strategies can be designed to facilitate effective capture and dissemination of context specific and quality information. Hence, this research seeks to fill the knowledge gap by developing a systematic approach to enhance actors’ ISB process in the project environment and construction organisations.

1.3 RESEARCH PROBLEM

Information comes in different forms: structured, semi-structured, and unstructured (Aitken, 2007). Unstructured information can be very difficult to use, as a result, much effort is required to transform unstructured information into structured information. However, numerous challenges surround the use of both structured and unstructured information (Aitken, 2007). This is due to exposed information sources and channels, the overloading of information, untimely and non-context specific information.
In construction, information can be easily captured; however, context specific information that may be ready just-in-time for use, is difficult to identify along the information life cycle (Tang et al., 2006). According to Davenport and Cohen (2005), it is difficult to access, share and evaluate unstructured information content since it is not vigorously managed by anyone but its originator. Smith and Tardif (2009), posit that information should be properly structured and made available in appropriate format to enhance readiness and adoption of process automation. Generally, construction actors rely on document-based information sharing where most of the information contained are unstructured and text-based (Jallow, 2011). In addition, the dispersed nature of the construction process results in the use of heterogeneous Information Technology (IT) systems to communicate and manage information and documents (Anumba et al., 2008). However, the management of such information coupled with fragmented heterogeneous process and systems makes actors’ IB and ISB a complex activity.

Traditionally, construction information management activities has predominantly been paper based until the last century (Ball, 2009; Björk, 2003). There is a transition from the use of drawing board through 2D CAD design to 3D and nD modelling, where explicit information such as specifications, time, and cost culminate into Building Information Modelling (BIM) process. This transition continue to revolutionise construction project delivery and organisation management; however, the bulk information to actors remains unstructured (Robinson, 2010, Kwasitsu, 2004). Essentially, the construction sector continues to embattle fragmented working process and transparency in the project organisation. According to Anumba et al. (2008), the sector lacks collaboration, coordination and knowledge management across various disciplines, the attributes of which is the lack of documented evidence on IB/ISB research. However, there are vast amount of construction literature about information flow measurement (Eckert et al., 2001; Fyall, 2002; Tribelsky and Sacks, 2010, 2011), information retrieval (Belkin, 1993; Demian and Balatsoukas, 2012), information and knowledge capture (East et al. 2009; Hari et al. 2005; Tan et al. 2006; Rezgui et al. 1998) and information presentation (Golparvar-Fard et al., 2007; Lee and Pena-Mora, 2006; Mao et al., 2007), and BIM (Eastman et al., 2011).
The emergence of BIM forms the fundamental platform for reshaping information management, project delivery and changes in project roles and relationships in the sector (Eastman et al., 2011). This is intended to transform a fragmented processes into collaborative integrated process (Eastman et al., 2011, Mao et al., 2007), from predominantly paper based manual working to intelligent information based systems (Lin, 2005). However, the unintended consequence of BIM and digitised solutions in construction production activities is the creation of large volumes of information retained as legacy document to support decisions. Such legacy has itself seen a transition from human memory, through paper-based databases, to digitised archives held in large data warehouses (Edum-Fotwe and McCaffer, 2000).

To date, substantial work on structuring information resources to support decision makers in digitised construction project environments has been carried out (Anumba et al., 2008). However, structuring what information, available at what time and to which actor will not only call for an appreciation of their role in the project environments, but also enhances their information use behaviour. Thus, establishing construction project actors ISB preferences will provide insights to develop innovative approaches to improve actors IB/ISBs in a BIM enabled project environments. Hence, it is justifiable to identify appropriate ISB characteristics of project actors in construction organisations to respond to questions such as:

- **how do actors seek information,**
- **what factors influence their information-seeking and information use/task performance behaviours,** and
- **how can all these process enhance project delivery?**

An important question that arises from the defined problems is whether actors at a particular stage of a project or organisation, exhibit common features in their ISBs. Hence, it is practical to explore avenues to understand project actors ISBs in order to develop strategies to support the information intensity of construction project delivery and organisation management.
1.4 RESEARCH JUSTIFICATION

The premise on which this research is undertaken is based on:

i. paradigm shift in the construction sector from paper based information process to n-D modelling for graphical information, and

ii. Information Overload syndrome stemming from suboptimal IB culture in construction project organisations.

Paradigm Shift in Construction Information Activities

Over the last two decades, the way information is produced and managed, and the volume of information created to support project design and site operational activities in construction continue to change at an accelerated pace. Some of the changes include a gradual migration from paper based 2-D drawing through 3-D to n-D modelling for graphical information (Aouad et al., 2006). These changes culminate into the growing reliance on BIM as an essential vehicle for communicating technical and functional information between key stakeholders. Concomitant with the changes in graphic communication is the increase digitisation of other forms of information to support the organisation and delivery of projects. Much of such digitised information is captured in Enterprise Resource Planning (ERP) solutions deployed within the project organisation (Shi et al., 2003). The core objective of such ERP solutions is to facilitate integration of functional and process elements of information management systems to expedite information availability on an almost real-time basis. This is intended to reduce the time and space required to seek, disseminate and use information. However, the lack of change from the traditional ‘macho’ culture, and a fragmented process inhibits optimal information-seeking, sharing and integration in construction organisations (Eastman et al., 2011).

Coincidentally, the UK government has mandated the construction sector to adopt BIM technologies, processes and collaborative behaviours that will unlock effective and efficient ways to enhance project delivery, performance and organisation management by 2016 (BIMTaskGroup, 2011). However, to realise the full benefits of BIM deployment, there is a need for change in the way Construction organises and manages information between key stakeholders. There is the need to adopt IB culture as a way of ‘life’. Some academic and professional bodies have advocated
many of the required changes (ConstructIT, 2008). The momentum behind such advocacy could potentially lead to a situation where BIM solutions become the norm in Construction (Eastman et al., 2011). However, achieving BIM maturation will require an understanding of actors’ IB/ISB orientations. Since BIM process requires information accumulation throughout the PLC between entities in the project organisation.

**Information Overload and Suboptimal Information Behaviour Culture**

Information underpins the commercial viability of AEC enterprises hence; the effectiveness of construction sector organisations depends on it. This implies IO adversely affects actors’ performance and successful project delivery. Information Overload research has advanced over decades with associated definitions by different authors (Edmunds and Morris, 2000; Eppler and Mengis, 2004). According to Dzokoto et al. (2013), IO “is the exposure of actors to abundant information from multiple channels and sources that affect effective decision making and information use”. Hence, the inability to capture context-specific information at the right time to the right actor poses challenges, which if not resolved could impact on the social and economic trends, and technological advancement of the construction industry (Allen and Wilson, 2003; Bawden and Robinson, 2008; Edmunds and Morris, 2000).

The IO syndrome arises through lack of structures or systems to manage, monitor and control information flow (Edmunds and Morris, 2000). This result in actors’ exposure to both relevant and irrelevant information through multiple channels and sources. As a result, relevant information may go unused (Wilson, 1996). Similarly, IO may also come about through diverse amount of information required by actors and created by actors (Bawden et al. 1999; Bawden and Robinson, 2009; Edmunds and Morris, 2000). Although, any kind of acquired information is vital to project organising and management, the desire to obtain appropriate level and quality of essential information, at the right time, at any stage of the project requires ease of access (Robinson, 2010). According to Robinson (2010), too much information can be as detrimental as too little. Hence moderate information level leads to effective performance, as both insufficient and excessive levels results in performance decline (Patrashkova-Volzdoska et al., 2003).
Information in any state generally comprises of facts; however, its value changes as it moves from person-to-person, person-to-system and system-to-system. This movement changes the value, meaning and interpretation that actors place on the information. Changes to information in transit can affect actors’ IB process and project outcome. According to Yunjie et al. (2006), the lack of effective ISB of employees in modern organisations affect job performance, ability to cope with uncertainty, knowledge acquisition, and comfortable social relationships. Similarly, the performance of individuals or organisations is affected by too much information (Edmunds and Morris, 2000; Eppler and Mengis, 2004). In addition, the nature of IB research in recent years has shifted from non-task to task-oriented approach where pioneering theories and models have been formulated to establish the human IB practices (Case, 2012; Fisher et al., 2005; Wilson, 1999).

Other significant development in recent studies in human IB in LIS research areas is the growing interests in identification and profiling of individuals’ ISB preferences (Dzokoto et al. 2014; Krikelas, 1983), and its influence on performance. However, successful implementation of performance improvement strategies requires a change in culture. Barr et al. (2005), posits that organisations must not only have the best assets but the best people and processes to compete successfully. According to Franco and Bourne (2003), organisational culture encourages improvement in performance measurement strategies. This is affirmed by Sousa and Aspinwall (2010), who state that culture is an important factor in the use of strategic performance systems.

Therefore, the intricate nature of Construction and the paradigm shift in its operations makes this research complex and relevant. This research deals with a multi-disciplinary topic, which has many facets and systems connected to it. From the brief overview, it is obvious that investigating the IB of project actors to establish their ISBs in the construction sector is rather a complex endeavour.

1.5 RESEARCH QUESTIONS

In order to understand actors’ IB in construction project organisations, the following questions drive the aim and objectives of this research. These questions emanate from the research problems. Thus, the study addresses the following questions:
i. Is there discernible ISB preference(s) of construction project actors?

ii. To what extent do information-seeking and information use/task performance factors influence actors’ ISBs?

Response to these questions and the IB problems identified would result to achieve the following research aim and objectives.

1.6 RESEARCH AIM AND OBJECTIVES

1.6.1 Research Aim
The overall aim of this research is to investigate the IB of project actors in the construction sector. This can be achieved through the principle of least effort (Zipf, 1949).

1.6.2 Research Objectives
The following are the outlined research objectives to help achieve the aim:

i. To investigate the extent of project actors’ IB/ISB culture in relation to performance in construction organisations.

ii. To investigate the extent of IB/ISB research of actors in general.

iii. To review literature to establish the extent of IB and/or ISB research of professionals in different industry sectors.

iv. To investigate the factors that influence actors information-seeking and information use/task performance in project organisations.

v. To conceptualise the ISB processes of actors in construction project organisations.

vi. To develop project actors Information-Seeking Behaviour Type (ISBT) model.

1.7 RESEARCH SCOPE
Information behaviour studies cover a wide area of knowledge of professionals in different industry sectors across different geographical boundaries. Similarly, construction PLC entails a wide range of activities, processes and interactions between actors and stakeholders. And the changes that is transforming the construction sector, and the UK government’s BIM strategy (BIM Task Group, 2011) underpins the need to scope this research to meet the identified aim and objectives. Therefore, this research limits itself to the UK construction industry as it geographical and industrial focus. Within this sector, the research covers key actors
involved in the project design development stages in both private and public sector organisations. Hence, project actors are the unit of analysis for the study. The study focuses on project actors in construction organisations across the UK to capture variations in their IBs in both private and public sector context.

1.8 STRUCTURE OF THE THESIS

The methodology adopted for this research is the positivist worldview (quantitative approach). This indicates the application of deductive research process. In order to exhaust the general requirements of positivism framework, elements of phenomenological (qualitative) approach were applied to provide appropriate exploratory insight into the phenomenon of IB activities of construction professionals. Figure 1.1 present the summary of the overall research outline.

![Thesis outline diagram]

**Figure 1.1 Thesis outline**

From figure 1.1, the first chapter reviews the research topic. This centres on the area of IBs, the paradigm shift in the construction industry and the problem of IO. This helped to establish the research background, research problem and
justification, research scope, aim and objectives. The second chapter applies systematic review to focus on historical background of the construction industry. This explores the economic significance and performance, information culture, project delivery and organisation management, and actors in the sector. The third chapter examines the historical background of IB studies. This covers definitions of key terms, theoretical background of actors' ISBs, different IB and ISB models.

The fourth chapter present the extraction of actors ISB orientations and factors that influence information seeking and information use/task performance through literature reviews on the dynamics of IBs/ISBs of professionals in different industry sectors. This covers the background and different approaches to IB studies. The fifth chapter examines the five ISB orientations and the twenty-two (22) information seeking and information use/task performance influencing factors. This chapter consolidates transferable factors and the ISB orientations of professionals in different industry sectors. The sixth chapter focuses on research methodology. This phase examines the purpose of research methodology, the philosophical paradigm and research approach, research design, research methods, data collection and analysis. The object is to advance the researcher’s understanding of methodology and lay the foundation for data collection. The chapter also reviews literature on the principles of least effort to form the basis for factor identification.

The seventh chapter applies qualitative inquiry to explore and collect data on IB/ISB activities of professionals in construction organisations. A one-to-one semi-structured interview of professionals involved in the project delivery process was adopted. This helped to establish the extent of IB/ISB culture and practices in construction organisations. Thematic analysis was applied to analyse the data. Findings from the exploratory inquiry were used to formulate quantitative research instrument (questionnaire) to collect the primary data for the research. The eighth chapter present the first part of quantitative findings including descriptive statistics of questionnaire items and the analysis of ISB questionnaire using various tools and techniques of IBM SPSS version 21.0. Relevant findings including the five types of actors’ ISB orientations, correlation analyses of the influencing factors, and a hierarchical structure of actors’ ISBTs are presented. The ninth chapter presents the second part of the data analysis. It focuses on regression analysis of
the ISBTs and the influencing factors that significantly predict actors’ ISBTs, and the test of hypotheses. The findings were used to review and refine the formulated framework, which is supported by extended literature review to ensure the novelty of the framework. The tenth chapter focuses on validation and discussion of research findings and the research model. The eleventh chapter present research conclusions, implications, limitations and recommendations.

1.9 PRINCIPAL FINDINGS OF THE RESEARCH
Essentially, the investigations into the IBs and ISBs of actors in the project environment and construction organisations revealed unique ISB preferences during information-seeking and information use/task performance. These preferences vary with respect to task complexity, and demands of the project. It was found that project actors exhibits five different Information Seeking Behaviour Types (ISBTs) during their information-seeking process. These ISBTs are Associate ISBT, Systematic ISBT, Cognitive ISBT, Serendipity/Fortuitous ISBT and Social Media ISBT. Out of the five ISBTs, it was found that the most preferred ISBT amongst construction project actors is the Associate followed by Cognitive, Systematic, Serendipity/Fortuitous and the least preferred is the Social Media ISBT.

That notwithstanding, it was found that these ISBTs are influenced by numerous factors during the information-seeking and information use/task performance process. Analyses of these factors revealed significant relationships between actors’ ISBT preferences and key influencing factors during project delivery and organisation management. Overall, the significant factors that influence actors' ISBT preferences during information-seeking are collaboration, working condition, age, accessibility, organisational setup, sources/channels, and trust. In addition, the key significant factors that influence actors' ISBTs during information use/task performance are accuracy, context specific, currency, effectiveness, efficiency, quality, relevance, reliability, satisfaction, and useable.

1.10 OUTLINE OF CONTRIBUTION TO KNOWLEDGE
This research provides a new insight into actors' ISB preferences in the project environment and the construction industry. The research identified five key ISBTs that actors’ exhibits during task performance. Similarly, the research identified key
factors that influence actors' ISBTs. The influencing factors are categorised into information-seeking and information use/task performance factors. In addition, the study has shown the degree of association of the influencing factors to the ISBTs. The study has also shown the extent to which the influencing factors influence actors’ ISBTs. Section 11.4 presents detailed contribution to knowledge. The study has developed an ISBT model to guide actors' ISBs in the project organisation. In addition, two technical/academic papers and a book chapter have been published in refereed international engineering and construction journals, conferences and doctoral workshops. Bibliographic details of these publications are provided in appendix A.
CHAPTER 2 : PERFORMANCE OF THE CONSTRUCTION INDUSTRY

2.1 OVERVIEW

This chapter reviews UK construction industry to assess its structure, and the factors that influence performance. The review responds to the first research objective, which is to investigate the extent of project actors’ IB/ISB culture in relation to performance in construction organisations. This establishes actors’ IB/ISB culture and the factors that underpin performance in the PLC and organisation management.

Construction is one of the largest industry sectors in terms of size and output in the UK and it contributes a Gross Value Added (GVA) of £92.4 billion (about 6.19%) in economic output (CBI, 2014; Rhodes, 2014). The sector contributes about 10% directly to the UK Gross Domestic Product (GDP) and drives historical GDP growth (CBI, 2014; Rhodes, 2014). This indicates the significance of the sector to the UK economy. Therefore, the ability to sustain improvement of performance activities that contribute to sector growth is highly important. However, construction projects and organisations continue to underperform at significant levels (KPMG, 2013). The main factors that causes underperformance are directly linked to behaviours of participants involved in the project delivery and organisation management (KPMG, 2013). Various factors according to literature findings contribute towards performance and sustainability of the sector. Hence, the subsequent sections present the performance of the construction sector.

2.2 HISTORICAL BACKGROUND OF THE CONSTRUCTION INDUSTRY

Historically, Construction is one of the largest industrial sectors in the world. However, indications shows that performance of construction organisations and construction projects continue to fall below expectations (KPMG, 2013; Standish Group, 2013). In global terms, the UK construction sector accounted for almost 16% of construction contracting value added, and about 8% of construction enterprises in Western Europe in 2010 (DBIS, 2013). A study by Deloitte (2014) ranks the UK third of total sales of construction. As the World continues to respond positively to the challenges of 2008 economic crisis, UK Construction continue to respond to the paradigm shift from paper/print based processes to opportunities presented by the digital economy.
Despite the stimulating forces shaping the global construction industry, there are significant barriers and red flag conditions that could cause a wipe out of these stimulants. The industry’s over reliance on national governments spending on infrastructure, and funding uncertainties is one key barrier to growth. Another red flag condition is the level of consistent project failures, and underperformance due to human related factors (KPMG, 2013). According to a global survey by KPMG (2013), 72% of respondents were adamant that national governments budget deficits and public funding is the biggest barrier to growth. Although 79% of the respondents indicated that investments in risk management strategies have paid off, about 77% indicated that underperforming or failed projects are generally due to factors including delays, poor estimates, failed risk management processes, poor relationships between participants, poor subcontractor performance, and others. Figure 2.1 present the main causes of underperforming projects in the global construction industry.

![Figure 2.1 Main causes of underperforming projects [adapted from KPMG (2013)]](image)

Factors identified in figure 2.1 indicate that processes or systems do not cause project to fail but rather, the human elements (i.e. culture of the sector) aspect within construction. Human IB activities (such as information creation, seeking, sharing, hoarding, use, and duplication) are the main factors that cause projects to underperform. Consequently, problems of subcontractor performance, design errors and omissions are major contributors to project failures (KPMG, 2013).
The construction process is highly complex and time dependant, which varies from project to project in terms of size. According to Pearce (2003), the significance of the sector is determined by the definition of the industry. Pearce defined the industry through narrow and broader views. The narrow definition focuses on on-site construction activities undertaken. This conforms to the Standard Industrial Classification (SIC) 45 (Office for National Statistics, 2007). Similarly, the broader definition covers the entire construction activities including supply chain for construction materials, products and assemblies, and professional services (such as management, architecture, engineering, design and survey). Figure 2.2 presents the linkage between the narrow and broader definitions of construction.

![Figure 2.2 Composition of the construction industry](adapted from Pearce (2002))

As shown in figure 2.2, the narrow definition comprises of on-site activities by contractors. This includes the production and quarry of construction materials, manufacture of construction products, building materials and assemblies, sale of construction products and services. On the other hand, the broader sector includes the supply chain for construction materials, products and assemblies, and services. The broader definition directly draws attention to the economic activities that depends on the narrow definition. Hence, the prospects of these activities are critically inter-dependent with the affluences of the contractors.

Bennett (2003) highlights three main categories of the construction industry: general building construction, engineered construction and the trade contractor, who usually works as the subcontractor for a general or prime contractor. These
definitions are provided by the UK Department for Business Innovation and Skills (DBIS, 2013) as (i) construction contracting industry; (ii) provision of construction related professional services; and (iii) construction related industry materials. Figure 2.3 presents details of activities undertaken in the sub-sectors.

![Diagram of construction industry sectors](image)

**Figure 2.3 The construction industry sectors [adapted from DBIS (2013)]**

Business units that create jobs to contribute to the national economy generally undertake activities in each of the sectors. A detailed definition of the construction industry together with a full list of variety of industries defined in the 2007 Statistical Industry Classification (SIC) statistics can be found in Office for National Statistics (2007). The works undertaken in the above categories may either be procured by private sector and/or public sector organisations (Rhodes, 2014). Works procured under public sector organisations focuses on housing and infrastructure. Similarly, works procured under private sector organisations focuses on housing, infrastructure, industrial and commercial facilities. According to Harvey and Ashworth (1993), the ability for the industry to deliver projects to contribute to the national economy is influenced by key characteristics that include:

- the physical nature (size and cost) of project, product and processes
- projects or products are generally executed and delivered on the client’s premises (construction sites)
the sector is project based (project focus)
- extensive involvement of small, medium and large organisations.
- generally, projects or products are one-off designs and lack any prototype models or precedents
- extensive specialities, (for example the design process are generally separated from the construction process, hence a fragmented process)
- price methods adopted for the valuation of projects or product is typically based on controlled bidding
- there is high level of unforeseen risks and uncertainties
- generally, construction projects take much longer to complete and deliver.

These characteristics indicate that the construction process is achieved through involvement of different stakeholders' irrespective of project size.

Currently, construction contributes £90 billion to the UK’s economy in value added, comprising of 280000 businesses and covering over 2.93 million jobs equivalent to about 10% of total UK employment (Deloitte, 2014). In addition, the UK construction industry has the large number of privately owned companies and is more fragmented than its major competitors in Western Europe (Deloitte, 2014). This drives the high proportion of small, medium size businesses and a relatively high number of self-employment.

The culture of the construction process is such that the client usually engages the architect(s) with an initial concept. The architecture firm takes the lead in ensuring the design of client’s concept. The client then engages the services of a general contractor to perform the fieldwork. The general contractor engages the services of specialist subcontractors to provide specialist services. Hence, the entire process revolves around different actors' and a fragmented number of self-employed, small/micro or medium to large business units. However, the level of fragmentation is linked to significant challenges that is evident in underperformance of construction projects and construction organisations (KPMG, 2013).

2.3 ECONOMIC SIGNIFICANCE OF UK CONSTRUCTION INDUSTRY
UK construction industry remains one of the largest in Europe despite the recent economic and financial crisis (DBIS, 2013). The overall value chain of the industry
contributes a GVA of £92.4 billion, and it accounts for 6.19 % of the total economic output (CBI, 2014; Rhodes, 2014). The sector consistently drives GDP growth; but the economic and financial crisis period (from 2008 to 2010) saw contractions, but there have since been spurts of growth. The sector grew significantly in 2013 and 2014, but it is still 5.9% down on the 2007 growth level. The third quarter (Q3) of 2014 saw the creation of 2.10 million construction sector jobs, thus 6.3 % in total. This has since increased to 2.93 million, which is equivalent to 10% of total UK employment (DBIS, 2013). Although smaller, the product and services is vital to the sectors’ performance and contributes to economic benefits. Other contributions of construction activities to UK’s economy are its ability to create, build and maintain the workplace, the infrastructure and the amenities. Hence, the UK needs a modern and efficient construction industry to enhance its economic prosperity.

Internationally, UK-based construction organisations continue to perform relatively well in comparison to their European counterparts. A recent assessment of the performance of construction companies in the EU-27 nations present UK in third place in the ranking of total sales by country (Deloitte, 2014). However, UK was rated as having the largest number of privately owned companies and is more fragmented. Indicators such as number of firms and number of jobs created are essential to facilitate the analysis of the sector’s significance to the economy. However, high fragmentation levels contributes to the alarming rate of project failures, process duplications, design errors and project delays (KPMG, 2013).

Another challenging impact of the 2008 and 2009 recession to construction organisations was the unprecedented increase in the cost of raw materials, limited available funding, government spending cuts, falling consumer levels and corporate failures arising from inappropriate risk management strategies (DBIS, 2013; KPMG, 2013). In general, these factors have influenced the operations of construction companies to seek improved strategies to transform project delivery, organisation management and sustainable supply chain processes. Organisations continue to seek new ways to improve, use advanced ICTs, and different approaches to eliminate waste. The UK government’s awareness of the numerous challenges faced by the sector is highlighted in key areas that need major changes to augment
performance and growth. Figure 2.1 outlines the essential features of the industry’s
type and the challenges it faces for future growth in the form of a SWOT analysis.

Table 2.1 SWOT analysis of key features of the industry’s nature and challenges [adapted from HM Government (2013)]

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Key sector to UK economy</td>
<td>➢ Sector integration</td>
</tr>
<tr>
<td>➢ Wider economic significance</td>
<td>➢ Low levels of innovation</td>
</tr>
<tr>
<td>➢ Large supply chain</td>
<td>➢ Lack of collaboration and</td>
</tr>
<tr>
<td>➢ World class design skills</td>
<td>➢ Limited knowledge sharing</td>
</tr>
<tr>
<td>➢ Low entry cost and low Capital</td>
<td>➢ High construction costs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Large growth opportunities in emerging markets</td>
<td>➢ Access to finance</td>
</tr>
<tr>
<td>➢ Low carbon construction</td>
<td>➢ Fall in Skills levels</td>
</tr>
<tr>
<td>➢ Wide implementation of BIM technologies</td>
<td>➢ Lack of career attraction</td>
</tr>
<tr>
<td>➢ Cost reduction</td>
<td>➢ International trade</td>
</tr>
<tr>
<td></td>
<td>➢ High fragmentation levels</td>
</tr>
</tbody>
</table>

The SWOT analysis presents the major challenges facing the construction industry
and its potential impact on the economy. A recent report (titled *Construction 2025*)
by the UK government sets out significant strategies to challenge the sector to
ensure efficient project delivery process and sector management to take advantage
of the growth in the global construction market (Rhodes, 2014). Certainly, the UK
government has identified weaknesses in the industry and has indicated its
preparedness to work in conjunction with a range of institutions to ensure the
realisation of the following strategies:

➢ A 33% reduction in both initial costs of construction and life cost of assets.
➢ A 50% reduction in overall time from inception to completion for new build
  and refurbished assets.
➢ A 50% reduction in greenhouse gas emissions in the built environment.
➢ A 50% reduction in the trade gap between total exports and total imports
  for construction products and materials.

These strategies demonstrate a need for a culture change in construction
organisations management and project delivery. However, for these strategies to
be achieved, *Construction 2025* further outlines an ‘action plan’ that it intends to implement in the short and medium term. This includes:

- **Smart construction/digital design**: Build on the relative strength of the UK as a hub for digital design.
- **Low carbon and sustainable construction**: Use technological developments and new materials to reduce the ecological impact of construction.
- **Global trade**: Use the UK’s trade relationships to foster new opportunities and investment.
- **Image of the industry**: Engage with young people to overcome negative stereotypes. Maintain high health and safety standards.
- **Skills and capabilities**: Make apprenticeships less dependent on market fluctuations.
- **Future work opportunities**: Government to refine the infrastructure pipeline in order to provide a better indication of future demand.
- **Supply chain**: Work to resolve blockages and issues in the supply chain.
- **Research and Innovation**: Develop funding and collaboration opportunities for businesses and researchers in areas identified as priorities.

The action plan indicates a determination to transform the entire industry from recruitment drive through procurement processes, project delivery and operations to process management. Thus, a culture change amongst actors and the need for integrated information task delivery.

### 2.3.1 Paradigm Shift in the UK Construction Industry

Despite the impact of the recession on the construction industry, the UK’s economy has a steady growth since late 2009, and a strong growth through 2013 and 2014. However, this is still 5.9% down on the 2007 level whilst the economy is 2.4% up over the same period (Rhodes, 2014). The growth in the sector can be attributed to the transitional phases that the sector underwent some six decades ago with the view to achieving competitiveness, sustainability and efficiency. This transition results from a series of government reviews and reports dating back to the end of the Second World War where the sector was identified as highly fragmented. Subsequent reports during the 1960’s (Emerson report (1962) and Barnwell report...
(1964)) emphasised the need for improvement to foster trust, collaboration and eliminate adversarial relationship (Wolstenholme et al., 2009).

Latham (1994), stated that UK construction industry could achieve 30% real cost savings within five years through collaborative working practices. Latham was of the view that a culture change that involves key stakeholders at the various phases of the construction process is significant to successful project delivery.

Egan (1998), proposed pragmatic culture changes to the construction sector to focus on ‘lean thinking and performance improvement strategies. Egan identified five key drivers for change. This includes committed leadership, focus on the customer, product team integration, quality driven agenda, and commitment to people. He also identified four process improvements strategies such as product development, partnering the supply chain, project implementation and component production. These drivers and improvement processes are linked to areas such as construction project cost and predictability, delivery process and accident reduction.

In 2002, the Strategic Forum for Construction (SFC 2002) published a report ‘Accelerating Change 2002’. This report targeted integrated project teams and the supply chain by stating that “major long-term benefit from integrated teamwork is essential for relationship continuity” which can ensure the transfer of knowledge and expertise from project-to-project and between actors (Egan, 2002). Most recently, Strategy for Sustainable Construction Progress report (2009) emphasised the adoption of lean and agile approaches to production to drive improvement processes such as efficiency, value to clients and sustainable objectives in construction organisations. Figure 2.4 presents the timeline for the historical reviews that has transformed the construction industry to date.
All these reviews and the recent strategies for BIM adoption suggest that the sector is moving in the right direction for effective collaboration, integration and sustainable project delivery and organisation management. This is in line with the UK government’s mandate to ensure that by 2016, construction sector organisations adopt BIM processes (BIM Task Group, 2011). The realisation of full potential of ICT tools deployment in construction is yielding a wide range of recognition by clients’ and supply chain organisations (RIBA, 2014). Tools associated with BIM processes for project modelling, delivery, collaboration, integration, and organisation management demonstrates a great potential for effective IB activities by project actors (RIBA, 2014). However, for the proposed strategy to be fully operational, there is more to explore about IB culture of project actors, than the technological solutions that majority of research currently focus on (Akanmu et al., 2013; Anumba and Aziz, 2006; Domdouzis et al., 2007; Golparvar-Fard et al., 2009; Redmond et al., 2012). This requires a forward thinking approach through IB strategies such as knowledge capture, information-seeking, sharing and use, and integrated systems (Goodier et al., 2007). In addition, there is the need to align corresponding changes in project implementation process, work tasks and skills with actors’ IB culture.

2.3.2 Information Culture in the Construction Industry
The success or failure of projects is largely linked to the quality and timing of context specific information (Marchand et al., 2002; Paterson, 1977), available at the right level, and to the right actors. Similarly, the timely completion of project relies on timely capture, dissemination and use of context specific information (Gorse and Emmitt, 2009). However, the impact of fragmentation is such that the working life of most actors is characterised by endless movement from projects-to-
projects. These limit actor development and sustainable information culture. Similarly, the industry’s image is often propagated as that of a ‘macho’ domain, which prevents modernisation and change. This shields the interest of actors who sees themselves as being bypassed by post-modernist notions of the ‘knowledge economy’. This nature of behaviours impedes establishment of a IB culture.

The economic challenges to businesses in present times is such that organisations continue to rely on process and procedures to influence behaviours in a linear manner with the view to provide stability and order (Brodbeck, 2002). These procedures restrict people from dealing with issues and new situations. As Stacey (2000) put it, ‘rigid-rule-bound organisations’ apply a “command and control” structure and procedure to spell out how people should behave. This shows that such organisations are incapable of generating new forms of behaviours to meet new goals. Others have proposed that procedures should be made to guide people, and give freedom to rely on experience, knowledge and skills to achieve outcomes through a structured ‘self-organising framework’ (Stacey, 2011; Brodbeck, 2002). This is consistent with organisations that allow self-consciousness in system thinking or the intelligence of natural law for greater simplicity (Lewin, 1999; Sherman and Schultz, 1998; Stacey, 2011). Brodbeck (2002), suggest a different type of control, which influences confidence in patterns but without ‘force and guarantee of details’.

Culture is a multifaceted phenomenon that shapes the behaviour of people in context. In construction, culture underpins the way actors interact with each other, and behave with information. Culture in construction emanates from strong traditions and personalities. According to Deal and Kennedy (2000), organisations can have a strong culture provided the following dimensions exists:

i. organisational values;

ii. organisation’s ‘heroes’ and role models;

iii. organisations ‘rights and rituals’ which defines behaviour;

iv. networking culture of formal and informal information sources and channels.
Information culture relates to organisational values, policies, behaviours, practices and social interactions towards the use, management, and control of information (Choo et al., 2006). Ginman (1993), defines information culture as the “transformation of intellectual resources maintained alongside the transformation of material resources”. According to Ginman (1993), the primary resources for this type of transformation are varying kinds of knowledge and information where the achieved output is a processed intellectual product. Ginman found that a highly developed information culture is positively associated with organisational practices and successful business performance. According to Ginman (1993), information culture is a strategic goal; hence, it should be planned in the same manner as the planning of transformation of physical resources. Similarly, Svärd (2014), posit that information culture is a set of human activities undertaken towards information.

According to Curry and Moore (2003), organisational culture underpins effective information management; hence, it depends on the value placed on the information, the impact it has on decision making and the exploitation of Information Technology (IT). They identified information culture to consist of communication flow, cross-organisational partnership, internal environment, information system management, information management, and process and procedures. Davenport and Prusak (1997), on the other hand consider information management as “patterns of behaviours” that expresses information orientation of an organisation.

On the other hand, Marchand et al. (2002), posit that information orientation measures the extent to which top level management perceive their organisation to possess capabilities associated with effective information use. According to Marchand et al. (2002), organisations can achieve information orientation by determining the degree to which they possess competence and synergy across the following key information capabilities.

- **IBs/values**: the capability to encourage and promote behaviours and values in actors,
- **information management practices**: the capability to manage effective information use over its lifecycle including sensing, collecting, organising, processing and maintenance; and
➢ **information technology practices**: the capability to effectively manage IT applications and infrastructure to support operations, process, innovation and decision-making.

In a sector such as Construction, the complex relationships that exist between actors, firms and other stakeholders inhibit effective identification of information requirements. This hinders effective information creation, dissemination and use. This is compounded by the nature of construction activities. Austin et al. (2002), posit that the AEC sectors continue to experience difficulties in ways to capture, understand and replicate processes. Hence, if the sector is able to map out appropriate ways to capture such processes, identification and removal of waste, the process can be achieved effectively (Austin et al., 2002).

### 2.4 PERFORMANCE OF THE CONSTRUCTION INDUSTRY

The industry uses performance measurement tools and techniques to continually improve businesses in the areas of process, products and management of actors (Robinson and Carrillo, 2005). According to Lin and Shen (2007), growth in this area can be attributed to three main reasons; (i) the heightened improvement in business performances in other industry sectors notably, manufacturing; (ii) the complexity of construction projects in the information age; and (iii) the challenges associated with managing project. These views are shared by Cain (2008), who posits that construction organisations can achieve best practice through performance measurement.

In the UK, Constructing the Team (Latham, 1994), Rethinking construction (Egan, 1998) and Accelerating Change (Egan, 2002) reports were major advocates for performance improvement and growth in the sector. Cain (2008), posits that these represent the manifestation of end-user dissatisfaction. Latham (1994), highlighted the magnitude of project failures in the sector and stated that unnecessary cost of construction project exceeds 30% of the capital cost. Egan (1998), suggested that 30% of construction is rework, whilst labour usage is about 40 – 60% of potential efficiency. Similarly, accidents accounts for 3 – 6% of total project costs, and material waste account for 10%. KPMG International (2013), found that the prime causes of underperforming projects include delays, poor estimating process, failed risk management processes, design errors and poor subcontractor performance.
Hence, better risk management could potentially reduce these failure factors, since effective risk management is attributed to human factors and culture as well as process and procedures (KPMG International, 2013).

2.4.1 Causes of Construction Project Failures

Several factors (including cost overruns, time overruns, design errors, poor risks management and delays) have been identified to cause construction organisations to underperform (KPMG International, 2013). However, the main causes of project failures include inadequate pressures on human resources, parallel deadlines from multiple projects, risk management, and organisational cultural issues. The most significant factor which underpins all these failures is “delay” (Assaf and Al-Hejji, 2006; Kaming et al. 1997; KPMG International, 2013; Kumaraswamy and Chan, 1998; Standish Group, 2009; Toor and Ogunlana, 2010).

The impact of project failures does not only affect clients’ but also, the end user, the construction organisation, the actors involved, the sector and the economy as a whole. The consequence of delay to the client/owner can result in revenue losses emanating from lack of production, rental, residential or social facilities. On the other hand, delays affect construction/contractor organisations by way of high overhead costs and loss of revenues as a result of extended working periods, inflated material cost, and increased labour demands/cost (Assaf and Al-Hejji, 2006; Chan and Kumaraswamy, 1997). Studies have shown that delay factors within construction projects and organisations are common across the world (Arditi et al. 1985; KPMG International, 2013; Sambasivan and Soon, 2007). Assaf and Al-Hejji (2006), found that 30% of construction projects in Saudi Arabia completes within schedule; however, the average time overrun is between 10 to 30%.

Delay comes in various forms, usually identified as addition of time or additional days required. In Construction, delay can be defined as time overrun beyond specified target or agreed date by involved parties to complete or deliver a project. According to Stumpf (2000), “delay is an act or event that extends the time required to perform tasks under a contract”. Therefore, timely task completion has significant impact on the project duration. Chan and Kumaraswamy (1997), extracted five principal delay factors from 83 common construction project delay factors to include
poor risks and site management and supervision’, unforeseen ground and site conditions, slow decision making by the project teams, client-initiated variations and work variations.

Kaming et al. (1997), identified several factors that influence costs and time overruns in construction projects. They concluded that frequency of project failures due to cost overruns is higher than time overruns. According to Kaming et al. (1997), the most important factors that causes time overruns includes resources shortage, inadequate planning, unskilled labour, poor productivity and design changes.

Assaf and Al-Hejji (2006), identified 73 main causes of delay factors in large construction projects from the perspectives of the owner, contractor, architects and engineers. According to Assaf and Al-Hejji (2006), contractors consider factors such as preparations and drawing approvals, progress delays, payment by the owner and design changes as critical to project failure. In addition, architects and engineers consider cash problems, relationship issues and slow decision making by the owner as the main causes of project delays. Similarly, the owner considers design errors due to inadequate and unskilled workforce as critical project delay factors.

Sweis et al. (2008), identified 40 project delay factors from the perspectives of consultants, contractor and the owner. They extracted three significant factors each and concluded that consultants view poor planning and scheduling, financial difficulties of contractors and change orders by the owner as key delay factors. They assert that the contractor consider financial difficulties, change orders from the owner and inadequate labour as significant to project delays. In addition, the owner views poor planning and scheduling, financial difficulties of the contractor and importance of technical staff as the three main delay factors. Sambasivan and Soon (2007), categorised project failure factors into delays and effect of delays. In all, they identified 28 failure factors, extracted 10 important delay factors, and 6 key factors that have different effects on delays. KPMG International (2013), categorised underperforming projects factors in the perspectives of both the owner
and the client. They identified eight (8) different factors for each and concluded that project delay is the most significant factor amongst all.

The above review indicates that “delay” is the most common and significant failure factor, followed by design issues/errors across all spectrums of the construction process. Moreover, majority of the identified failure factors are underpinned by actor IB/ISB related factors (Chan et al. 2004; KPMG International, 2013). Overall, the failure factors can be classified as factors that influence the success of project implementation (Chan et al., 2004; Fortune and White, 2006; Toor and Ogunlana, 2009; Zafar et al., 2012). Chan et al. (2004), grouped project success factors into five main categorise which includes; project related factors, procurement related factors, project management actions, external environment, and actor related factors. The primary factor that underpins these five categorise is “time”. Thus, any delay or non-delay project activity has the potential to cause failure or success.

Although, majority of the identified failure factors can be resolved by the application of systems, procedures and policies; the actor related behaviour factors requires a change in culture

2.4.2 Construction Process
The construction process comprise of activities (including concept, design development, implementation, information creation and information flow, and others) intended to contribute to the production, repair, maintenance, and recycling of buildings/infrastructure in the built environment (Bennett, 2003; Carassus, 2004; Halpin, 2010). Similarly, the activities of firms that build or demolishes buildings and/or infrastructures, manufacturers of building components and machinery, provision of services, by professionals, government bodies and other stakeholders forms part of the process (Carassus, 2004). Figure 2.5 present the main process of construction including sub-systems and framework conditions. The figure depicts that the construction process follows a close-loop cycle in the PLC. It shows that raw materials flow through various processes and systems integrated with design information flow through to completion of a facility.
The facility is then used, serviced, maintained and recycled into raw materials for reuse. These are executed through project management to achieve set objectives.

There has been extensive research on projects and project management within the construction research environment. This is influenced by underperformance of construction organisations and construction projects. Studies conducted in this arena largely focuses on project delivery systems, project management systems and techniques, and performance improvement (Khalil, 2002; Bennett, 2003; Chen et al., 2011; Harris et al. 2013; Konchar and Sanvido, 1998).

2.4.4 Project Management Process
PMBoK (2008), defines project management as ‘the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements’. The construction process has distinguished characteristics stemming from the PLC stages to organisation management. These result in unprecedented number of actors with specialist skills to implement them. Traditionally, the sector organises construction activities using project teams, Temporary Multi Organisations (TMOs), and other stakeholders. This contributes to a fragmented process; the consequence of which is poor performance in project delivery and organisation management. The delivery and management of projects describes the procedures
and processes of how actors are organised, interact, seek, share, use and manage information, and how clients’ objectives are transformed to achieve the project. Hence, the understanding of project in order to select appropriate delivery system can improve performance (Ojiako et al., 2008; Oyetunji and Anderson, 2006).

Literature provides several definitions of project/project management. This tends to influence the project delivery systems, management systems and techniques, and performance improvement approaches. The common but appropriate definitions that mainly describe projects and project management are provided in table 2.2.

Table 2.2 Definition of project

<table>
<thead>
<tr>
<th>No.</th>
<th>Definition of project/project management</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Projects are unique, transient endeavours undertaken to achieve a desired outcome.</td>
<td>APM, 2004</td>
</tr>
<tr>
<td>2</td>
<td>A temporary undertaken, that involves the assembly and design of resources to achieve a specific objective.</td>
<td>Turner, 2006</td>
</tr>
<tr>
<td>3</td>
<td>A coalition of powerful individuals and interest groups.</td>
<td>Newcombe, 2003</td>
</tr>
<tr>
<td>4</td>
<td>A unique set of coordinated activities, with definite start and finish points, undertaken to meet specific performance objectives within defined schedule, cost and performance parameters.</td>
<td>BSI, 2010</td>
</tr>
<tr>
<td>5</td>
<td>A temporary endeavour undertaken to create a unique product, service or result.</td>
<td>(PMBoK, 2008)</td>
</tr>
<tr>
<td>6</td>
<td>A management environment created for delivering one or more business products according to a specified business case.</td>
<td>PRINCE2, 2009</td>
</tr>
<tr>
<td>7</td>
<td>A value creation based on a specific mission, undertaken in a given or agreed timeframe and under constraints, including resources and external circumstances.</td>
<td>Maylor, 2010</td>
</tr>
</tbody>
</table>

From the definitions, common themes such as unique, temporary, focused, timely delivery and meeting specified objectives emerge. This unique view underpin reasons for the fragmented and adversarial nature of the industry (Blismas et al., 2004). However, definitions by Newcombe (2003), and Turner (2006), necessitate the coalition of actors and resources due to the extensive level of fragmentation.
and specialisation. Typically, projects go through identifiable phases. The ‘to’ and ‘fro’ movement of project ideas (information) depends on effective decision-making. Bertelsen (2003), purport that construction project delivery involves large amount of people who deliver activities through social interactions; hence, they are considered ‘highly transient human systems’. The interactions amongst these actors’ are such that any “break” or change in communication or information tend to delay the project (Gidado and Wood, 2008).

Construction projects generally begin with a client’s need for a facility (often a vague idea or a specific brief). The client approaches a design professional (the architect), who defines the nature of the brief. During this phase, the brief ‘travels’ between various actors, and through various reviews to capture the conceptual definition before the final construction can begin (Halpin, 2010). An ideal review process can be time consuming, and often results in duplicated process thereby delaying the entire project. This may be due to series of factors including the ‘transient’ nature of actors, lack of structured IB/ISB activities, poor decision-making process by the client and many more. Hence, effective interactions between these actors is critical to smooth delivery and progress of a project (PMBoK, 2008). At the contractor’s end, problems encountered in the design will often bring the project to a halt. This initiates further reviews, resulting in project delays. Hence, the most demanding and information critical phase that defines the outcome of a project is the design development phases. RIBA defines these phases as concept design, design development, technical design, and specialist design (RIBA, 2013) as shown in figure 2.6. These phases culminate into the construction phase to define the project outcome and aftercare.

![Diagram of RIBA Plan of Work](image)

**Figure 2.6 RIBA plan of works highlighting the design development phases**
2.4.5 Project Delivery Process

A project generally advances through stages/phases from initial idea conception through design development to construction, operations, decommission and/or aftercare. This complex process is such that there is no definite agreement on what constitute the life cycle phases. As such, different definitions continue to appear however, they signify similar processes. RIBA identifies five key phases of the project delivery process to include briefing, sketch plans, working drawings, site operations and feedback. PMBoK (2008), posit that management of project is accomplished through appropriate application and integration of logically grouped project management process comprising of initiation, planning, executing, monitoring and controlling, and closing. Maylor (2010), argues that the PLC can be replicated within each phase of large projects as each of the phases represent mini-project. Thus, the project delivery process is more akin to cycles of activities rather than a linear progression approach. Maylor (2010), identifies a 4-D structure of the delivery process as define the project, design the project process, do it or deliver the project and develop the process. Therefore the most common PLC phases predominantly used in Construction is represented in figure 2.7.

![Project life cycle phases](image)

**Figure 2.7 The PLC process [adapted from Lim and Mohamed (1999)]**

The PLC allows key actors to consider the project as a sequence. This provides a structured approach to progressive delivery of expected outputs. Each phase of the PLC comprises of numerous tasks and issues, which provide the extent of complexity for actors to deal with in the project environment. According to Maylor (2010), the level of complexity from numerous issues is a reason why there are fewer true examples of excellent project management. The level of activities in the lifecycle generally varies with time. Maylor (2010), posit that it is important to have a competence culture across the phases than being excellent in one area with
other areas failing. Thus, a cross competence in the phases can have a direct influence on actors’ performance and the outcome of the project delivery process.

The design phase is information intensive and critical to defining the project output and a successful tenderer. Hence, actors involved in these phases not only prepare detailed designs/drawings but also, detailed contract conditions containing legal requirements, technical specifications and other relevant documents. Errors encountered at these phases are akin to project delay. Hence, high quality, but timely information is vital to performance of actors involved at these phases (Bennett, 2003). To achieve the activities in the PLC, large amount of resources including both large and small firms, sub-contractors, actors, and other stakeholders are put together by means of project delivery systems or procurement strategies (Bennett, 2003).

According to Morton and Ross (2008), the set of arrangements for ordering and managing construction project is considered the ‘procurement route’, and this is divided into traditional and non-traditional. The traditional procurement methods includes traditional lump sum fixed cost/time, design and build or turnkey, novation, construction management oriented methods, on-call multi-task contracting, guaranteed maximum price and full cost reimbursable methods (Bennett, 2003; Walker and Hampson, 2008). The non-traditional methods include design and build or turnkey, forms of management oriented procurement methods, and partnering and prime contracts. The traditional or conventional procurement routes remain the most popular within the sector where the clients send their discrete design to the appointed architect. The architect develops project briefs, sends it to the designer, through to the surveyor, and thence to the constructor for the construction phase.

In 2007, the Royal Institute of British Architects (RIBA) produced a work plan titled *The RIBA Outline Plan of Work 2007* to guide actors in the procurement processes to support the project delivery process. It is rather inconclusive that the RIBA Outline Plan of Work aligns to a single (traditional) procurement route and makes assumptions about the timing of planning applications. However, the RIBA Plan of Work shows the traditional contractual arrangements as the most predominant procurement method as presented in table 2.3. It is worth mentioning that there is a
high uptake in other forms of procurement methods. For example, the Design and Build method has grown in popularity, with 40% of responding practices indicating that they use both one stage and two stage variants.

### Table 2.3 Procurement route by RIBA members [adapted from RIBA (2013)]

<table>
<thead>
<tr>
<th>Procurement Methods</th>
<th>Common Procurement Route Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Methods</td>
<td>86%</td>
</tr>
<tr>
<td>One Stage Design And Build</td>
<td>41%</td>
</tr>
<tr>
<td>Two Stage Design And Build</td>
<td>39%</td>
</tr>
<tr>
<td>Management Contract</td>
<td>18%</td>
</tr>
<tr>
<td>Private Finance Initiative (PFI)</td>
<td>10%</td>
</tr>
</tbody>
</table>

However, the Management Contract and Private Finance Initiative (PFI) routes have not seen a rise in its usage though widely used on larger projects. It is also evident that, a number of common variants exist with certain forms of procurement (RIBA, 2013). This is particularly true for Design and Build procurement methods, where the information used to form the *Employer’s Requirements*, and the subsequent *Contractor’s Proposals*, vary from project to project (RIBA, 2013).

### 2.5 CONSTRUCTION PROJECT ACTORS

The project environment is composed of diverse groups of people, teams, professionals and other entities, with varied roles and responsibilities, skills, knowledge and expertise. This group of people are expected to rapidly establish a co-operative working relationship in a short period as well as engage on entirely different terms and conditions. However, the lack of defined structures, channels and sources of information amongst a group of people tends to exacerbate tensions by the need to deliver projects under stringent time constraints (Dainty et al., 2007). Chua et al. (1999), maintains that active participation and cooperation of key players in the project environment depends significantly on the capability of key personnel and the competency of the team. Mohsini and Davidson (1992), suggest that conflicts amongst actors have adverse effect on project performance.

In their extensive meta-review of literature of professional in different fields, Leckie et al. (1996), identified some key findings in relation to common trends to include:
regardless of their training and expertise in a particular area, professionals often assume a number of complex and different work roles as part of their work position,
these roles have a constellation of tasks associated with them.
tasks required in each role are likely to prompt information needs and/or information-seeking.
there are key factors that may facilitate or inhibit their information-seeking and/or use behaviours.
Leckie et al. (1996), posits that factors such as organisation, years of experience, area of specialisation and others act as a filter in actors information-seeking process. Therefore, it is vital to categories the diverse group of project participants into actors and/or roles to establish their function(s) and information needs. According to Zhang and El-Diraby (2009), functionalist have always considered roles as a set of expectations of behaviours and knowledge attributes that society place on individuals. Thus, roles are functions. In construction, roles can be classified as static, inflexible and often defined by an authoritative body (Office for National Statistics, 2010). Steimann (2000), summarises the definition of roles into many different features that includes:
roles depend on relationships
object may play different roles simultaneously
roles comes with its own properties and behaviour
object may play the same role several times, simultaneously
sequence in which roles are acquired and relinquished can be subject to restrictions.
These features indicate that roles are a collection of functions performed to meet a need. Actors on the other hand, can be categorised by set of attributes. Thus, an actor is a professional, individual, institution or an entity who manages, controls, influences or is influenced by a product, process or an activity (Spink et al., 2002).

According to Zhang and El-Diraby (2009), the attributes that constitutes an actor includes professional attributes (such as educational qualifications, experience and skills levels), logistics, personal and performance attributes which tends to be stable over a period of time. Hence, construction project actors in this context are defined as professional entities or organisation(s) with extensive experience,
knowledge and skills to provide support, influence or are influenced by activities or processes in the project environment. Chua et al. (1999), refers to actors as key players involved in performing various activities in the project environment. These activities include design, survey, construction, civil works, electrical works, mechanical, logistics, planning and many more (Edum-Fotwe et al., 2001).

### 2.5.1 Actors in the Project Lifecycle Process

The PLC forms the sequential phases to execute a project. Each phase employs several key actors with different attributes, information needs and requirements, IBs and ISBs to achieve the relevant tasks. Often, these actors are defined in relation to their involvement in each phase of the project. Therefore, by defining the actors’ involved, appropriate channels/sources can be designed to establish their specific information needs and information requirements. In addition, these channels and sources can facilitate effective capture and dissemination of appropriate level and quality of information to the actor just-in-time for effective and efficient use. Table 2.4 presents some key information actors involved at different phases of the PLC. This is not an exhaustive list since actor identification is project dependent. Each of these actors have varied information needs and requirements. Hence, their level of engagement may be controlled by their information needs and requirements.

According to Edum-Fotwe et al. (2001), information actors generate and provide or acquire and process information to facilitate activities of a particular phase in the construction supply chain. Therefore, by identifying actors’ information needs within the PLC, context specific information can easily be directed to actors based on their ISB preferences to facilitate effective decision-making.
Table 2.4 Key information actors in the construction project organisation [adapted from Edum-Fotwe et al. (2001)].

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<thead>
<tr>
<th>Idea Generation</th>
<th>Initiation</th>
<th>Planning</th>
<th>Implementation</th>
<th>Termination</th>
<th>Services, Use &amp; Aftercare</th>
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2.5.2 Project Actors Information Needs and Requirements
In construction organisations, key activities carried out by actors include information seeking, creation, sharing and use. Actors’ information needs and requirement in a BIM enabled project organisation focuses on their ability to exchange accumulated information to facilitate better project delivery and organisation management. This is stipulated in BSI (2013), where information activities of the PLC process are merged with the requirements of key actors.

In a BIM environment, key actors require two kinds of information. These are 3D BIM model and Construction Operations Building Information Exchange (COBie) spread sheets. The 3D model is an electronic representation of the building and its facilities, services and systems. This enables key actors to understand the kind of information in the model and how systems and components fit within the project structure. The COBie spread sheet helps to organise information about new and existing facilities, and share structural information to enable actors to document spatial and physical knowledge about the project (East et al., 2009). Table 2.5 present the information exchange activities amongst actors to meet their information requirements and information needs.
Table 2.5 Project information exchange activities within the PLC [adapted from BSI (2013)]

<table>
<thead>
<tr>
<th>Information Management</th>
<th>Project delivery management</th>
<th>Lead designer</th>
<th>Task team manager</th>
<th>Task information manager</th>
<th>Interface manager</th>
<th>Information Originator</th>
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<tbody>
<tr>
<td>Enable reliable information exchange through a common data environment (CDE)</td>
<td>Assure delivery of information exchanges</td>
<td>Co-ordinated delivery of all design information</td>
<td>Production of design outputs of a discipline-specific, package-based or time-based task</td>
<td>Direct the production of task information in compliance with standards and methods</td>
<td>Manage spatial co-ordination on behalf of a task team</td>
<td>Develop constituent parts of the information model in connection with specific tasks</td>
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<tr>
<td>Maintain and receive information into the information model</td>
<td>Confirm suppliers ability to deliver information requirements</td>
<td>Manage information development and information approvals</td>
<td></td>
<td>Direct the production of task information using agreed systems</td>
<td>Propose resolutions to co-ordination clashes</td>
<td></td>
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<tr>
<td>Configure information for Project Outputs</td>
<td>Overall lead for configuration management</td>
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<tr>
<td>Accept reject information exchanges within the CDE</td>
<td>Accept reject information exchanges within the CDE</td>
<td>Confirm status and approve information for issue within the CDE</td>
<td>Issue approved information within the CDE</td>
<td>Confirm that information is suitable for issue within a CDE</td>
<td>Propose resolutions to clashes</td>
<td>Ownership of model information</td>
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<tr>
<td>No design responsibility or right to issue instructions</td>
<td>Approve design changes proposed to resolve clashes</td>
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2.6 SUMMARY

Certainly, the construction industry is significant to the economic development of UK and other countries in the world. The industry contributes significantly to the global economy (Deloitte, 2014; Eurostat, 2013). It has been established that the construction industry currently contributes about £90 billion to the UK economy in value added, comprising of 280000 business and covering over 2.93 million jobs equivalent to about 10% of the total employment (Deloitte, 2014). At the same time, UK construction industry is considered to have the largest number of privately owned companies and is more fragmented than its major competitors in the western Europe (Deloitte, 2014). Essentially, the construction process relies heavily on key project actors, and numerous stakeholders to achieve the project delivery process and organisation management. Whereas these actors rely heavily on context specific information to make critical decisions, any issues or delays associated with seeking, sharing, and use of information has direct impact on the outcome of projects. This result in a high level of underperformance where key factors that causes projects and organisation to fail or underperform. These have been linked to human related behaviour factors, which are underpinned by lack of IB and ISB culture in the sector.

The subsequent chapter explores key terms in IBs and ISBs studies, and purposefully selected models that underpin this study. The chapter reviews significant theories in LIS to establish actors ISB orientations, and the factors that influence their information-seeking and information use/task performance behaviours.
CHAPTER 3: INFORMATION BEHAVIOUR RESEARCH

3.1 OVERVIEW
This chapter presents a general overview of IB research with a particular focus on ISB research. Key terms relevant to IB and ISB studies are discussed. Theories that support ISB study are reviewed briefly to set the scene for the underpinning theory to this research. The chapter further reviews different but relevant IB/ISB models found in literature with special emphasis on models that focus on information-seeking and task delivery and the factors that influence such IBs and ISBs in different industry sectors.

3.2 BACKGROUND OF INFORMATION BEHAVIOUR RESEARCH
The origin of IB related studies dates back in centuries with no consensus on a definite date of the exact origin. Bates (2009), suggest that there was an inclination of human IB in 1876 by Samuel Green “who encouraged librarians to ‘mingle freely’ with library users [to support them] in every way”. In contrast, Wilson (1994), credits Ayres and McKinnie (1916), for the origin of the study of IB genre. On the other hand, Wilson (2008), argues that the origin of IB studies can be traced to the Royal Society Scientific Information Conference 1948 where a number of papers on IB of scientists and technologists were presented (Ellis et al. 1993; Wilson, 1994). Similarly, Case (2012), posits that the first study of information use dates back to 1902. According to Case (2012), Charles Eliot (1902), discussed the ‘used’ and ‘unused’ portions of library collections. However, Bouazza (1989), claim that the history of user studies goes back in the 1920s. These different claims of the origin of human IB related studies suggest that the antecedent of human IB research date back in the areas of early investigations of library uses and user characteristics.

Since then, the understanding of IB related subject research has evolved from library use to basics of new discoveries and applied sciences and the engineering domain (Bates, 2009; Case, 2012). The paradigm shift, coupled with major sponsorships from government institutions led to several conferences, literature reviews and publications of scientific information and engineering materials, and how certain professionals (such as scientists and engineers) seek and use information (Bates, 2009; Case, 2012; Fisher et al. 2005; Wilson, 2008). Significant reviews on the term “information needs and information use” were conducted in the
late 1950s through to later part of the 1960s by numerous researchers including Tornudd, 1959; Menzel, 1960; Davis and Bailey, 1964; Auerbach, 1965; Paisley, 1965; North American Aviation, 1966; DeWeese, 1967 (Case, 2012). However, in the late 1960s, research interest in information use and information needs began to decline. This led to the introduction of the Annual Review of Information Science and Technology (ARIST) (Case, 2012). The ARIST studies appeared in 1966 as a stand-alone volume on “communication research in LISs” (Bates, 2009; Case, 2012). This led to increased discovery of significant bibliographies on the topic. These discoveries saw a subsequent increase in research studies and literature reviews on information needs and information use of scholars and professionals in different context (including scientist, engineers, social sciences, healthcare professionals, librarians, education, and businesses).

According to Bates (2009), the increased number of researchers and scholars resulted in the introduction and use of metaphors in human IB domain to illustrates key concepts and methodologies. For example, the 1993 ARIST saw the birth of new phrases to explain actual ISBs of professionals. This includes “berry picking” by Bates (1989), “environmental scanning” by Choo and Auster (1993), “browsing” by Chang and Rice (1992), “information gatekeeper” by Metoyer-Duran (1991), “information foraging” by Pirolli and Card (1999), “information poverty” Chatman (1996, 1999), and “information clutch” by Caldwell et al., (2008). Publications of comprehensive IB related literature in the ARIST as a stand-alone volume ended in 2011. This has led to the transfer of shorter literature reviews into Journal of the American Society for Information Science and Technology; which according to Case (2012) suggest that any literature on IB for such platforms need to be more focused and specific to the context as there are high level of competition in publications.

Hewins (1990), noted three new developments taking place in the human IB studies as (i) increased new methods of research in the areas of human information needs and uses; (ii) the focus of LIS research on users’ cognitive process; and (iii) the spread of information needs and use research across different disciplines. Wilson (2008), assert that the progress in human IB research demands the need to understand people’s information search preferences, how their information use
behaviours orders the design and development of systems and strategies to support professional and non-professional capacities.

Several IB research ends in conceptual models to depict the context within which IB is studied, the factors that influences actors ISB and the issues under investigation. The majority of these models by renowned authors (including Wilson, Kuhlthau Savolainen, Leckie, Bystrom and Jarvelin, and many more) provide a sound theoretical foundation for predicting changes in people's ISBs in context. Researchers often use models to represent the theory of ISB because models are easier to grasp, and often based on specific problem(s). The next section present discussion of key terms and specifically selected models that aligns to the aim and objectives of this study.

3.3 KEY CONCEPTS IN INFORMATION BEHAVIOUR STUDIES

The concept of IB is achieved through the process of information, information need, information-seeking, and information use. These concepts are analysed to establish specific characteristics that underpin actors ISBs in order to develop the questions likely to emerge through the reviews to constitute the basis for qualitative and quantitative data collection. For the purpose of this research, key terms are defined in view of actors' IB activities in the construction project environment. These definitions do not aim to provide a universal meaning to the terms, but to set a standard in context to avoid ambiguity.

Information

The term “information” is significant in every aspect of human activities. Several definitions associated with the term have evolved around terms such as “data”, “knowledge” and /or “information”. Wilson (2005), argues that unless actors recognise the concept and context of information used; it would be difficult to understand their information needs. Shenton and Hayter (2006), claim that both scholars and ordinary people find it difficult to grasp the concept and meaning of the term. Hence, in this study, some key definitions are selected to formulate the true nature of “information”.

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Bates (2009), assumes information to represent “all instances where people interact with their environment in a way that leaves some impression on them - that is, adds or changes their knowledge store”. This indicates that people acquire information from all other physical layout of their working environments from design to interactions with various factors in real situation. Similarly, Case (2012), posit that information can be “any difference one perceive in their environment or within themselves”. However, Case (2012), argues that majority of the issues surrounding the definition of “information” stems from the utility, physicality, truth, structure, process, and intentionality of the term. Hence, Case adopts the definition of Gregory Bateson (1972), as “any difference that makes a difference to a conscious human mind” (Case, 2012). As a way of confirming his position on the definition of information, Case (2012), posit that a truly universal concept of information would need to fulfil at least the following requirements:

i. allow for common-sense notions of information used in everyday discourse.

ii. allow for unintentional origins of information (observation of the natural world) as well as for purposeful communication among people.

iii. allow for internally generated information (memories, constructions) as well as externally generated information (reading a text).

iv. allow for types of information beyond that needed for solving a problem or making a decision.

v. admit the importance of informal sources (friends) as well as formal sources (data or documents).

vi. Involve the human mind, either in the creation, perception or interpretation of information; to leave out such a requirement is to declare that anything is information and that would leave no focus in the investigations.

Another interesting definition for “information” comes from Ingwersen and Järvelin (2006, p.20). According to them, information “is the result of a transformation of a generator’s cognitive structures (by intentionality, model of recipients’ state of knowledge and in the form of signs). And something which when perceived affects and transforms the recipient’s state of knowledge”. McCreadie and Rice (1999), looked at the definition of information to have implications for notions of access in the following ways:
“Information as commodity/resource”. This involves, the transmission of information in a message between a sender and a receiver, such that the receiver interprets and understands the content as intended by the sender.

“Information as data in the environment”. This concept views information broadly to include all available objects or systems within the actors’ environment that stimulate their processing capabilities.

“Information as a representation of knowledge”. This view looks at information as a record of knowledge, where the information is represented in books, print documents, internet, or other electronic and computer media.

“Information as part of the communication process”. This indicates the cognitive nature that actors apply to information rather than in words or data and knowledge, which is what users’ do with the data rather than what data does to users’.

The above definitions provide a delicate meaning to information, which is relevant to the IB/ISB of project actors. Hence, in the context of this study, “information” is considered to mean the non-physical (cognitive) and physical actions (non-cognitive) and process that contributes new material (information) to existing knowledge in context.

**Information Needs**

The term “information needs” dates back to the origin of human ISB in 1948 (Wilson, 1981). Researchers have since found it difficult to identify a consensus definition. According to Wilson (1981), the reason lies in inadequate methodology and failure to do research that is ‘cumulative’. Wilson (1981), state that part of the problem of defining the term is because some authors and researchers link it to attributes such as ‘wants’, ‘expressed demand’ and ‘satisfied demand’. Case (2012), and Belkin and Vickery (1985), attribute the problematic nature of agreeing on a definition to its existence in the cognitive state of actors. Wilson (1981), argues that the notion of “information need” is an unrealistic concept since most information needs cannot be specifically observed since they can be accounted for by general needs of a person. He posits that the likely failure of scholars agreeing on a definite definition is due to their inability to identify the context within which information needs are carried out. According to Wilson (1981), psychologists have split the concept of human information needs into three interrelated categories:
- physiological needs, such as the need for food, water, shelter;
- affective needs, such as the need for attainment, domination;
- cognitive needs, such as the need to plan, learn a skill.

All these categories happen stochastically in the mind of the information seeker; which contributes to the difficulty of defining the term “information need”.

According to Harter (1992), “information needs” of individuals can be likened to their psychological state of mind at the point of the need due to its stochastic nature. However, Yunjie et al. (2006), considers information need of actors as “the demand of a specific task or a problem situation that motivates ISBs”. Yunjie et al. (2006), posit that the nature of a person’s ISB is an indication of their information needs which culminates from their current situations, tasks execution or providing solutions to a problem. Essentially, the information needs of actors relate to the tasks in question and the technicality of associated information.

Ingwersen and Järvelin (2006), assert that actors “information need” signifies the needed knowledge to fill the identified gap in order to achieve the task. This may lead to further request for information-seeking and formulation process depending on the task requirement. However, actors’ information request results in the formulation of the information need as conceived and gained at a point during the process to an information sources.

**Information-Seeking Behaviour**

This term is often confused with “information-seeking” or “IB” to the extent that some scholars tend to merge them as one whilst others confuse it with information need. However, extant literature clearly shows a definite distinction between these terms (Case, 2012; Wilson, 2000). According to Case (2012), most researchers do not bother to define “information-seeking” since it is closely linked to the concept of “need” than it is to the notion of “information”. Bates (2009), assert that the wide use and study of “IB” in the 1990s contributed to the diminishing use of the term “information-seeking”. According to Bates (2009), it is linked to the reason why researchers came to feel that “information-seeking” suggest a direct and specific process to finding information, and does not include other avenues in which people interact with information.
Some researchers have linked actors’ information-seeking to a recognition of a knowledge gap in their cognitive process (Zerbinos, 1990). Others have linked it to the acquisition of new knowledge to solve problem (Marchionini, 1997). Johnson (1997), offers a more restrictive definition of information-seeking as the “purposive acquisition of information from selected information carriers”. Wilson (2000), however defines ISB as the “purposive seeking for information as a consequence of a need to satisfy a goal”. On the other hand, Case (2012), defines ISB as “a conscious efforts by actors to acquire information in response to a need or gap in their knowledge”. Ingwersen and Järvelin (2006), state that “information-seeking” is the process of searching or seeking information through different sources and interactive information retrieval systems”. Hence, for the purpose of this study, actors ISB is defined as the behavioural activities (such as cognitive process, interacting with colleagues, documents, both electronic and non-electronic information systems, accidental and/or planned information capture) actors undertake to acquire appropriate information to achieve an outcome.

**Information Use Behaviour**

According to Wilson (2000), information use behaviour consist of both “physical and mental acts involved in incorporating information found in a person’s existing knowledge base”. This definition confines the information user to their cognitive application of the acquired information. It portrays a psychologist perspective of information use. Wilson (2000), further posit that a person’s ISB may involve physical acts such as anotating important or significant sections in a text as well as mental acts that involve comparison of new information with exiting knowledge.

Generally, after actors capture information relevant to their needs, they apply the information to perform tasks, resolve problems or use the information for any intended purpose. Hence, actors’ information use behaviour is the total process involved in the application of the captured information to perform tasks, resolve problems, or use the information to meet intended purpose.

**Information Behaviour**

Information behaviour involves the many different avenues in which people interact with information. More specifically, it addresses the ways individuals and groups
seek and use information to support their social and professional activities, and provide insight on human relationship to information. Many scholars have used this term to demonstrate the way actors seek, share, store, retrieve and use information. Bates (2009), describes IB as “the many ways in which human beings interact with information, in particular, the ways in which people seek and utilise information”. On the other hand, Wilson (2000), describe human IB as ‘the totality of human behaviour in relation to sources and channels, including both active and passive information-seeking and information use’.

With these definitions, it is important to establish the relationship of construction actors to the information they employ to make decisions and judgments. Establishing a generic profile of construction actors’ IB can unlock the problem of sub-optimal decisions making. This can create avenues for better and improved structuring of decision support provided through deployed technology solutions in the sector. However, considering the fact that project actors rely on many different sources and channels, tools and systems to achieve optimum information use; it can be argued that the definitions by Wilson (2000), and Bates (2009), does not fully reflect the IB of construction project actors. Similarly, Case (2012), defines IB as the “information-seeking process, the totality of unintentional or passive behaviours (encountering information by chance), and the purposive behaviours that do not involve seeking, such as actively avoiding information”. Pettigrew et al. (2001), defines IB “as the study of how people need, seek, give, and use information in different context, including workplace and everyday living”.

Although the above definitions lay emphasis on the actors’ environment, they limit the actor to available information systems, tools, and avenues. Therefore, in the context of this research, the IB of the project actor is the drive with which the actor declares a need for information by going through the seeking, searching, sifting, analysis, use and store process through available systems and technologies to acquire appropriate information. The actor can retrieve the stored information at a later stage through various channels and sources for further use. All these definitions interconnect with IB as the primary term which encompasses information, information need, information-seeking, and information use behaviours to satisfy intended purpose. Figure 3.1 present a nested IB model (Wilson, 1999).
Figure 3.1 A nested model of actors’ IB highlighting ISB [adapted from Wilson (1999)]

This model demonstrates that available information initiate actors information needs, which drives the ISB, and information use behaviours. This then culminates into their IB. This primarily encompasses the variety of methods; systems and processes actors employ to capture appropriate information for use. The ISB concept (as highlighted) is the most significant and interactive phase. It engages actors with their internal and external environment; hence the focus of this study. Although IB is the primary concept in which information is used, the concept of ISB encompasses the totality of active and passive behaviours of actors. This is evidenced in the majority of models formulated in this area of research; which are often based on specific theoretical dimension (such as the principles of least effort, cognitive, sense making, cultural, and social theories).

3.4 THEORIES OF INFORMATION-SEEKING BEHAVIOUR RESEARCH

Human IB researchers and authors predominantly use models to illustrate their research concept. This is due to the difficulty associated with establishing causation in human behaviour, especially the ISB phenomenon in which important aspects cannot be observed (Case, 2012). Models are often defined in relation to theories, and the thinking process that help to identify and present important factors and the likely sequences and interactions in the information-seeking process. According to Case (2012), models and theories are simplified versions of reality; where diagrams
and flow charts are used to simplify the content of models. Bates (2005), posit that there is no sharp divide between a model and a theory about the same phenomenon. However, much of the representation of work done in ISB related studies does not have any theoretical framework or references associated to it (Case, 2012). This suggest that such works must be ignored completely or relegated to the “miscellaneous” category (Wilson, 1994). According to Bates (2005), some models stand as theoretical beacons for years, guiding and directing research in a field, before it matures to the point of producing something closer to a true theory.

According to Case (2012), a theory is a “set of related statements that explain, describe, or predict phenomena in a given context”. Similarly, Bates (2005), posit that theories tend to focus around establishing a good understanding, and explanation of a phenomenon. Theories constitute broad assumptions regarding the nature of reality and the purpose and methods to carry out investigations. As a result, the researcher seeks to understand the foundations behind model construction to establish the distinctions between “metatheories”, “theories” and “models” (Bates, 2005; Case, 2012). Hence, the author examines theories that underpin LIS research to identify the theoretical concept behind ISB of actors. The author present a brief definitions of “metatheories”, “theories” and “models” for clarity; however, for detailed explications of these terms, the reader is directed to Case (2012) and Bates (2005).

- **Metatheory**: addresses the primary philosophical assumptions about the extent of reality and knowledge behind a particular theory and other concepts most closely related (Case 2012, p.164). In short, metatheory is a theory about theory. Metatheory holds the fundamental assumptions regarding ontology (the nature of reality), axiology (the nature of values), epistemology (how we know) and methodology (how we find out) of research about the world and how it is investigated. It is the philosophy, which underpins the theory. Metatheory set out conceptual ideas about the phenomena and the context to investigate.

- **Theory**: is a statement that try to explain relationships among various phenomena from which inferences and deductions are made (Case, 2012).
Thus, theories are explanations or generalisations and the principles developed for a specific context.

- Model: is a tentative identical structure used as a testing device (Bates, 2005).

**Activity Theory**

Proponents of *activity theory* which includes Vygosky, Rubinshtein, Leont'ev and others began their work in the 1920s with a focus on studies in workspace and computer usage (Case, 2012; Kaptelinin and Nardi, 1997). This theory has since found its way into the IB studies arena. Activity theory is primarily concerned with a set of principles which includes human reasoning (internalisation) and object-orientation (externalisation) to create a structure of activities or new artefacts (Case, 2012). The primary foundation of this theory is the creation of *activities* (which addresses actors’ needs) and *actions* implemented through certain operations (the seeking process). These operations provide adjustment to current situations (information requirements or needs) which are synonymous to activities of project actors. For example, some actors rely on their cognitive process to create information; others follow a systematic or rely on their colleagues for information. In addition, others rely on accidental or the social media to seek information. All these approaches require actors to perform series of both internal and external activities to capture appropriate information. Hence, the application of activity theory to actors ISB is significant in this research.

The activity theory suggests that external activities triggers internal (cognitive process) activities into operations. Thus, the activity theory differentiates between internal and external activities. Hence, internalisation provides a means for actors to explore interactions with reality without performing and manipulating real objects (mental stimulation, imagination, consideration alternatives, and others) (Kaptelinin and Nardi, 1997). Hence, any form of activity has an important role in forming consciousness (Case, 2012). The activity theory is widely applied in tasks analysis for information system development than IB related studies however, significant authors including Nardi (1996); Spasser (1999); Wilson (2006); Allen, Karanasios, and Slavova (2011), and others continue to advocate its relevance and use in IB related studies.
**Constructivism/Constructionism Theory**

Another theory rooted in ISB research, which is relevant to this study, is the constructivist/constructionism theory. According to Case (2012), this theory originates from education (Dewey, 1960) and psychology (Bruner, 1973; Vygotsky, 1980). However, the core of the constructivist theory is derived from philosophy and learning theory (Dewey, 1960). On the other hand, the origins of constructionist research stems from different theorists which emphasises the importance of language and social interaction in knowledge formation and the establishment of social/power relationship (Case, 2012). Researchers in social sciences have often combined these theories as one or sometimes as two separate concepts (Case, 2012). Bryman (2012), considers both constructivism/constructionism as referring to the ontological position, which asserts that social actors continually accomplish meanings associated to social phenomena.

Both theories accentuates the importance of language and social interactions in knowledge formation and the establishment of social relationship (Case, 2012, p190). Dewey's (1960), philosophy of instrumentalism emphasised pragmatic problem solving through actions undertaken in the real world. According to Case (2012), constructionism focuses on the way individuals construct understanding, meaning, and identities through dialogue and discourse. This is evidenced in Tuominen et al. (2005), that constructionism stresses the emergence of various forms of talk, interactions and use of languages amongst members of a community in different context.

The relevance of this theory to this study lays in the fact that project actors rely on their cognition, knowledge, emotions, experience and skills, sources and channels to create information to make informed decisions. Tuominen et al. (2005), posit that the constructivist prefers the term “information practice” over “information behaviour”. This is because the former assumes that the information-seeking and use process are constituted socially and dialogically, rather than based on ideas and motives of individual actors.

Frohmann (2001), postulates that constructionist begins with the assumption that when information needs, user’s sense-making or relevance criteria are studied;
people are always concerned with practices of the use of language that are “overt, public, disciplined, and institutionalised”. This can be assumed to provide a broader sociological perspective for understanding actors information-seeking and information technology use. Particularly when one studies how actors’ information practices and technologies are constructed in discourse and conversation. Prime examples of constructivist thinking can be found in Cole and Kuhlthau (2000); Julien (2004); Williamson (2005); and Wilson (2000).

**The Sense Making Theory**
The broad application of this theory is in understanding the relationship of communication, information and meaning amongst actors. The *sense-making* theory is integral to understanding how humans explore meaning from created information. This theory considers a generalisable approach to investigating how humans make and/or unmake sense in different forms (Dervin, 2005). This is paramount to project actors’ ISB process since actors generally contemplate on different forms of information needed at any particular point during task delivery or solution provision. As a result, sense making theory focuses on actors’ as the main creators of information at a specific moment in time and space (Dervin, 1992).

Case (2012), posits that the sense-making theory sees information as something that is constructed internally to address discontinuities (such as gaps, spaces, time, inconsistencies, movement, and other factors) in life; as opposed to other approaches to information-seeking that sees information as something “out there” that is passed onto people. According to Dervin (2005), the sense-making theory mandates a conceptualisation of the communication process as a gap bridging process and not in the purposive problem solving sense. This suggests that the sense-making theory is a continuous process applicable at any point in the actors’ information-seeking process. This is affirmed by Dervin (2005), that new moment in time-space requires a gab bridging step irrespective of whether that step has manifested as habitual and unconscious; capricious and accidental; or invented and planned. The application of the sense-making theory helps to understand the interpersonal and intrapersonal relationships between groups of people, institutions and organisations.
The Principle of Least Effort

In information intensive environments, time is essential to task delivery, and information is critical to decision-making process. As a result, the mandate for actors is to seek and capture context specific information within a certain period to make decisions that have long lasting impact. Thus, actors generally strive to resolve problems or provide solutions in a manner that requires the least amount of time and effort. This implies project actors require the most efficient and easily accessible sources and channels where they can expend the least amount of effort to seek appropriate information. With this concept, a theoretical framework for this study was derived. This emanates from literature review of IB related studies and investigation of various IB/ISB models.

Hjørland (2004), assert that a philosophy is something that one constructs to solve problems related to their field of study, and not just something to choose. Hence, the Zipf’s principle of least effort (Zipf, 1949) is considered the most appropriate theory for this research. According to Zipf (1949), individuals tend to adopt a course of action that enable them to expend the least average rate of probable work – thus the least amount of effort required. In other words; the least effort principle. Zipf (1949), posit that individuals minimise their average rate of work-expenditure over time in their behaviour, and not just their work-expenditure at any moment or in any isolated problem, without reference to future problems.

It is perceived that actors generally spend little amount of effort to seek information with the view to save time, improve their ISBs and performance; however, this is not the case. Actors usually try to find the easy-to-use, accessible sources and channels of high quality than those that are less easy to use; however, this tends to be very challenging. Factors such as ease of use and accessibility are vital to actors than quality of information (Bates, 2005). Actors’ consistent information creation, seeking, and use behaviours forms an automatic part of their general behaviour. This affirms the influence of IB on actors' professional role and performance in general. According to Donohew et al. (1984), information acquisition is an automatic human behaviour, which brings pleasure. This is because information-seeking requires actors to take action in response to some
disquieting internal state (an “anomalous state of knowledge”, “uncertainty”, or “visceral need”) (Case, 2012).

Zipf’s theory of “least effort” is supported with evidence from aspects of his studies on human behaviours, most of which is based on studies of the use of language. For example, he applied statistical distribution to examine the repetition of common words in the text of James Joyce’s novel *Ulysses* with its 260,340 running words (Zipf 1949). He concluded that the 10th most frequent word occurs 2,653 times; whilst the 100th most common word occurs 265 times; and the 1000th, 26 times. A distribution of data emerged from the outcome with which the number 26 appears as a constant. Zipf calls such a relationship “harmonic distribution” and posits that human allocation of resources (such as words in documents, documents in files, or people in cities) tend to fall into such arrangements. This indicate the economy of effort; where humans use short and common words whenever they can (leading to highly frequent usage of just a few words) rather than longer words that take much effort.

Numerous authors and scholars (including Agarwal et al. 2011; Bates, 2005; Case, 2012; Connaway et al. 2011; Gratch, 1990; Jansen and Rieh, 2010; Poole, 1985) have demonstrated a body of work of Zipf’s (1949), function as a paradigm or grand theory studies of information-seeking. A review of information-seeking literature by Poole (1985), found that 40 out of 51 sampled studies support Zipf’s *principle of least effort*. Poole demonstrates that Zipf’s *principle of least effort* has the earmarks of a general theory, and propositions may be derived from it. Hardy’s (1982), application of the *principle of least effort* indicate that actors take a path of least resistance when seeking information than the quality of information source. Similarly, O’Reilly (1982), suggest that actors apply the *least effort principle* because of pressures to find the appropriate information to produce results.

According to Zipf, the importance of the *principle of least effort* lies in its universality in regards to human behaviour. Thus, humans generally consider the long haul of any task performance in other to devise the most efficient avenue to expend their *least effort* to execute the task. In essence, this paradigm is significant in project actors’ ISB, and it is synonymous to construction project actors’ ISB. This is
because they all resort to easily accessible channels and sources for information, than expending much effort to seek context specific information. According to Poole (1985), information channels and sources uses a function of user awareness. Case (2005), suggest that humans generally prefer to access sources they are more familiar with and have used in the past than to try out new ones. Therefore, as the potential content and capabilities of knowledge of a source increases, the use of that source tend to increase as well (Case, 2005).

**Justification of Principle of Least Effort Theory**

The discussion of theories, metatheories and models establishes that Zipf’s *principle of least effort* underpins this study. This is because it underpins actors’ daily ISB activities in project organisations. As indicated in previous chapters, “time delay” is the most significant factor that underpins performance, success or failure of projects and construction organisations. Hence, any effort to reduce the amount of “time” spent in actors day-to-day activities is paramount to performance improvement, successful project delivery and organisation management.

Similarly, extant literatures suggest that actors expend least amount of effort in their information-seeking and information use behaviours. This is because actors prefer to seek information from their own knowledge, personal files/storage, and/or face-to-face or direct communication with sources internal to their working environments as opposed to visiting physical libraries, or other external sources. Zipf (1949), illustrates his principle with an example that a person solving an immediate problem views the concept of movement over paths against the background of probable future estimated problem(s). Moreover, the person strives to resolve the problem in a manner to minimise the total work required to resolve both the immediate and the probable future problems. This implies the person will strive to minimise the probable average rate of work expenditure (over time). In so doing the person will minimise the effort expended. Hence, least effort is a variant of least work. This suggests that actors subconsciously consider the application of the least amount of effort and time to achieve maximum output in any work done.
3.5 CONCEPT OF INFORMATION-SEEKING BEHAVIOUR MODELS

Social scientists, scientists, engineers, and other professionals have consistently used models to develop, define and represent theories. A model focuses on specific problems more than theories. These researchers often use models to explore the thinking behind innovative ideas, concepts and theories. Models may be in the form of a flowchart, a diagram or a structured representation of the author’s theoretical considerations. Generally, models are in the form of a diagram that attempt to use statements to describe the activities it represent, be it causes and consequences or relationships among stages of activities. According to Bates (2005), a model is mostly useful in the description and prediction stages of understanding a phenomenon. Most scholars in the IB research arena tend to communicate theories and findings using models to present actors’ activities during their IB process. A model makes it easier to illustrate casual process under investigation. This makes it easier to see if hypothesis are consistent with what is under investigation.

Case (2012), posits that models ranges from purely pragmatic and descriptive, to formal statistical path analyses. Johnson (1997), states that models represent the strengths and weaknesses of organising a complex process. Whereas the strength of a model depicts key elements of an investigator’s approach and selection of explanatory factors, it can become a weakness when it is over generalised (Case, 2012). According to Johnson (1997), theoretical models of information-seeking must address three key issues:

i. provide a sound theoretical basis to facilitate change predictions in ISBs,
ii. provide guidance for effective strategy design to enhance ISBs,
iii. explicitly conceptualise ISB, by developing a vivid description of it.

This implies, the content and compositions of models should have a purpose and reflect its intended objectives. Wilson (1999), describes a model as a framework for thinking about a problem. He states that it may evolve into a statement of relationships among author’s theoretical propositions. This is because models help to analyse consistency or relationship between hypothesised problems and real scenarios.
3.5.1 Models of Information-Seeking Behaviour

Over the past four decades, numerous publications of ISB models have emerged. Majority of these models vary in postulation, structure, scope, purpose and context. Some model designs represent general perspective of ISBs whilst others are context specific. For the purpose and context of this study, eight information-seeking models of professionals in engineering, healthcare, and information and/or social sciences are analysed. These models are chosen because of their extensive use, context, how they help to easily explain the ISBs of actors, and consistency with the present study. In addition, these models are selected because of the embedded factors that underpin actors’ information-seeking and information use/task performance behaviours. These models are generally user-centred rather than system-centred. Some authors have more than one model; however, the review focuses on models relevant to the aim and objectives of this research. The eight key models chosen for discussion in the subsequent sections include Wilson (1981), Wilson (1999), Ellis (1989), Kuhlthau (1991), Leckie et al. (1996), Byström and Järvelin (1995), Foster (2004) and Krikelas (1983).

Wilson’s First Models of Information Behaviour

Series of ISB/IB models developed by Wilson in 1981, 1994, 1997 and 1999 demonstrate patterns of actors’ IBs and ISBs in different context. These models reflect the trend in theory and practice of information-seeking and IB studies. However, this research focuses on the first and second models of Wilson, since these models focus on the IB needs of the “user” and the information-seeking context. Figure 3.2 present Wilson’s first information-seeking model. This model presents a way of thinking in the field of “user studies” which shows the interrelationships between different concepts of ISB. The model illustrates the process encountered by the user during information-seeking to satisfy a need.
Figure 3.2 Wilson’s 1981 model of IB [adopted from Wilson (1999)]

The model identifies 12 main components that demonstrate series of events the user exhibit during the process. The model starts with the “information user” (the project actor) with a need (specific or generic) which drives the desire to seek information. Wilson postulates that the “user” explores several available sources or channels (including information systems, colleagues, and libraries), to make demands for required information. During this period, the user exchange or transfer information with other actors. The outcome of the information-seeking and the search activities may lead to a success which results in the use of the acquired information or a failure. The failure outcome according to the model is a ‘dead’ end with no further activity. This demonstrates a weakness in the model. For example, the “failure” factor, which proceeds “demands on other information sources” factor, could have been linked to the “need” or “ISB” factors by way of another arrow to continue the information-seeking process.

Case (2012), posits that the important aspect of this model is its recognition for information exchange with other people during the information use and seeking behaviours. Wilson acknowledges the limitations of this model by suggesting that the model “does little more than provide a map of the area and draw attention to gaps in research. According to Wilson (2000), the model provides no suggestion of causative factors in IB and, consequently, does not suggest hypotheses to be
tested. This model is limited in its application due to its linearity and the assumption that the “user” follows a linear path without any regard to the causal factors that lead to the search process, and no links to any hypothesis. Perhaps the arrow between “other people” and “information exchange” factors should be bi-directional to represent information movement. In addition, a feedback arrow could be used to link “failure” factor to “ISB” factor to make the process cyclical to meet user demands. This model partially demonstrates some activities that project actors' exhibits during their information-seeking process. However, many aspects need further investigation to conceive the true nature of the ISB of project actors. The model pays little attention to formal information transfer; however, it lays emphasis on information exchange between actors. Hence, people in this context identify important information source in different circumstances through direct engagement with formal systems (such as a library, project documentation systems, and common data environment).

This model is relatively significant to this research in that actors' ISB is central to how they seek information. It highlights the triggers of actors’ information-seeking process as a “need”. In addition, it lays emphasis on actors’ reliance on colleagues (associates) and systems for information. The model identifies certain key factors (including sources/channels, satisfaction, success, failure, and useable) that influence actors’ information-seeking and/or information use/task performance behaviours. A significant limitation is that the model generalises actors ISB without establishing any differences or preferences in the way actors seek information. It assumes that actors follow the same information-seeking process. However, the model portrays both associate ISB and systematic ISB preferences. This is because the model emphasises actors’ reliance on colleagues and systems (including libraries) to meet their information needs.

**Second Wilson’s General Model of Information-Seeking Behaviour**

This model as presented in figure 3.3 is based on revision of the 1981 model (figure 3.2). This model expands on the ISB studies of professionals in other environment including decision making, psychology, innovation, healthcare communications and consumer researchers (Wilson, 1999). It focuses on the information needs of the actor, and the encountered barriers during the process. These barriers represent
the “intervening variables”. This model comprehensively depicts actors IB process. The inclusion of other theoretical models of behaviour makes it a richer source for hypotheses and further research than Wilson’s earlier model.

The model considers the cognitive process (activating mechanism factor) actors exhibit by raising three explicit theories at specific stages to analyse the likely barriers actors encounter in their IB process. These include:

- the stress/coping theory opens up more to why actors may or may not meet their ISB needs.
- the reward/risk theory explains explicitly, actors preferred specific information sources during the process.
- the social learning theory focuses on self-efficacy, and the successful nature of the information acquisition process to meet their needs.

From the model, the “activating mechanism” suggests a motivating factor that drives actors to overcome the “intervening variables” to enable the ISB process to be realised. The dynamics of this model demonstrates that actors truly exhibit different ISB orientations. However, the model fails to capture that. The author acknowledges that the model presents some dynamics of actors’ ISBs. For example, factors such as passive attention, passive search, active search and ongoing search presents four different search methods that helps to actively search
and acquire the needed information via appropriate sources and channels, evaluate the searched information and use the information. This is represented by the “information processing and use” feedback loop to indicate a restart of the process after successful information-seeking process. Perhaps Wilson could have been more specific with identifying the activating mechanisms that prompts the use of theories rather than just stating the broad theories to generalise the intervening variables encountered during the ISB process.

According to Niedzwiedzka (2003), Wilson’s separation of “information need context” from the person, the intervening variables and features of the information sources presents ambiguity; as these are central to the context. In addition, the activating mechanisms must be in operation at all stages during the information-seeking process but not only at the point of decisions to seek information. Similarly, the model lacks specific details concerning the key factors that influence the information-seeking/use, although Wilson indicates their integration in the activating and intervening variables.

The significance of this model to this study is its resemblance to the conceptual framework for this study. In that, this study identifies key factors that influences (the intervening variables) actors’ information-seeking and information use/task performance behaviours from which hypotheses are generated. In addition, the model demonstrates the dynamics of different ISB orientations, although it fails to identify any ISB preferences.

Ellis model (Ellis 1989; and Ellis, Cox and Hall 1993)
Figure 3.4 shows Ellis’ model of ISB. This was developed using a grounded theory approach from an initial empirical investigation of social scientists in academic settings. The model was later used to investigate other professionals including physicists, chemists, (Ellis et al., 1993), engineers and scientists in industrial settings (Ellis and Haugan, 1997). Originally, the model was presented in series of paragraped events. In the model, Ellis (1989), clearly indicate that different behaviour variables does not constitute a fixed sequence or a single set of stages. However, he state that the actions required at each stage of the process may vary, and be iterative (Case, 2012). The initial model featured six key activities to study
social scientists. This was later expanded to include the last two activities after investigating the ISBs of physicists and Chemists (Ellis et al., 1993). The expanded model was then used to investigate the ISB of engineers and scientists in industrial context (Ellis and Haugan, 1997).

![Diagram of Ellis' model of ISB]

Figure 3.4 The Elis' model of IB [adopted from Wilson (1999)]

The eight key activities that depicts Ellis's ISB model are:

- **Starting**: this indicates the beginning of information search process where the actor defines the questions to ask, and the sources or channels to approach (for example asking knowledgeable colleagues; consult electronic and/or non-electronic resources);
- **Chaining**: this stage requires the actor to follow identified footnotes, citations and/or references from known materials or knowledge gained during the "starting" phase.
- **Browsing**: at this stage, the actor is familiar with the subject matter and tends to identify key areas of interests to search for context specific information.
- **Differentiating**: at this stage, the actor uses filtration process to assess information sources by examining differences in quality and relevance and the quantity of information obtained.
- **Monitoring**: the actor at this stage maintains awareness of new developments and new materials in the subject area (for example by setting up alert feed for regular updates) and from specific sources (for examples journals, conference papers, and databases).
- **Extracting**: at this stage, the actor examines specific information sources and selectively identifies relevant materials for use.
Verifying: this is the stage where the actor checks the searched information to ensure accuracy and correctness in the captured information.

Ending: the actor concludes the information search process by performing a final literature search to ensure that the required need is achieved.

Ellis’ (1989) model is the most widely used and cited among the selected models. Various scholars who study the ISB of professionals in context such as social scientists (Meho and Tibbo, 2003), humanities (Bronstein, 2007), economists and business analysts (Thivant, 2005), and information-seeking and its direction at tasks performance level (Järvelin and Ingwersen, 2004) have used this model.

The model shows a progressive but partially cyclical information-seeking process. It ensures that activities at each stage of the process is verified and confirmed before progressing to the next stage. However, there are some challenges to the successful application of this model. For example, the “extracting” and “verifying” phases suggest an examination of captured information to retrieve context specific information. However, unless the information is used, one cannot confirm its viability. A critical limitation to this model is its lack of identifying factors that influences the information-seeking process. Similarly, there is no inclination to any ISB preferences, although there are indications to suggest a systematic approach.

This model can be improved by introducing a “use” factor just after the verification stage, followed by a feedback loop from “use” to browsing to facilitate filtration of good information from bad information to form a cyclical process. Bronstein (2007), after applying Ellis’ model to establish a strong relationship between information-seeking activities of Jewish scholars suggested a revision of the model to include certain elements related to stages of Jewish research. Meho and Tibbo (2003), also suggested a revision of Ellis’ model after using it to investigate 60 social science faculty members from 14 different countries to describe and analyse their ISBs. All these are indications of some limitations to this model. However, it is noted that the eight phases of the original model plus the suggested “use” factor and the feedback loop establishes a primary foundation for any form of ISB processes.
**Kuhlthau Model**

Figure 3.5 present the Information Search Process (ISP) developed by Kuhlthau (1991). This model emanates from stages of learning. It addresses intellectual access to information and ideas, and the process of seeking meaning rather than physical location of sources. Its universality depicts the cognitive and affective process and stages actors' exhibits during information-seeking to capture and evaluate information for use.

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**Figure 3.5 Kuhlthau’s model of ISP [adapted from Kuhlthau (1993)]**

The model stems from years of research on students’ information-seeking process. It emphasises the uncertainty students demonstrate during the ISP, and the emotions they exhibits during the intervening variables (Wilson, 1999). It shows how they motivate themselves to actualise the needed information. This model contains seven stages, which move in a vertical direction from left to right as a time sequence at three horizontal levels. It complements Ellis' model by attaching to the stages of the ISP. The model depicts information-seeking as a ‘construction’ process. It identifies the various tasks that actors perform at each stage, and it highlights their cognitive activities during the process.

The “initiation phase” is characterised by awareness of lack of knowledge or uncertainty by the actor to satisfy a need. The actor advances to the “selection” phase to identify and select relevant topic(s) to pursue, and to define a method of approach. The actor at this stage examines and identifies channels and sources with which to proceed. The actor moves to the “exploration” stage by searching for information in a broad and generic manner. At this phase, the actor becomes
confused and lost in the process; due to no defined specific context to search. According to Case (2012), some actors at this stage may abandon their effort to expand their understanding. At the fourth stage “formulate”; the actor identify some key terms and key areas to search. The actor formulates information focus and narrows down the search to context specific information items. The fifth stage “collection”, is where the actor focuses attention on gathering context specific information, analyses and record appropriate information for use. At the “presentation” stage, the actor uses the captured information to resolve a problem as identified at the initial “need” stage. Finally, the “assessment” stage ends the process where the actor comes to the realisation of some sort of achievement and accomplishment. This assumes a successful information-seeking process; however, there are no guarantees. As indicated by Case (2012), the “exploration” stage can be doubtful and confusing as the ISP becomes difficult to frame to information systems or other persons.

The model limits its focus on actions, cognition and emotions that occurs during the search process, and it does not offer any exploitation regarding the “before” and “after” scenarios of the whole search sequence. This model does not present contextual factors that lead to recognition of the need. Although the model identifies some influencing factors, there is no emphasis on how these factors influence the ISP. The relevance of this model to the present study is its recognition of cognitive and systematic orientations of actors ISB process; however, it fails to identify these as ISB orientations, other than as part of the information-seeking process.

**Leckie, Pettigrew, and Sylvain’s Model of Information-Seeking of Professionals**

Figure 3.6 present the model of information-seeking of professionals (including engineers, lawyers, and doctors) by Leckie et al., (1996). The model contains six characteristic factors connected by arrows depicting the flow of information. All arrows but one is unidirectional between “outcomes and characteristics of information needs”. This model focuses on the supposition that actor’s professional work role drives the type of task they perform. It also determines the kind of information required to initiate the information-seeking process.
The task influences actors “information needs characteristics”. Some of these characteristics include actors’ cognitive behaviour, prior knowledge, and available information sources. The unidirectional arrow labelled “information is sought” makes the model a two-way information-seeking process. The feedback arrows links actors’ information needs characteristics to sources and awareness of information to outcome of the process. The result of the information-seeking process depicted as “outcome” has a major influence with sources and awareness of available information. This is because these components connect with feedback arrows to demonstrate the various processes the actor exhibits to acquire information to satisfy the “need”.

Leckie et al. (1996), posits that the information-seeking process is greatly influenced by a number of interacting variables, which ultimately affect the outcome. However, these variables are not identified in the model except “professional role”. Leckie et al. (1996), were quick to indicate that actors’ ISB is trigged by a need in relation to task complexity. A noteworthy variable that underpins this model is familiarity and success with sources in relation to prior information-seeking outcomes. Hence, factors such as professional role,
accessibility, trust, timeliness, cost, packaging, and quality can be some motivators to actors’ consistency with information use.

Case (2012), point out that the model has a limited application to everyday life information-seeking due to its focus on work-related process. However, work roles could be replaced with everyday life activity to initiate the information-seeking process. The model fails to identify the various sources actors approach to seek information. This model is significant to the present study because it is task oriented and it focuses on professionals whose daily activities are underpinned by information. The model acknowledges feedback process to ensure verification of captured information. However, it fails to distinguish actors' ISB preferences, although there is a slight indication of cognitive information-seeking orientation.

**Byström and Järvelin’s Model**

This Model shown in figure 3.7 is based on the research work undertaken by Feinman et al. (1976), and Mick et al. (1980), about the way information users operate, and the stages in which they retrieve information.

![Figure 3.7 The information-seeking model [adapted from Bystrom and Jarvelin (1995)]](image-url)
Byström and Järvelin (1995), based their model on the importance of “task complexity” in the information-seeking process of the user and how the user’s knowledge gap drives the process. In their empirical research of 14 civil servants, Byström and Järvelin (1995), identified the channels and sources these civil servants access to capture appropriate information. They were able to establish how complex tasks drive information seekers to proceed with the process. They demonstrate that as task complexity increases, need for complex information grows. This results in suboptimal information-seeking outcome. This complexity is synonymous to the construction process, in that projects generally progress through the PLC with different degrees of complexities and information needs. According to Case (2012), complex tasks are those for which actors lack adequate “mental model” to make effective judgement on what needs to be done, or evaluate information efficiently. Such tasks are distinct from everyday routine tasks.

Byström and Järvelin's (1995), model contains nine key components structured as a feedback process to highlight levels of tasks complexity and its influence on the success (and/or failure) of the information-seeking process. The model begins with identification of a knowledge gap. The actor examines key personal factors (including education, experience, attitude, mood and motivation), situational factors (including time availability and accessibility), and organisational factors. These factors coupled with the actors’ preferred information-seeking style evolves during the process. These factors enable the actor to determine the choice of action (such as prioritising the process, selection of appropriate channels and sources) to take and the implementation process. The actor evaluates the outcome of the implementation to consider whether the needs have been met and whether the task can be completed. If not, the feedback loop to the “personal style of seeking” and “need analysis” enables further actions to repeat the process until an acceptable outcome is achieved.

The benefit of this model is that it considers the user’s capabilities, experience and expertise; however, this can also be a limitation. This is due to the lack of application of the model to a range of professionals who may not have “unique” personal factors or characteristics as identified above. Although the model highlights “situational and organisational factors” to influence actors' information-
seeking process, it fails to identify the specific factors that underpin the process. Similarly, the model fails to identify any specific “personal styles” that actors' exhibits during the process and the sources and channels they approach to seek information. However, it recognises the different information-seeking orientations. The model is significant to this study because it allows professionals the flexibility to adopt their personal information-seeking orientations. It also identifies key information-seeking and information use/task performance factors (such as situational factors) and demographic factors (such as personal factors). In addition, the model approaches the entire information-seeking process in a cyclical manner. Overall, the model acknowledges actors’ ISB preferences.

**Foster Model**

Figure 3.8 present the nonlinear ISB model. This model is the outcome of ISB study of 45 interdisciplinary academics and postgraduate students.

![Figure 3.8 Nonlinear model of ISB [adapted from Foster (2004)]](image)

The model is made up of six components – three core processes (opening, orientation and consolidation), and three levels of contextual interactions (cognitive approach, internal context and external context) each composed of individual activities and attributes. The model demonstrates the dynamic interaction between the components through time in a nonlinear manner. Foster (2004), likened the
nonlinear interactions to an artist’s palette, where activities remain available throughout the course of the information-seeking process. The pattern of activities in the model portrays actors’ ISB as nonlinear, dynamic, holistic and flowing.

Similar to considerable information-seeking models, the Foster model initiates the information-seeking process with an “opening”. This relates to actors state of actively engaging in seeking, exploring and revealing information needs to perform specific tasks. With this model, the information seeker has no limitation or boundaries to explore to capture required information. According to Foster (2004), “Breadth Exploration” and “Eclecticism” are the two activities actors undertake to facilitate the information-seeking process. “Breadth Exploration” is a conscious expansion of searching to allow exploration of every possibility, whilst “Eclecticism” encompass accepting, gathering and storing information from diverse range of both passive and active sources over a considerable period of time” (Foster, 2004).

As the actor explores numerous amount of available information at the opening phase, they move to the point of identification from existing research. Key themes (such as disciplinary communities, latest opinions, review existing literature and relevant sources) are explored to build a representation around the information gathering process. This is termed “orientation”. At this stage, the actor continues to identify which direction to look in order to define the problem at hand. The final phase of the core process is the “consolidation”, where the information seeker examines progress made and tries to synthesise relevant themes to decide whether further information-seeking is necessary. The core processes are enclosed by three levels of contextual interactions with the first being “cognitive approach”. This relates to the information seeker’s mode of thinking, willingness to identify and use relevant information to an interdisciplinary problem. This leads to the “internal context” where the seeker’s level of experience and prior knowledge helps to motivate the process. Foster (2004), posits that major influences at this phase is categorised as feelings and thoughts, coherence, knowledge and understanding.

The final phase of the contextual interactions is the “external context” where the actor assesses other sources outside the organisation. The actor is exposed to
major influencing factors (such as social and organisational, time, navigation issues and access to sources). Hence, with this model, the actor rely on their cognitive approach, knowledge, experience, internal and external contexts to dynamically and freely explore avenues without limits to seeking specific information.

The lack of direction and regard to the amount of time it takes the actor to realise when to stop the process is rather a limitation to this model. This is because there is no definite end to the information-seeking process. In addition, the unidirectional arrows suggest that the core process does not have any form of limitations, ending and/or time boundaries, which is a problem on its own. Forster fails to identify the triggers of the information-seeking process, the factors that influence the information-seeking process and any information-seeking preferences. However, this model present actors’ with the freedom to explore their cognitive, internal and external factors to facilitate the information-seeking process. Although the model does not mention any ISB types, it acknowledges the importance of cognitive information-seeking approach.

**Krikelas Model of Information-Seeking Behaviour**

Figure 3.9 present James Krikelas ISB model. This model explicitly depicts actors information-seeking by highlighting the importance of uncertainty as a motivating factor, and the potential for actors to seek information from memory, personal files and/or colleagues.
The model contains 13 components which are linked together by unidirectional arrows which primarily flow in one direction (downwards) except three arrows which flows in the opposite (upwards) direction. This suggest that the downward arrows are causal processes whereas the upwards arrows suggests a feedback process however, there is no continuity. Krikelas indicates that actors’ information-seeking process is triggered by uncertainty about a problem or solution provision. Hence, the process originates initially from actors’ cognitive process. The actor then consults other external sources including colleagues and/or personal files (such as library). Krikelas states that the “urgency” and perceived importance of the problem influences the pattern of information-seeking.

From figure 3.9, it can be seen that “information gathering” (such as cognitive process) and “information giving” (information from external sources – colleagues and/or library) tend to suggest the beginning of the information-seeking process which is triggered by the need (either deferred or immediate) for creating an event (context of seeking). Information giving is defined as “the act of disseminating messages which may be communicated in written [or graphic], verbal, visual, or tactile forms” (Krikelas, 1983). The model suggest that the “deferred need” is
feedback to the actors subconscious memory whereas the “immediate need” triggers the source selection either internal (cognitive and/or personal files) or external (associates and/or library systems). This indicates that the model explores different ISB orientations depending on the urgency and perceived importance of the problem or information needs. Because of the cognitive process, the actor consults their personal files to retrieve any stored information. This factor is linked to the information-gathering factor to form a feedback loop. Krikelas posits that actors are both senders and receivers of information, and that neither role is independent of the other.

Case (2012), posits that this model does not restrict itself to one type of occupation. In other words, the model underpins different information-seeking orientations. According to Krikelas (1983), information gathering is an attempt to continually construct a cognitive environmental ‘map’ to facilitate the need to cope with uncertainty. Thus, the process of information-seeking has a more general and a less formal purpose. Although this model is simple and clearly depicts actors’ information-seeking process, the direction of the arrows from “need” to the twin initial factors (information gathering and information giving) seem rather out of place. In addition, the model fails to identify appropriate factors that influence the information-seeking process and whether the process actually yields any significant outcome. However, the model acknowledges different information-seeking orientations (such as cognitive and/or systematic) amongst actors during the process. Hence, its relevance to the present study.

### 3.5.2 Comparisons and Implication of the Eight ISB/IB Models

The review of the eight IB/ISB models reveals differences in vocabulary, study context, significance and age; hence, the difficulty associated in comparing them. However, majority of the models lean towards establishing different ISB orientations. Majority of these models have unique antecedents, key factors that influence actors’ behaviours and information use/task performance. The models present a more useful heuristic foundation for designing empirical study for information-seeking. Interestingly, the authors of the eight models come from information studies literature. Each of the models have some significance to this study. For example, Wilson’s (1981) information-seeking model demonstrates the
importance of actors’ ISB types as central to the entire information-seeking process. It indicates that actors’ information-seeking process begins with a “need”, and that actors rely on colleagues for information. Similarly, Wilson’s (1999) model identifies key intervening variables that influences actors’ ISB. These variables are represented as “influencing factors” in this study from which hypotheses were generated. The combination of Wilson’s models portrays significant ISB preferences amongst actors.

The eight stages of Ellis’s (1989) model of ISB, and the six stages of Kuhlthau’s (1993) model establishes the primary foundation for actors' ISB. In both cases, they acknowledge the sequences actors exhibit during the information-seeking process. Both Ellis and Kuhlthau’s models proclaim some key factors that influence actors’ information-seeking and information use/task performance; however, they fail to identify these factors. Similarly, Leckie et al’s. (1996) model is significant to this study in that it is task oriented and focuses on professionals whose daily activities underpins different information orientations. This model identifies relevant information-seeking and information use/task performance factors; although it fails to identify actors’ information-seeking preferences.

On the other hand, the task complexity focus of Byström and Järvelin’s (1995) model highlights how actors knowledge gap drive their information-seeking process. Byström and Järvelin’s (1995) model allows actors the flexibility to adopt personal information-seeking styles and personal factors. Similarly, Foster’s (2004) nonlinear ISB model, and Krikelas's (1983) model enables actors to explore their cognitive, and internal and external factors to facilitate the information-seeking process. They suggest that actors exhibit different information-seeking orientations, which depend on perceived importance and urgency of the need. Overall, these models indicate that actors’ ISBs are generally triggered by a need or problem. This then activates different variables, which engages actors to adopt appropriate information-seeking preference/style and appropriate sources to seek information. Attributes of the eight models with significant outcomes from extensive literature review forms the basis for the conceptual framework for this research.
The present study advocates that, actors’ exhibits different ISB orientations during their information-seeking process. Hence, the one-size ISB approach (as indicated by these models) does not fit all. Actors’ generally seek information from different sources and avenues. Some actors approach these sources and channels based on their personality styles, orientations, available resources, and/or circumstances (external or internal factors). For examples, the working conditions (independent or working in teams) of actors can influence certain ISB orientation(s).

Several authors and scholars have also demonstrated that engineers predominantly rely on their colleagues for majority of their information than other sources and channels (Allard et al. 2009; Fidel and Green, 2004; Hertzum 2000, 2002; Kwasitsu, 2003; Robinson, 2010). On the other hand, academics, scientists, social scientists, humanities, and others generally work independently. Hence, research in these areas portrays different ISB orientations. Other categories of group of people/professionals (such as students, journalists, lawyers, physicians, and nurses) tend to orientate towards other types of ISBs. These ISB types are often portrayed as information sources in these models. However, these sources exists as personal preferences and lean towards personality styles (McCrae and Costa, 1997). In addition, these sources are influenced by circumstances and other personal and social factors, hence; they are best described as ISB types or orientations rather than ISB source. Hence, the information-seeking preferences actors’ exhibits in relation to professional orientations or personal circumstances suggest that these actors’ are predisposed to different ISB types. Therefore, the models discussed can be embedded into any type of actors ISB orientations identified in this study. Table 3.1 presents the summary of the comparison of the eight IB/ISB models discussed above.
## Table 3.1 Comparison of the IB/ISB models

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Number of key stages</th>
<th>Key antecedent</th>
<th>Key influencing Factors</th>
<th>Exhibited behaviours</th>
<th>Perceived ISB Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilson (1981)</td>
<td>12</td>
<td>Need</td>
<td>Seeking or purchasing, sources/channels, satisfaction, success, failure, usable</td>
<td>Demands, success, failure, use, transfer, satisfaction, or non-satisfaction</td>
<td>Colleagues (associate), systems (systematic)</td>
</tr>
<tr>
<td>Wilson (1996)</td>
<td>20</td>
<td>Context: person-in-context</td>
<td>Psychological, demographic, role-related, environmental, source characteristics, context specific, sources, success</td>
<td>Passive attention, passive search, active search, on-going search, seeking, use and processing</td>
<td>Cognitive, systems, colleagues, social avenues (e.g. social media)</td>
</tr>
<tr>
<td>Ellis, (1989)</td>
<td>8</td>
<td>starting, browsing, chaining, monitoring, differentiating, extracting, verifying, ending</td>
<td>Research project/task</td>
<td>Sources /channels, context specific, quality, relevance, quantity, usable, accuracy</td>
<td>Systematic</td>
</tr>
<tr>
<td>Kuhlthau, (1993)</td>
<td>21:3 levels by 7 stages (Feelings, thoughts and actions, 7 stages: initiation, selection, exploration, formulation, collection, presentation, assessment)</td>
<td>Uncertainty or a gap in knowledge (need)</td>
<td>Accessibility, satisfaction, channels/sources, context specific, usable, success</td>
<td>Feelings: uncertainty, optimism, confusion, clarity, satisfaction, thoughts: interest, self-awareness Actions: seeking, exploring, documenting</td>
<td>Cognitive, systematic, social media</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Page</td>
<td>Needs, tasks</td>
<td>Sources, awareness, demographic factors (including experience, qualifications, role), sources, availability, success, accessibility, trust, timeliness, cost, packaging, quality</td>
<td>“outcomes”</td>
<td>Factor(s)</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Leckie, Pettigrew, and Sylvain, (1996)</td>
<td>6</td>
<td>Needs, tasks</td>
<td>Sources, awareness, demographic factors (including experience, qualifications, role), sources, availability, success, accessibility, trust, timeliness, cost, packaging, quality</td>
<td>“outcomes”</td>
<td>Cognitive</td>
</tr>
<tr>
<td>Byström and Järvelin (1995)</td>
<td>9</td>
<td>Subjective task complexity, knowledge gap</td>
<td>Personal and situational factors; organisational factor, sources/channels, context specific, sources/channels, time, internal context (i.e. experience, knowledge, qualification), access, organisational factors, social factors</td>
<td>Information needs analysis; choice of actions; implementation; evaluation</td>
<td>Personal Information seeking style</td>
</tr>
<tr>
<td>Foster (2004)</td>
<td>6</td>
<td>Opening, Research work</td>
<td>Context specific, sources/channels, time, internal context (i.e. experience, knowledge, qualification), access, organisational factors, social factors</td>
<td>Information need and knowledge gab are driven by task complexity.</td>
<td>Cognitive</td>
</tr>
<tr>
<td>Krikelas, (1983)</td>
<td>13</td>
<td>Need-solving problem or creating event</td>
<td>Sources, personal files (i.e. experience, knowledge), Observations; interpersonal contact, use of literature, documents, recorded literature (i.e. video/audio), memory or personal files, giving, gathering</td>
<td>Cognitive, systematic, social media</td>
<td></td>
</tr>
</tbody>
</table>
3.6 SUMMARY

This chapter examined the historical background of IB and ISB related studies and the theoretical foundation on which these studies are undertaken. It identified and provided definitions to key terms relevant to IB and ISB studies. Furthermore, an overview of ISB models and their significance to the present study was discussed where comparisons of the models were carried out to extract key influencing factors and ISB orientations.

Information behaviour and ISB related research has evolved over the past decades from broader areas of industry to narrow areas of context specific and task focused research. This transition results from the changing nature of the way and manner actors seek and use information, and their exposure to the numerous information sources and channels. Review of previous studies showed that majority of IB related studies employ some form of metatheory, theory and/or models to reveal the philosophical concept behind the process. Whereas models are often defined in relation to theories and metatheories, they generally illustrate important factors that facilitate the likely sequences and interactions in the information-seeking process. The reviewed models present useful insights into actors’ ISBs, and avenues to support the fundamental considerations for conceptualising a model for this study.

The subsequent chapter reviews IB studies of professionals in different sectors with a focus on actors in the construction sector. Detail analysis of actors ISB orientations, and key factors that influence actors’ information-seeking, and information use/task performance that establishes relevant foundation for hypothesis development are extracted and presented.
CHAPTER 4: DYNAMICS OF INFORMATION-SEEKING BEHAVIOUR

4.1 OVERVIEW

Information is intrinsic in successful project delivery and organisation management. Hence, by virtue of dynamic professionals with appropriate attributes, effective IB culture can be achieved. Professional occupations have provided platforms for ISB and IB related studies over decades. According to Julien et al. (2011), 39% of groups identified in their study were occupational. McKechnie et al. (2002), posit that 32% of their investigations featured some kind of professional “workers”. Similarly, Julien and Duggan (2000), pointed out in their longitudinal study that half of respondents were occupational. This indicates the level of ISB and IB related research in different occupations. Moreover, actors continue to be exposed to vast amount of information sources and channels resulting in IO and its impact on performance (Allen and Wilson, 2003; Edmunds and Morris, 2000; Robinson, 2010).

Until recently, many organisations continued to capture all kinds of information irrespective of quality, time, cost, and performance. This phenomena leads to information waste and cost burden. A recent survey indicate that that 80% of information filed by professionals is never used (Inc Staff, 2003). Furthermore, research indicates that performance of actors and organisations can be affected by too much information (Butcher, 1995; Eppler and Mengis, 2004).

The nature of work in AEC sectors is such that project actors are able to capture information easily. This may be due to their exposure to numerous information sources and channels. However, these actors find it challenging to capture context specific information that may be readily available for use for the next task/project (Tang et al., 2006). This tendency leads to performance delays. Smith and Tardif (2009), posits that inadequate information management directly contributes to project delays and construction waste. Hence, this chapter present a review of IB and ISB literature of different occupations with particular focus on the characteristics of actors' ISB orientations and the factors that influence their information-seeking and information use/task performance. This review synthesises and extracts different ISB orientation to categorise the unique ISB types amongst construction project actors. This chapter directly responds to research objectives three, four and five.
4.2 INFORMATION-SEEKING BEHAVIOUR OF PROFESSIONALS IN DIFFERENT OCCUPATIONS

4.2.1 Scientists’ Information-Seeking Behaviour Process

The focus of the earliest ARIST chapters (1966-1974) together with review of information needs and uses were on scientists and engineers. This enabled researchers to establish the pattern of ISBs and IBs in sciences and engineering professions. Bates (1996), presents detailed review of ISB and IB related studies of progression made by researchers from the 1950s through to the 1990s.

Researchers have continually employed both quantitative and qualitative methods including questionnaires and interviews to study scientists’ ISBs. In their study, Bichteler and Ward (1989), interviewed 56 geoscientists and found that scientists rely on professional contacts as their main sources for information. They posit that scientist follow this up with journal literature to seek information in an “on-demand” mode. They identified key factors (including delays, physical access, and quality, retrieval by geological concept, red tapes, and language barriers) as challenging to scientists ISBs. They concluded that geoscientists spend about 2 to 10 hours per week looking for information. Bichteler and Ward (1989), failed to recognise any research method(s) in their investigation. Similarly, their data analyses fall short of rigour with no justification to the findings and results.

Similarly, Noble and Coughlin (1997), used questionnaire survey to capture the ISB patterns of 131 chemists. They concluded that 85% of these chemists rely on print journals for majority of their information. They found that factors such as time, funds and knowledge of available resources, accessibility and IO as key obstacles to chemists’ ISBs. A weakness to this research is the lack of rigour in the methods employed and the lack of appropriate literature to support the research. The authors failed to establish any basis and relevance of their findings. Palmer (1991), adopted a variety of structured inventories and semi-structured interviews to elicit ISBs and the importance of information sources from agriculture researchers. She applied statistical cluster analysis to classify the “information-seeking styles” of these researchers into five main groups including none-seekers; lone wide rangers; unsettled self-conscious seekers; confident collectors; and hunters. According to Palmer (1996), the lone seekers do very little information-seeking; whereas lone
wide rangers work alone and read/scan a wide variety of literature. On the other hand, unsettled self-conscious seekers are indecisive, whereas confident collectors are in control of their work. In addition, hunters are attentive to emerging materials and patterns in their narrow area of investigation.

Flaxbart (2001), interviewed chemistry professors to establish their IBs and preferred information sources and concluded that these chemists prefer electronic journals to print library materials. Flaxbart indicates that significant time-savings, convenience and easy access are the reasons behind their choice. However, the research by Flaxbart (2001), can be regarded as non-scientific since there is no statistical foundation, and no methodological approach to justify the findings. On the other hand, Kuruppu and Gruber (2006), favoured a mixture of face-to-face interviews of 37 scientists, and two separate focus groups to investigate the ISBs of agricultural and biological scientists. Their conclusion indicates that scientists rely heavily on literature, electronic resources and journals for information. They indicated that scientists preferred convenience of easy source access over information quality than to visit the physical library. However, this study lacks rigour in the data analysis, lacks methodological foundation, and the conclusions drawn are rather vague for justification.

Brown (2005), employed survey instrument to investigate scientists from four disciplines; Astronomy, Chemistry-Biochemistry, Mathematics and Physics. In all, 49 of 80 persons responded to her survey. The study found that scientists rely on both electronic and printed journals for majority of their information. She found that these professionals use available physical libraries, bibliography databases and online catalogues to seek information. According to Brown, scientists rely heavily on journal literature to support their research and creative activities, and they scan latest issues of journals to keep abreast with current developments in their field. Brown posits that Mathematicians prefer to seek information from monographs, preprints and conferences and often personal communications to meet their information needs. Similarly, she found that Chemists’ employ continuous and on-demand process to setup information alert systems (automatic information capture) to capture current and up-to-date information from journals and to stay abreast in new developments. Brown indicates that Physicists and Astronomers place high
value on current journal literature. Although findings from Brown’s study are statistically justified, she relies primarily on descriptive statistics to justify her findings. Similarly, the number of respondents to her survey is rather inadequate to support generalisation of her findings. Although Brown’s study suggests information-seeking preferences of scientists; she fails to justify how these scientists seek information and the factors that influence their ISBs.

Hemminger et al. (2007), surveyed 902 academic scientists of all disciplines to investigate their ISBs. They concluded that these scientists prefer to seek information via the internet in the convenience of their offices or labs, than to visit physical libraries. They posit that scientists rely on different sources (including journals, web pages, databases and personal communications) to capture information. However, Hemminger et al. (2007), failed to apply any statistical or scientific justification to their analysis and the research.

Jamali and Nicholas (2010), employed self-administered web-based questionnaires to survey 114 physicists and astronomers to elicit patterns of their ISBs. They found that majority of astronomers rely on information from disciplines other than physicists. This implies a more interdisciplinary ISBs where they rely on colleagues from other disciplines. However, they indicate that some physicists rely on their own literature than literature from other disciplines. This research is limited by small sample size, non-statistical significance of findings, subjective opinions of respondents and restraint associated with generalising findings.

**Characteristics of Scientists’ Information-Seeking Behaviour Process**

In trying to establish the ISB of scientists and the factors that influence their information-seeking and information use/task performance behaviours, it is obvious that researchers in this area employ mixed method strategies (questionnaires and interviews). The review indicates consistent ISB pattern amongst scientists where they rely mostly on electronic sources and channels (including catalogues, journals, web pages) and the physical library (including databases, personal libraries and conferences). Although some physicists rely on colleagues and personal contacts, the majority prefer some kind of systematic information-seeking approach. In general, scientists’ ISB underpins the *principle of least effort*. For example Seggern
(1995), indicate that scientists prefer “ease of use” by relying on personal collections, informal communication and physically accessible sources than the use of external libraries and formal literature search.

On the other hand, mathematicians prefer to attend conferences to seek information. They rely on monographs and personal communication for majority of their information. This suggests an orientation towards cognitive, associate and serendipity/fortuitous information-seeking approach. Key influencing factors such as sources, accessibility, availability and time are evident in scientists ISBs. The review suggests scientists prefer to apply information alert systems to stay abreast to encounter current information but disregards information quality.

Overall, scientists predominantly orientate towards cognitive ISB approach (such as reliance on personal communications, knowledge, and/or experimental outcomes - often-accidental discovery) and/or systematic approach (such as reliance on physical libraries, databases, catalogues, and others) and sometime serendipity/fortuitous information seeking approach (such as attending conferences).

4.2.2 Engineers Information-Seeking Behaviours
Engineering (including mechanical, manufacturing, chemical, electrical, and aeronautical) is a specialised profession operating in a range of environments. The work of engineers focuses on product design and development, project delivery, problem solving, and servicing of technical plants rather than the production of general conclusions, which is in contrast to other professions. Engineers do not only engage in the design, development, testing, and manufacturing, but in research, management, consulting, services, and sales.

Anderson et al. (2001), used questionnaires to investigate the ISB of aerospace engineers and scientists, from which 872 out of 2000 questionnaires (90% engineers and the rest scientists) were retrieved as good data. According to Anderson et al. (2001), the principle of least effort support engineers strong preference for oral communication over written communication. They posit that the decision “to use” or “not to use” is a fundamental factor in engineers information sources/channel selection. However, they found other factors such as quality and
accessibility of written communication to be insignificant during oral communication. Anderson et al. (2001), indicate that sequential choice based on task complexity and uncertainty is the reason behind their preference for personal collections and oral communication within their organisation and sometimes to confer with other external entities. A lesser choice is to refer to literature, and then consult with library intermediaries for their information. Anderson et al. (2001), indicate that the reasons behind lack of library usage includes (i) classification systems, (ii) time constraints, (iii) rational behaviours based on cost estimates and success probability, and (iv) the intermediary role of Liberians. Although the captured data was lesser than the sample size, it significantly represents the sample size. Similarly, the study employs a sound theory. However, the sample comes from the same organisation hence, bias in their conclusions. In addition, the study does not consider other sources and channels employed by these actors.

Information-seeking within engineering organisations and amongst engineering actors is often triggered by personal, environmental, situational and circumstantial factors including needs, stress and coping variables (Courtright, 2007; Hertzum and Pejtersen, 2000; Kwasitsu, 2003; Wilson, 1994). These variables usually occur simultaneously to actors perception of events, risks and rewards as well as past experiences and perception of self-efficacy (Courtright, 2007). Kwasitsu (2004), found that major triggers of the information needs of engineers originates from problem solving followed by idea exploration, and project planning. This findings confirms Leckie et al’s. (1996), study on how specific tasks, experiences and work roles influences actors information needs in the project organisation.

Several ISBs studies consistently confirm that engineers spend on average, around 40% to 66% of their working time to seek, process, communicate, disseminate and engage in information related activities (Allard et al., 2009; King 1994; Leckie et al., 1996; Robinson, 2010). Lowe et al. (2004), posit that design engineers spend 21% of their working time to search and absorb information. In contrast, Allard et al. (2009), observed 103 engineers in high-tech firms, and estimated that they spend one-quarter of their time engaged in some type of “information event”. They posits that due to improvement in information searching technology, engineers use less time to seek information. They indicate that engineers choose the internet as their
“primary sources even though information availability may not be timely or authoritative”. On the other hand, Robinson's (2010), empirical investigation of 78 design engineers indicate that these actors spend approximately 56% of their working time in IB activities. Robinson posit that engineers spend significant time receiving information they have not requested than what they have requested, and this behaviour pattern is also demonstrated when they provide others with information. These findings contradicts claims made by Allard et al. (2009).

Ellis and Haugan (1997), identified variation of information needs of engineers and scientists at different stages of project delivery process. They posit that engineers’ information-seeking is very extensive at the initial phase of a project, where both formal and informal channels are utilised. However, engineers tend to be very selective at the advanced stages. According to Ellis and Haugan (1997), as engineers become aware about task complexities, their use of formal channels decreases. They tend to rely on person-to-person communications. Other research suggest that engineers make more use of their knowledge, colleagues, and other sources within their organisations than technical literature (du Preez and Fourie, 2009; Hertzum and Pejtersen, 2000; Pinelli, 1991; Tenopir and King, 2004). Often, literature used by engineers tend to be trade related (including manuals, working drawings, reports, handbooks, and trade journals) than research publications.

Engineers generally uses two types of information – contextual information and technical information. Contextual information is generally undocumented and has far less detail. This type of information includes data on the context design processes. Hertzum and Pejtersen (2000), posits that associates are often the best sources for this kind of information since there is no official channel to document it. On the other hand, technical information includes technical reports, specifications, documentation of technical solutions, and results. This type of information is often archived in a central location, not used very often and may be indexed to facilitate efficient search (Allard et al., 2009). Leckie et al. (1996), discovered that engineers rely particularly on their colleagues and other internal sources to meet their information needs than physical libraries. Allard et al. (2009), posits that colleagues do not only serve as sources of verbal information but also, as facilitators in finding relevant document sources. In contrast, Hirsh and Dinkelacker (2004), suggest that
software engineers rely mainly on electronic sources for majority of their information. Even though some percentage of software engineers frequently consult colleagues outside of the company for some new and unfamiliar information, they do not turn to colleagues inside their company to meet their information needs (Hirsh and Dinkelacker, 2004).

Chakrabarti et al. (1983), concluded that information availability and ease of use are the driving factors behind technical information source selection by managers, scientists and engineers. On the other hand, Taylor (1991), revealed from the IB study of engineers, legislators and practising physicians in different context that, work environment is the most influential factor in their IB/ISBs. Taylor indicates that engineers seek interpersonal sources for majority of their information.

Pinelli et al. (1991), surveyed 2309 engineers and scientists to establish their information-seeking habits and practices. They concluded that source relevance is the most compelling reason for use of technical report, followed by source accessibility, technical quality and reliability. According to Pinelli et al. (1991), variables such as accessibility, ease of use, expenses, familiarity, and availability are “sociometric”. Case (2012), asserts that sociometric data are those indicating “Who talks to whom” in a work and/or social environment. Holland and Powell (1995), posit that the most rated single source by engineers is “word of mouth” followed by personal document collections, and then libraries or databases. External sources including colleagues from outside their company are also considered a good source. However, it is evident that the most highly ranked “people” information source by these engineers is intrapersonal, and “personal experimentation” (Holland and Powell, 1995).

Yitzhaki and Hammershlag (2004), surveyed both academic scientists and software engineers to compare and contrast their use of information and perception of source accessibility. They concluded that differences in factors such as age, education, seniority, research type and use of certain sources are influential in their information sources selection. Reponses from 233 participants indicate that information accessibility partly correlate with its use and this relationship is stronger among academic scientists than industrial engineers.
Kwasitsu (2003), applied questionnaire survey and semi-structured interview to study design, process, and manufacturing engineers in a microchip manufacturing company. According to Kwasitsu (2003), these engineers rely heavily on colleagues internal to their work environment followed by personal memory and personal files, and the internet. Kwasitsu posit that factors such as work role, experience, tenure, task complexity, accessibility, availability, relevance, reliability, and currency, ease of use, technical language, personal mastery, cost, and technical quality are influential in engineers ISBs and source selection. Kwasitsu (2003), identified three key findings regarding engineers information-seeking and the factors that influence their ISBs. Their finding indicate (i) a significant difference in engineers IB/ISBs, (ii) that engineers with higher educational qualifications are less likely to depend on personal memories and “personal mastery” (information tool mastery) as sources of information, and (iii) the higher the engineers level of education; the more likely they are to depend on libraries for information. Similarly, Gerstberger and Allen (1968), postulate that demographic factors such as work roles and complexities in various stages of the PLC influences information source selection by engineers and scientists. Whereas Allen (1966), indicate that accessibility is the most influencing factor for engineers source selection, Court (1997) opined that engineers rely solely on their memories for information, which is in contrast to the findings by Kwasitsu (2003).

Wallace and Ahmed (2003), undertook two separate observational studies in the same aerospace company to investigate the ISBs of design engineers. The first study observed three groups of four designers. The findings indicate that design engineers rely on colleagues for majority of their information and that persons responding to the information request rely on their cognitive abilities. However, they indicated that novice engineers had the most questions to ask. This findings is relative to that of Court (1997), who indicate that designers make extensive use of their memories to retrieve information rather than search through documents. Wallace and Ahmed (2003), conclude that three key factors (such as speed, context and confidence) influence engineers source selection. In their second investigation, Wallace and Ahmed (2003), contrasted the ISBs of six experienced and six novice design engineers. Their findings suggest that experienced engineers adopt specific strategies to acquire information. Whereas novice engineers do not
know where and which information to capture, which make their information-seeking less effective. They point out that novice engineers are reluctant to approach experienced engineers immediately when they have queries, preferring to list their questions until they find the appropriate time to ask. They also found that social and personality factors played significant role.

du Preez and Fourie (2009), applied Leckie et al's. (1996) model and semi-structured time line interviews to investigate the ISBs of 11 consultant engineers. They discovered that these engineers rely highly on personal knowledge, personal files, and colleagues for their information. They indicates that certain individual and circumstantial attributes (including age, role, geographic location of project, personal preference) and other task related factors (such as context, frequency predictability, complexity and importance) are influential in the ISB of consulting engineers. However, the investigations by du Preez and Fourie (2009), lack rigour and substance due to reasons including inadequate sample size, bias in sample and findings, lack of detailed analysis, and no justification for choice of strategy.

Leckie et al. (1996), found in their extensive meta-review of the ISB of engineers, healthcare professionals and lawyers that these professionals (particularly engineers) rely on their colleagues and other internal information sources (such as reports, technical documents, and manuals) for majority of their information than visits to the library. They posit that work role, experience, tenure and task complexity influences engineers ISBs and sources selections. These findings are consistent with the findings of Hertzum and Pejtersen (2000). Hertzum and Pejtersen indicate that engineers rely on colleagues and internal document because of trust and ease of access.

**Characteristics of Engineers Information-Seeking Behaviours**
The above reviews suggest that researchers in this arena employ qualitative and quantitative or both research strategies to investigate engineers IBs/ISBs. However, majority of the investigations lack rigour in the analysis and application of both techniques. General conclusions indicate that engineers have an established ISB orientation and that they predominantly rely on colleagues for majority of their information. This notwithstanding, some engineers tend to consult other sources.
including personal knowledge, technical and trade document, technical white papers, and others (including social media, and serendipity/fortuitous) depending on the context. Demographic factors (including age, knowledge, experience, and qualification), and other factors (such as ease of use, accessibility, relevance, reliability, context, speed/time, and quality) are vital to engineers information-seeking and information use/task performance behaviours. The reviews indicate that though engineers are exposed to vast information sources and channels their accessibility and use are rather suboptimal.

4.2.3 Information-Seeking Behaviour of the Sciences
Occupations such as sciences, social sciences and humanists have generally appealed to IB/ISB researchers. Researchers have concluded that the primary literature of sciences is journals, whereas humanists are likely to consult books and archives (Case, 2012). Brittain (1970), point out that journal literature is highly important to both social scientists and scientists; however, the former rely more on institutional data generated for reasons other than social research. Case (2012), suggests that humanist can have broader information sources since they draw on artefacts of popular culture across the ages. A recent consensus suggest that the sciences satisfy majority of their information needs through contact with colleagues within the same working environment and network at conferences (Bouazza, 1989; Case, 2012; Hogeweg de Haart, 1981).

According to Bouazza (1989), although scientists, social scientists, and humanists rely more on formal information sources than informal sources, they do not behave in the same way as far as information use is concerned particularly during data collection stage of research, and course preparation. Bouazza (1989), indicate that scientists information use is influenced by intervening factors (such as availability, accessibility, quality, cost, and ease of use); demographic factors (including seniority, experience, speciality, educational level, professional orientation and subjective impression of users); and environmental factors (including the stage of the research, the physical, social, political, and economic environments surrounding the user). In his investigation of 20 social scientists, Ellis (1989) identified six stages of information-seeking patterns to include starting, chaining, browsing, differentiating, monitoring, and extracting. Ellis concluded that informal
contacts are the primary sources of information for this group particularly at the starting and monitoring phase. Meho and Tibbo (2003), applied Ellis’ (1989) model to study 60 faculty members from 14 different countries. They employed structured and semi-structured electronic mail interviews to the 60 members, and face-to-face interviews to five faculty members for reality check. They found that these scholars face inadequate academic structures and financial support, difficult research conditions, unavailable or deliberately suppressed information, and a lack of helpful subject indexing. Meho and Tibbo (2003), indicates that these scholars rely more on personal collection, fieldwork, other libraries, and archival materials than their own university library collection. They posit that the ISB of these scholars are influenced by factors such as context, identity, accuracy, objectivity and reliability.

Krampen et al. (2011), investigated 298 psychologists to analyse their information-seeking habits. They found that these psychologists are very poor users of citation databases due to a direct link to poor experience with professional information resource training and low interests in IB training. They suggest that these psychologists tend to rely more on self-help and self-teaching. This confirms the findings of Wiberley and Jones (1994), that humanities scholars tend to work alone. Krampen et al. (2011), identified key demographic factors such as age, role, and material mastery to influence the ISBs of these professionals.

Cole (1998), used grounded theory to study 45 PhD students to establish their information acquisition pattern. He indicated that in a given knowledge domain, historians create knowledge structures through four-stage information process that differentiates experts from novices. Westbrook (2003), employed open-ended questionnaire survey of 215 scholars in women studies and identified six types of information resource problems faced by these scholars. They include difficulties to find and use; poor quality and coverage; limited quantity; unsatisfactory information on the internet; difficulty in information interdisciplinarity; and overabundant information. They highlighted three kinds of information related problem: doing and keeping up with research, learning how to do and keep up with research, and managing information. Westbrook (2003), concludes that these scholars use information-seeking channels including books, journals, government documents, people, databases, the internet, grey/archival material and other media.
**Characteristics of Information-Seeking Behaviour of the Sciences**

The aforementioned review of the sciences indicate that this category of professionals rely more on formal sources than informal sources. They rely more on journals, physical library and electronic resources and personal knowledge, than other sources to seek information. The review also revealed key influencing factors including context, availability, accessibility, currency, accuracy, sources/channels, quality, cost, and ease of use, and relevance. In addition, key demographic factors including age, seniority, experience, speciality, and educational level, are identified to influence the information-seeking and information use/task performance behaviours amongst the sciences. In addition, researchers in these areas tend to employ both qualitative and quantitative strategies to investigate social scientists. Hence, it can be concluded that the sciences, social sciences and humanists orientate towards cognitive, systematic and/or associate ISB types.

**4.2.4 Information-Seeking Behaviour of Other Professionals (including Healthcare, Journalism, and Lawyers)**

**Information-seeking behaviour of health care professionals**

The structure and competition of occupations such as healthcare, journalism, and the judiciary suggests different ISBs of actors who operate in these arenas. Researchers continue to investigate these occupations because of the varied nature of information needs. For example, in the healthcare sector, increasing life span, life styles, and affluence drives sophistications in healthcare provision. In addition, different medical problems contribute to the drive in healthcare information. Hence, growth in ‘evidence based medicine’ suggests that demands for structured information and knowledge by healthcare professionals is vital to their IBs/ISBs.

A study by the American Medical Association (AMA) demonstrates a significant increase in the use of the internet by physicians to seek information. The study indicates that 70% of 2000 physicians rely on the World Wide Web (WWW) for electronic mails, medical information sources, travel information, product information, patient information, and professional communications. Haug (1997), investigated 12 physicians and concluded that physicians generally consult local textbooks and colleagues for most of their information. This findings is consistent with the findings of Gorman (1999). According to Gorman (1999), most of the
information needs pursued by physicians are satisfied by textbooks, drug texts and people (such as colleagues, consultants and non-physicians). Gorman concludes that primary information used by physicians comes from humans rather than recorded sources. This implies, much of the knowledge physicians use to treat patients is narrative (for example; the story about a patient's history of symptoms and treatment). However, Gorman failed to identify the factors that influence the ISBs of these professionals. Similarly, Osheroff et al. (1991), posits that physicians largely rely on medical records to capture about half of information needed to treat patients, whilst the remaining half is captured from published sources and synthesis of information from personal knowledge, experience and the patients.

Gruppen et al. (1988), investigated 387 primary care physicians and revealed that for each case, physicians indicate (i) their willingness to proceed with treatment without seeking additional information, (ii) their preference for sources of supplementary information, and (iii) their preference for continued care responsibility. They indicate that physicians ISBs is influenced by factors such as experience, age, sources, context specific, currency, and knowledge levels.

Urquhart (1998), assert in two separate research projects (the Value and EVINCE projects) that medical staff (including nurses, consultants, doctors, and senior house officers) generally stay abreast with new materials from sources (including journals, text books, the internet and experienced colleagues). According to Urquhart (1998), these professionals rely on source such as own knowledge (cognitive), library (electronic and physical), colleagues (associates), and education. Urquhart (1998), point out that factors such as age, experience, seniority, education levels and professional role are influential in the IBs/ISBs of these professionals.

According to Case (2012), changes in the format of medical information from printed documents to internet based published electronic information results in difficulties with information access, convenience, and usability especially for nurses and other practitioners. On the other hand, Bennett et al. (2006), found that colleagues remain a common information sources in medical practice. Bennett et al. (2006), surveyed 3347 physicians to capture their ISBs. They posit that majority of physicians regularly use the internet to seek information on current research,
context specific topics, new information on a disease area, and information related to specific patient problem. According to Bennett et al. (2006), physicians view electronic media (including journals, social media, video/audio, and web sites) as increasingly important source for clinical information, with decreased use of journals, colleagues, meetings, and local continuing medical education (physical libraries). They identified context specific, accessibility, currency, source credibility, relevance, speed, time and ease of use as the main factors that influence the information-seeking and information use/task performance of physicians. However, Bennett et al. (2006), highlighted factors such as IO, time delays, lack of specific information, too slow internet systems, software complications, and searching difficulties as barriers to their ISBs. These findings are consistent with the findings of Casebeer et al. (2002).

In a study of 2200 US Office based physicians of all specialities, Casebeer et al. (2002), found that the internet is the main source of medical information. They assert that this source enhances provision of better care rather than for patient-physician communication. They identified factors such as source credibility, ease of use, accessibility, availability, speed, and time, as influential in physicians information-seeking and use behaviours. They indicated that IO, time, and lack of specific information to respond to defined questions are barriers to their ISBs.

**Information-seeking behaviour of journalists**

Another information dependant occupation is journalism. Journalists transfer any conceived, captured or found information through writing, speaking, and/or filming (Case 2012). This profession is highly information intensive to the extent that they produce information continuously (on daily if not hourly basis) hence, the important need to structure captured information as events continue to unfold. Fabritius (1999), employed qualitative methods (such as interviews and observations) to study journalist in four departments of a Finish newspaper. Her findings indicate that the influence of different “cultures” in which journalist belong manifest in the values, norms, activities and routines that make up work practice in context. According to Fabritius (1999), journalist rely on a wide range of sources (including people, documents, archives, first-hand observation, internet, and social media) to seek information. She concludes that the way journalist process news items,
together with situational factors (such as lack of time, accessibility and availability) are the strongest constraints on their ISBs.

In a study of 300 media Liberians and journalist in the UK, Nicholas et al. (2000), found that the internet is the most common information source. Nicholas et al. (2000), employed open-ended interviews and observations to investigate the use of internet media and its impact on traditional information services and channels. They indicate that extensive internet users are the midcareer reporters (including student journalists, media librarians and media journalists) rather than the youngest and the most computer literate. They suggest that senior journalist (the over 50s) rarely use the internet due to lack of training. Nicholas et al. (2000), concludes that these professionals rely mostly on electronic sources (such as online newspapers, journals, and articles). They identified key factors including age, tenure, education (training), accessibility, ease of use, quality and reliability as the factors that influences the IBs/ISBs of journalist. Nicholas et al. (2000), posits that journalist use the internet for communication, accessing statistical information, staying abreast with information, and accessing different websites. They affirmed that IO is a major factor which prohibits internet usage. On the other hand, they suggest that access to the internet increases the use of other information sources than diminish it.

Attfield and Dowell (2003), employed unstructured interview approach to investigate 25 journalists in The Times newspaper to understand the forces that motivates their IBs. They assert that the daily activities of journalists generally begin with “editors’ conference”. This happens twice-daily where journalists' are informed of the news ‘angle’ or the approach for each story, the intended word count and assignment deadlines. These constraints trigger the ISB of journalists'. As a result, journalists' approach different internal and external sources (including different online electronic news cutting services, archival materials, feature articles, personal profiles, contacts, knowledge, databases, and personal libraries) to meet their information need. According to Attfield and Dowell (2003), journalists gather information on the basis of its value with regard to a particular angle. Hence, motivating factors such as establishing an angle, newsworthiness, correspondence /truth, and originality are influential in their ISB triggers. Some key factors such as usefulness, relevance, time, age, experiences, knowledge (user judgement

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/cognitive ability), context specific, accessibility, current, satisfaction, cost, channels, and sources are found to influence journalists seeking original materials for publications. They suggest that the need for greater knowledge is associated with novices and junior journalists working “off-pitch”. Attfield and Dowell (2003), present a detailed overview of journalists’ ISB with informative findings. However, the small sample size, the unstructured interview approach, and the short lengths of interviews suggest a rather hasty piece of work that lack true representation of journalists’ ISBs. Similarly, they suggest using a ‘grounded theory’ approach to analyse the data however, there is no justification for this approach. However, their findings reflect journalists’ daily activities.

Ansari and Zuberi (2010), used questionnaires to investigate 185 journalists to establish their ISBs. Their findings indicate that journalists who work for newspapers and televisions predominantly rely on libraries for most of their information. However, professionals in the media identify information sources through common knowledge and article reviews. In addition, they found that media professionals increasingly use the internet as a fast and quick way to seek information. However, use of the internet among newspaper practitioners is high, compared to practitioners on both radio and television.

**Information-seeking behaviour of the judiciary**

This occupation cannot afford to ignore any new rulings, decisions or regulations that concern their practice. They tend to stay abreast with current published and unpublished literature. Attorneys ISBs can be compared to that of scientists (Case, 2012). Cole and Kuhlthau (2000), studied 15 early and late career attorneys to investigate their ISBs. They posits that the ability for one to link recognition of a problem to a solution is what makes them “expert” in the law. Cole and Kuhlthau identified a “four-point value-added arc” which underpins how lawyers link problems to solutions. These four points are considered as mechanisms for creating and packaging information, and using the information to influence others.

Kuhlthau and Tama (2001), employed qualitative approach to investigate eight practicing lawyers to gain a better understanding of their ISB. They indicate that lawyers generally prefer printed text to computer databases. This is because the
former enhances their chances of serendipitous and fortuitous information discovery compared to computer databases, which requires well-specified requests, and does not offer options to examine a wide range of information at a particular time. They assert that lawyers rely on printed texts because this kind of text can be arranged in a physical space, which enables them to maintain orientation in task delivery and cross-referencing of cases/information. They posit that the use of printed text enhances lawyers’ cognitive activities during task performance. Generally, lawyers access both legal and non-legal literature, electronic and non-electronic sources for majority of their information. However, they emphasised that lawyers tend to formulate subjective theories to support their daily activities especially when dealing with complex tasks. Kuhlthau and Tama (2001), identified factors such as knowledge, experience, tenure, education, context specific, accessibility, sources, channels, and time as influential in lawyers’ ISBs. A weakness in this study is the small interview sample, and lack of clarity regarding the use of either structured or semi-structured interview approach. Similarly, the lack of rigour in the data analysis compounds justification of these findings. However, the authors are commended for their comparisons of lawyers ISB to other occupations.

In her frustration to dispute the notion regarding legal research and information-seeking, Wilkinson (2001), used interviews to investigate 150 practising lawyers. She was quick to conclude that legal research should not be considered as information-seeking. However, she indicated that tasks such as administration of law practices constitute problem-solving and information-seeking activities. Wilkinson indicates that lawyers overwhelmingly prefer informal sources when seeking information although this differs in smaller organisations.

Choo et al. (2008), conducted a large comparative study of three organisations; engineering firm, law firm and public health agency to explore the link between information culture and information use. They found that law firms rely on informal internal sources for majority of their information. Interestingly, they found that public health agencies prefer to share information with parties external to their firms; however, both engineers and lawyers were unlikely to do so. They indicated that variables including mission, history, leadership, employees, traits, industry, and
national culture determines an organisation’s information culture. They assert that information culture is often shaped by the cognitive and epistemic expectations embedded in the way decisions are made and tasks are performed

**Characteristics of ISBs of professionals in different occupations**

From the above reviews, important distinctions of ISBs of different professional groups are evident. These are supported by several influencing factors. Healthcare professionals, for example, generally rely on both internal and external sources through formal and informal channels for their information. Although there is a paradigm shift in the information sources used by healthcare professionals, they predominantly rely on traditional approaches. Thus, healthcare professionals seek information from textbooks, drug texts, people (including patients and expert colleagues), the web, and the internet. These professionals prefer to share information with parties external to their organisation. Critical factors such as accessibility, convenience, and usability are influential in their ISBs. Overall, it can be concluded that healthcare professionals orientate towards associate, systematic, and/or social media ISBs.

On the other hand, attorneys generally prefer internal sources (such as printed text, colleagues, and personal knowledge) than external sources. They rely on customised information to make effective decisions. Thus, actors in the judiciary predominantly rely on informal internal sources (including journals, electronic library resources, personal knowledge, expert colleagues, personal networks, and internal library) for their information. It was found that lawyers prefer printed text to electronic/database information, since printed text enhances their chances of serendipitous and fortuitous information discoveries. Key factors such as context specific, time, and quality are found to influence their ISBs. Hence, it can be concluded that this category of professionals lean towards a serendipitous/fortuitous, systematic, associate, and/or cognitive ISB approach.

Similarly, it was found that journalists rely on a wide range of information sources and channels (including people, personal knowledge, documents, first-hand observation, internet, electronic media, and social media) to meet their information
needs. Time, accessibility, availability and other key factors are found to influence their information-seeking and information use/task performance behaviours.

In general, the reviews revealed that researchers in these areas employ a mixture of qualitative and quantitative or both methodologies to investigate the IBs and ISBs of social scientists, scientists, humanists, engineers, and other professionals (including healthcare, journalism, and the judiciary). Table 4.1 presents a synthesis of extracted facts that underpins the IB/ISB preferences of these professionals including employed research methodologies, and relevant factors that influence their information-seeking and information use/task performance behaviours.
### Table 4.1 Summary of ISB orientations and influencing factors of professionals in different occupations

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Applied research approach</th>
<th>ISB orientation/Approach</th>
<th>Influencing information seeking and/or information use/task performance factors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ISB characteristics of scientists</strong></td>
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<tr>
<td>Bichteler and Ward (1989)</td>
<td>Interviewed 56 geoscientists</td>
<td>Rely on colleagues (personal contacts –associate) and then library (systematic)</td>
<td>Time, access, quality, red tapes and technical language barriers</td>
</tr>
<tr>
<td>Noble and Coughlin (1997)</td>
<td>Questionnaire survey of 131 chemists</td>
<td>Printed journals (systematic)</td>
<td>Time, funds, and knowledge, access, sources/channels, IO</td>
</tr>
<tr>
<td>Palmer (1991)</td>
<td>Structured and semi-structured interviews of 67 agriculture researchers</td>
<td>Scan wide variety of literature, set-up alert systems to stay abreast with emerging materials, (systematic)</td>
<td>Five main groups including none-seekers; lone, wide rangers; unsettled, self-conscious seekers; confident collectors; and hunters. Later identified six subjective information-seeking styles of the researchers to include overlords, entrepreneurs, hunters, pragmatists, plodders and derelicts</td>
</tr>
<tr>
<td>Flaxbart (2001)</td>
<td>Interviewed university chemistry professors (no sample size noted)</td>
<td>Rely more on electronic journals than printed materials from the library</td>
<td>Time-savings, conveniences, easy access</td>
</tr>
<tr>
<td>Kuruppu and Gruber (2006)</td>
<td>Mixture of face-to-face interviews of 37 scientists, and two separate focus groups (agricultural and biological scientists)</td>
<td>Primary literature and electronic resources and journals (Systematic), Rely on search engines including social media as well. Rarely visit physical library space</td>
<td>Accessibility, quality</td>
</tr>
<tr>
<td>Hemminger, Lu, Vaughan, &amp; Adams, (2007)</td>
<td>Surveyed 902 academic scientists</td>
<td>Prefer to seek information and personal communications (cognitive, associate)</td>
<td>Convenience, easy access</td>
</tr>
<tr>
<td>Study</td>
<td>Methodology</td>
<td>Finding</td>
<td>Comments</td>
</tr>
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<tr>
<td>Jamali and Nicholas (2010)</td>
<td>Self-administered web-based questionnaire to survey 114 physicists and astronomers</td>
<td>Information from disciplines other than physicists (i.e. colleagues - associate), own literature (personal library - Systematic)</td>
<td>Convenience, easy access, trust, availability</td>
</tr>
<tr>
<td>Brown, (2005)</td>
<td>Electronically distributed questionnaire (49 responses) – surveyed Scientists from four disciplines; Astronomy, Chemistry-Biochemistry, Mathematics, and Physics</td>
<td>Prefer electronic database, conferences, personal knowledge, personal contact, and library systems</td>
<td>Accessibility, availability, trust and least effort, currency and awareness</td>
</tr>
</tbody>
</table>

**ISB characteristics of engineers**

<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
<th>Finding</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allard, Levine, &amp; Tenopir, (2009)</td>
<td>Observed 103 engineers in high-tech firms (both USA and India)</td>
<td>choosing the internet as their primary sources</td>
<td>Spend one-quarter of their time</td>
</tr>
<tr>
<td>Robinson, (2010)</td>
<td>Observed 78 design engineers using a novel handheld</td>
<td>Different sources and channels</td>
<td>Engineers spend approximately 56% of their working time</td>
</tr>
<tr>
<td>Study</td>
<td>Sample and Methodology</td>
<td>Findings</td>
<td>Notes</td>
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<tr>
<td>Ellis and Haugan, (1997)</td>
<td>Studied engineers and scientist in oil and gas company</td>
<td>Formal and informal channels, internal communications, person-to-person communication, knowledge, contacts within personal network, library personnel used as intermediary for literature search</td>
<td>Accessibility, availability, trust, reliability, and many more</td>
</tr>
<tr>
<td>Hirsh and Dinkelacker (2004)</td>
<td>Studied software engineers at Hewlett Packard Laboratories</td>
<td>Rely on electronic sources (i.e. the world wide web – social media) colleagues (Associate)</td>
<td></td>
</tr>
<tr>
<td>Chakrabarti, Feineman,&amp; Fuentevilla, (1983)</td>
<td>Managers, scientists and engineers</td>
<td>Channels and sources; availability and ease of use</td>
<td></td>
</tr>
<tr>
<td>Pinelli (1991)</td>
<td>Surveyed 2309 aeronautics engineers</td>
<td>Technical report (Systematic), colleagues (associate)</td>
<td>Accessibility, source, relevance, quality and reliability, ease of use, availability, expenses, familiarity</td>
</tr>
<tr>
<td>Holland and Powell (1995)</td>
<td>Longitudinal investigation of 60 engineers</td>
<td>Word of mouth (associates), own document collections and use of library or databases, “personal knowledge” (cognitive), “personal experimentation”</td>
<td>Sources</td>
</tr>
<tr>
<td>Yitzhaki and Hammershlag (2004)</td>
<td>Surveyed both academic scientists and industrial software engineers (233 participants)</td>
<td>Personal knowledge (Cognitive), library (systematic), and search engines (social media)</td>
<td>Demographic factors including age, education, seniority, research type and use. accessibility, sources, useable,</td>
</tr>
<tr>
<td>Study (Year)</td>
<td>Methodology</td>
<td>Findings</td>
<td>Demographic/Contextual Factors</td>
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<tr>
<td>Kwasitsu (2003)</td>
<td>Applied structured survey questionnaire and by semi-structured survey</td>
<td>People (associate), memory/knowledge (cognitive), corporate Libraries (systematic), and the internet (e.g. search engine or social media)</td>
<td>Demographic factors (such as higher educational qualifications, work role, experience, tenure, task, sources, complexity, accessibility, availability, relevance, reliability, currency, ease of use, technical language, personal mastery, cost, and technical quality)</td>
</tr>
<tr>
<td>Wallace and Ahmed (2003)</td>
<td>Two separate observational studies in the same aerospace design engineers (first group were 12, second group were 12)</td>
<td>Colleagues (Associate), cognitive ability, experienced engineers adopted specific strategies (systematic)</td>
<td>Experience, sources, accessibility, speed, confidence, trust, social and personality factors</td>
</tr>
<tr>
<td>du Preez and Fourie (2009)</td>
<td>Employed semi-structured time-line interviews to study 11 consultant engineers</td>
<td>Personal knowledge (cognitive), personal files (systematic), and other people (associate), Internet, File Transfer Protocol (FTP) sites and digital cameras (social media)</td>
<td>Individual attributes, circumstance, and demographic factors including age, experience, geographic location, professional role, personal factor, and task related factors (such as context, frequency predictability, complexity, and importance)</td>
</tr>
<tr>
<td>Leckie, Pettigrew and Sylvain, (1996)</td>
<td>Meta-review of literature on the ISB of engineers, healthcare professionals and lawyers</td>
<td>Colleagues</td>
<td>Working condition, work role, experience, area of speciality, tenure and task complexity, awareness, sources, outcome</td>
</tr>
<tr>
<td>Anderson, Glassman, McAfee, and Pinelli, (2001)</td>
<td>Questionnaire survey to study 872 aerospace engineers and scientists</td>
<td>Personal contacts or networks (associate), oral communication (cognitive), libraries (systematic),</td>
<td>Time, cost, the role of the librarian, accessibility and availability,</td>
</tr>
<tr>
<td>Source</td>
<td>Description</td>
<td>Isb Characteristics</td>
<td>Challenges</td>
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<td>----------------------</td>
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<tr>
<td>Bouazza (1989)</td>
<td>Scientists, social scientists, and humanists</td>
<td>Rely more on formal information sources than informal sources,</td>
<td>Intervening factors such as availability, accessibility, quality, cost, and ease of use; demographic factors including seniority, experience, speciality, education, professional orientation and the subjective impression of the users</td>
</tr>
<tr>
<td>Ellis (1989)</td>
<td>Studied 20 social scientists (six stages of ISB process include starting, chaining, browsing, differentiating, monitoring, and extracting)</td>
<td>Informal contacts were the primary sources</td>
<td>Sources /channels, context specific, quality, relevance, quantity, useable, accuracy,</td>
</tr>
<tr>
<td>Meho and Tibbo (2003)</td>
<td>Employed structured and semi-structured electronic mail interviews to study 60 social sciences from 14 different countries</td>
<td>Rely heavily on fieldwork data, and on types of information that usually are difficult to find except online or in national, special, and/or well-funded research university libraries. Books, journal articles, and newspaper articles Personal collection, fieldwork, other libraries, and archives than their own university library collection</td>
<td>Obstacles to IB/ISB research in stateless nation: Lack of funds, sources of information, accessing, networking, verifying, and information managing, subject indexing (i.e. subject headings, index terms, and classification), difficult conditions of conducting research in the field. Context, identify (country of publication), accuracy, objectivity, and reliability</td>
</tr>
<tr>
<td>Krampen, Fell and Schui, (2011)</td>
<td>Employed online survey data to elicit ISB of 298 psychologists in German speaking countries</td>
<td>Rely more on self-help and self-teaching (i.e. cognitive information-seeking)</td>
<td>Demographic factors including age, role, material mastery (expertise/experience)</td>
</tr>
<tr>
<td>Source</td>
<td>Methodology</td>
<td>Characteristics</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Cole (1998)</td>
<td>Employed grounded theory to study 45 PhD students</td>
<td>Rely on their cognition to seek information</td>
<td></td>
</tr>
<tr>
<td>Westbrook (2003)</td>
<td>Employed qualitative study by using open ended</td>
<td>Internet, books, journals, government documents, people, reference librarians,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>questionnaire survey via post was sent to 215</td>
<td>databases, the internet, grey/archival material, general exploration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>scholars in women studies</td>
<td>Accessibility, accuracy, level of qualification, availability, experience, education, time, sources, channels, Unsatisfactory, Quantity, quality, library use, and keeping up with relevant literature.</td>
<td></td>
</tr>
<tr>
<td>Haug (1997)</td>
<td>Studied 12 physicians</td>
<td>local textbooks and colleagues</td>
<td></td>
</tr>
<tr>
<td>Gorman (1999)</td>
<td>Employed semi-structured interviews to study clini</td>
<td>Library and digital sources, textbooks, drug texts, and strong preference for people (colleagues)</td>
<td></td>
</tr>
<tr>
<td>Osheroff et al. (1991)</td>
<td>Not indicated</td>
<td>Medical records, published sources, personal knowledge</td>
<td></td>
</tr>
<tr>
<td>Urquhart (1998)</td>
<td>Questionnaires to elicit response from 486 of 713</td>
<td>Biomedical and social sciences literature, patient records, personal knowledge, journals, text books, the internet and experienced colleagues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>medical staff (VALUE Project) and 311 from 776</td>
<td>Experience, seniority/tenure, educational qualifications, professional role</td>
<td></td>
</tr>
<tr>
<td>Bennett et al. (2006)</td>
<td>Employed questionnaire survey to study 3347</td>
<td>Internet, electronic media (journals, video tape, audio tape, web sites), and colleagues (meetings)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>physicians</td>
<td>Experience, context specific, Accessibility, currency, source credibility, relevance, access, speed, and ease of use (barrier – IO, lack of specific information, and navigation or searching difficulties).</td>
<td></td>
</tr>
<tr>
<td>Casebeer et al.</td>
<td>Employed questionnaire</td>
<td>Internet, electronic media (journals, video tape, audio tape, web sites), and colleagues (meetings)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Source credibility, quick,</td>
<td></td>
</tr>
</tbody>
</table>

**ISB characteristics of Other Professionals (including healthcare, journalism, and lawyers)**

- Ease of access, trust, availability, reliability, sources/channels
- Demographic background: Age, gender, speciality, accessibility, knowledge, patient factors such as severity of illness, practice setting, number of patient seen, quality, success, quantity, curiosity
- Experience, seniority/tenure, educational qualifications, professional role
- Context specific, Accessibility, currency, source credibility, relevance, access, speed, and ease of use (barrier – IO, lack of specific information, and navigation or searching difficulties).
<table>
<thead>
<tr>
<th>Year</th>
<th>Methodology</th>
<th>Participants</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2002)</td>
<td>Survey to study 2,200 US Office based physicians</td>
<td>Video tape, audio tape, web sites, and colleagues (meetings)</td>
<td>Accessibility, availability, and ease of use</td>
</tr>
<tr>
<td>Gruppen, Wolf, Van Vorhees, &amp; Stross, (1988)</td>
<td>Surveyed 387 primary care physicians</td>
<td>Personal case related knowledge (cognitive), clinical vignettes or case histories</td>
<td>Experience, tenure, age, education levels, sources/channels, currency, accessibility, availability, trust</td>
</tr>
<tr>
<td><strong>Journalists</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabritius (1999)</td>
<td>Employed qualitative methods to study journalist</td>
<td>People, documents, first-hand observation, internet, social media</td>
<td>Time*, accessibility and availability</td>
</tr>
<tr>
<td>Nicholas et al. (2000)</td>
<td>Open-ended interview questionnaires and observations to study 300 librarians and journalists</td>
<td>Mostly internet</td>
<td>Access, currency, age, tenure, sources, experience, training/education, ease of use, quality, reliability,</td>
</tr>
<tr>
<td>Ansari and Zuberi (2010)</td>
<td>Employed questionnaires to investigate 185 journalists</td>
<td>Libraries, common knowledge and review articles, internet</td>
<td>Fast and quick, Sources, knowledge</td>
</tr>
<tr>
<td>Attfield and Dowell (2003)</td>
<td>Used unstructured interview of 25 Journalist in The Time (London)</td>
<td>Internal and external sources, electronic news cutting services, archival materials, feature articles, personal profiles, contacts, databases, personal libraries, user judgement/ cognitive ability</td>
<td>Age, experience, tenure, as usefulness, relevance, time, experiences, knowledge, context specific, accessibility, current, satisfaction, cost, channels, and sources</td>
</tr>
<tr>
<td><strong>Lawyers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cole and Kuhlthau (2000)</td>
<td>Studied 15 attorneys</td>
<td>Reliance on personal knowledge, colleagues, databases and libraries</td>
<td>Age, experience, tenure</td>
</tr>
<tr>
<td>Kuhlthau and Tama (2001)</td>
<td>Not clear what was employed to elicit information from 8 lawyers</td>
<td>Serendipity, systematic, cognitive ISBs</td>
<td>Experience, context specific, timely and quality, effectiveness</td>
</tr>
<tr>
<td>Wilkinson (2001)</td>
<td>Investigate 150 lawyers</td>
<td>Informal internal sources</td>
<td>Sources</td>
</tr>
<tr>
<td>(Chun Wei Choo et al. 2008)</td>
<td>Used questionnaire to solicit the views of 650 persons in a law firm, engineering firm, and a public health agency</td>
<td>Informal internal sources (i.e. personal networks)</td>
<td>Sources</td>
</tr>
</tbody>
</table>
4.3 INFORMATION BEHAVIOUR STUDIES IN CONSTRUCTION

The construction process requires reliable and up-to-date information for successful project delivery and organisation management. However, the multidisciplinary skills of professionals tend to limit effective seeking, transfer and flow of information. Cheng et al. (2001), suggest that multidisciplinary skills limit the scope of cooperation between actors. This is due to lack of open lines of communication protocols, inappropriate communication channels, and unexpected communication breakdown (Cheng et al., 2001). Project actors require reliable and context specific information in almost real time to execute projects, resolve problems, and/or manage critical issues. To achieve such reliability, actors require a relative ease of access to information. However, the manner in which information is obtained and disseminated through exposure of actors to multiples of fragmented sources and channels is linked to IO (Allen and Wilson, 2003; Bawden and Robinson, 2008; Elliott, 2002). Some researchers argue that actors’ exposure to multiple sources and channels can be beneficial to their information-seeking and use behaviours. This is because different sources and channels actually help to reduce gaps in acquired information from any one source (Kwasitsu, 2003; Aurisicchio et al., 2012; Robinson, 2010). Patrashkova-Volzdoska et al. (2003), posits that too much information can be as detrimental as too little information; hence, moderate information and communication levels leads to effective performance. Dzokoto et al. (2013), posits that organisation can adopt a SMART push information capturing technology to control the problem of IO.

Information generally comprises of facts; however, its value changes as it moves from person-to-person, person-to-system and system-to-system. This movement changes its meaning and interpretation. Bateman and Snell (1999), assert that only 20% of information disseminated down the hierarchy from top management reaches their subordinates. According to Yunjie et al. (2006), lack of effective ISBs in modern organisations affect performance, ability to cope with uncertainty, knowledge acquisition, and upkeep of comfortable social relationships. Similarly, the process of active or passive information seeking from numerous sources is found to take longer, and is cognitively demanding (Robinson, 2010).
Researchers have established that critical factors such as time savings, information relevance, technical quality, and ease of access are key reasons behind actors information sources and channels selection (Fidel and Green, 2004; Pinelli, 1991). However, research in this area has failed to establish the phenomena behind actors’ information ISB preferences.

Makri and Warwick (2010), applied grounded theory methodology to nine architecture and urban design students to investigate their ISBs. They discovered that architecture students perform many interactive IBs/ISBs similar to academics and practitioners in other disciplines. Some behaviours discovered include exploring and encountering, and visualising/appropriating information. Their observations revealed the importance of information use behaviours, communication behaviours and multimedia materials for architectural design projects. According to Makri and Warwick (2010), although these students are exposed to many electronic resources and databases including RIBA digital library, and institutional library catalogues; they prefer to use internet search engines to seek majority of their information. They indicate that architecture students often discover vital information through serendipitous/fortuitous encounters. Makri and Warwick (2010), point out that these students display a wide variety of low level IBs (such as accessing, chaining, monitoring, surveying, searching, browsing, and encountering) that can be placed under five high level IBs (such as finding, assessing, interpreting, using, and communicating). Although conclusions can be drawn to the factors that influence the ISBs of architecture students, the study fails to identify these factors, and fall short of generating a full theory.

The diverse composition of construction organisations is such that there is a huge gap in project actors ISBs. As the sector continues to change rapidly, it is practical for design development operations to respond in order to meet clients' needs and expectations. This paradigm shift has resulted in actors' use of any means to meet their information requirements. Whereas some prefer face-to-face (associate) or library/database (systematic) information-seeking approach, others turn to the web/internet (social media) or accidental/incidental (serendipity/fortuitous) information-seeking process (Erdelez, 2005; Makri and Warwick, 2010). In other situations, actors rely on their knowledge (cognitive ability) (Sutcliffe and Ennis,
1998) to meet their information needs. These indicate that the ISB process of construction project actors’ is consistent with the ISB orientations of professionals in different occupations (such as scientists, social sciences, humanities, journalists, lawyers, healthcare and engineering). These approaches may occur at different phases of task performance within the project environment, since levels of required information vary from stage-to-stage.

4.3.1 Information-Seeking Approach of Construction Project Actors
Composition of the construction sector is such that different professionals with variety of skills from different backgrounds come together to form the project team. These actors work in the PLC. Generally, the sequence of operations in the PLC is such that the output of one phase becomes the input for the other. This process indicates interdependency of information generation. The quality and quantity of information required, and the ISBs of actors during the PLC vary. For example, at the idea conception phase, majority of actors primarily rely on their memory, intuition, knowledge and experience to generate information. Some actors may rely on accidental/incidental information discovery and/or social media sources. Others consult other internal sources (such as expert colleagues, experienced seniors, databases, and trade documents) for verification, but the majority of their information at this stage is cognitive dependent. As the project progresses, these actors adopt other ISB preferences to capture context specific information. Hertzum and Pejtersen (2000), posits that engineers rely on colleagues and internal documents to meet their information needs. However, majority of information from colleagues is unstructured and often based on tacit knowledge and experiences. Evidence suggest that actors in information rich environments spend majority of their time looking for context specific information from repositories containing unstructured information (Hertzum, 2002; Robinson 2010).

Certainly, communication between actors becomes critical, as each actor possess different set of information in the project organisation (Edum-Fotwe et al., 2001; Sebastian, 2011). Actors new to the project team are often overwhelmed with key responsibilities. These actors although may have remarkable demographic factors; they often require new set of task delivery skills as well as technical and social information to adjust to their new environment (Miller and Jablin, 1991). Miller and
Jablin (1991), posits that new employees can compensate their inadequacies and reduce their level of uncertainties by seeking-information about performance expectations and organisational or environmental issues. Morrison (1993), found that new employees prefer to adopt indirect approach (such as glean from cues or close acquaintances) to seek information, except when obtaining technical or context specific information. Certainly, these actors tend to seek task performance related information from their superiors, but social and normative information from colleagues/peers (Morrison and Vancouver, 2000; Morrison, 1993).

Generally, project designers work in isolated ‘silos’ whilst ‘construction’ actors struggle to understand design compositions. However, in a global project, collaboration of distributed multi-disciplinary teams working from different geographical locations is inevitable. This implies effective information-seeking and dissemination is paramount to achieving project success (Faraj and Alshawi, 2004). Anumba et al. (2008), posits that effective communication of project information between disciplines across different time zones and cultures can only be achieved if the “semantics of the information are adequately captured and transmitted”. However, this cannot be achieved through paper-based information-seeking and sharing methods. Hence, large construction organisations have resulted to computer integrated web-based information management tools (Chen and Kamara, 2005; Gyampoh-Vidogah, 2003). Some commonly used computer integrated web-based information management systems includes the project extranet, Project Specific Web Site (PSWS) and Common Data Environment (CDE). These are dedicated network systems, which provide a platform to support actors IB/ISB activities. Examples of such systems or technology providers includes Aveva (2015), Asite (2014), 4projects (2014), Autodesk Constructware (2014), Conject (2014), e-BUILDER (2014), and Meridian Systems (2014). Although these systems tend to support distributed actors to seek and disseminate project information, information shared on the extranet is still at document level and managed in a vertical hierarchy (Anumba et al., 2008).

A close observation of actors ISBs suggests a cyclical but linear process to seek information (see figure 4.1). With this process, actors adopt different ISB approaches depending on personality styles (McCrae and Costa, 1997; Tidwell,
2005), personal preferences, stage of the project, and magnitude and context of information required. It is envisaged that active IB/ISB of actors can contribute to context specific information accessibility and dissemination, integrated project delivery, effective communication, time and cost savings; if their ISB preferences are defined and supported by systems (Dzokoto et al., 2014). Thus, by formulating a framework that underpins actors ISB orientations, appropriate level of context specific information can be channelled to actors through integrated systems. Figure 4.1 present a conceptual framework of the cyclical nature of project actors' ISB.

Irrespective of ISB preference, actors generally follow a cyclical approach to capture information. Zerbinos (1990), posits that information-seeking occurs when there is a gap in knowledge. Figure 4.1 shows that actors’ information-seeking process is triggered by a need for information. At this stage, the actor examines their personal knowledge, and experiences, and then advances to other available sources and channels (both internal and external). The actor categorises available information sources and channels in relation to information quality, value and delivery time. During these stages, certain information-seeking and information use/task performance factors are activated. These factors generally influence actors’ ISB preferences. As the level of need increases, the demand for information increases. The intensity of the process depends on the context, the amount of information required, and time availability. Hence, key demographic and situational influencing factors becomes a priority. At this point, the actor sifts available information to capture context specific information. The actor uses the captured

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**Figure 4.1 Conceptual framework of cyclical information-seeking process of project actors [adapted from Dzokoto et al. (2013)]**
information to execute a task/project. At the later phases, key information use/task performance factors determine the applicability level of the captured information. This helps to determine levels of satisfaction in relation to the outcome of the task. Depending on the degree of information required, the process is repeated.

4.3.2 Construction Project Actors Information Source/Channel Selection

Generally, actors produce and interpret project information, documents and activity commands, make queries, comments and interests on documents. They rely on numerous information sources and channels to generate project information. Chakrabarti et al. (1983), posits that scientific and technical information systems consist of three components: sources, channels and content. These components are interdependent, in that some sources can serve as channels to contain the kind of information (content) required. Within this context, sources are the medium through which knowledge or information is stored, captured and presented. Whereas a channel is the medium through which information transfer occurs between stations including physical technologies or systems as well as people. And Content refers to the detailed constituent or knowledge component of information.

Yunjie et al. (2006), posits that information sources should not be confused with information content, since the same information can be available from multiple sources. Although this argument is true, it is also true that information content underpins the information sources. Some studies have used the terms channels and/or sources interchangeably to mean the same thing (Byström and Järvelin, 1995; Hardy, 1982). Hence, for the purpose of this study, information sources/channels is used interchangeably.

Extant literature suggest that project actors seek information from different sources: (for example; personal or impersonal, and internal or external) (Byström and Järvelin, 1995; Gerstberger and Allen, 1968; Hyldegård, 2006; Kuhlthau and Vakkari, 1999). Often, internal and external sources are put together to promote new developments, new technologies, provide real and direct networking opportunities to develop collaborative relationships, and corroborations. This is beneficial when the channels and sources are used effectively and that information transfer occurs through the right source/channel to the right actor (Spink et al.,
2002). However, it becomes a setback when information deliveries are unstructured, unregulated and leads to delays and IOs.

Cheng et al. (2001), posits that the use of several channels is appropriate in many circumstances for important or complicated information. According to Cheng et al. (2001), the choice of channels depends on four key criteria: (i) amount of information, (ii) instant information, (iii) effective communication, and (iv) efficient communication. Thus, actors’ consider all four criteria simultaneously in order to select the most appropriate channel/sources for the required information. Evidence suggest that actors usually choose their channels and sources based on key factors including information context, accessibility, reliability, delivery time (Pinelli, 1991; Kwasitsu, 2004; Fidel and Green, 2004; Savolainen, 2007; Robinson, 2010).

Multiple internal channels/sources such as colleagues (face-to-face), emails, meetings/briefings, technical documents, trade documents, reports, and intranet systems forms the initial point of call to seek information (Leckie et al., 1996). However, these actors are inevitably exposed to the external channels/sources, (such as internet, social media, electronic sources, emails, technical/trade magazines, journals, professional bodies, friends/colleagues, and experts on other specific fields). Table 4.2 present the sources/channels, and contents that underpins actors’ ISBs in project organisations.

Table 4.2 Components of project actors information sources, channels and content [adapted from Chakrabarti et al., (1983)]

<table>
<thead>
<tr>
<th>Sources</th>
<th>Contents</th>
<th>Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books (e.g. references, texts,</td>
<td>New knowledge (e.g. theoretical, basic research,</td>
<td>Electronic (e.g. emails, texts, cloud) and non-electronic (e.g.</td>
</tr>
<tr>
<td>handbooks, professionals)</td>
<td>developmental research, applied research, production technology)</td>
<td>Personal collection/library)</td>
</tr>
<tr>
<td>Periodicals (e.g. trade</td>
<td>Index to knowledge (e.g. index/printed information, index/consultants)</td>
<td>Telephone (within and outside the organisations)</td>
</tr>
<tr>
<td>magazines, technical manuals)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scientific journals, newspapers,</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

118
<table>
<thead>
<tr>
<th>People (e.g. work groups, expert colleagues, consultants, other contractors /subcontractors)</th>
<th>Derived knowledge (e.g. abstracts, summaries, reviews)</th>
<th>Library (within and outside organisations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Films (e.g. discs, DVDs, microfiche, other microforms.)</td>
<td>Other types of knowledge (e.g. facts, how to create information, current awareness, data)</td>
<td>Information specialists (within and outside organisations)</td>
</tr>
<tr>
<td>Magnetic media (e.g. machine readable tapes, audio/video tape, discs)</td>
<td>Other types of knowledge (e.g. facts, evidence, how to create information, current awareness, data)</td>
<td>Peoples (e.g. cognitive/memory, face-to-face, word of mouth.)</td>
</tr>
<tr>
<td>Others (e.g. proceedings, technical reports, white papers, memoranda, government other print and papers)</td>
<td>New knowledge (e.g. theoretical, basic research, developmental research, applied research, production technology)</td>
<td>Events (e.g. conferences, lecturers, meetings, breaks, briefings, memoranda, letters, white papers, work sheets, work instructions)</td>
</tr>
<tr>
<td>Internet (e.g. company websites, search engines, online catalogues, etc.)</td>
<td>New knowledge (e.g. basic &amp; applied research, theoretical, developmental research, production technology)</td>
<td>Social media (e.g. cloud, LinkedIn, Facebook, twitter, YouTube, video conference, webinars)</td>
</tr>
<tr>
<td>Social media (e.g. LinkedIn, Facebook, twitter, YouTube, video conference, webinars, televisons)</td>
<td>New knowledge (e.g. basic research, theoretical, applied research, developmental research, production technology)</td>
<td>Internet (e.g. company websites, search engines, online catalogues)</td>
</tr>
<tr>
<td>Events (e.g. conferences, lecturers, meetings, briefings, breaks, workshops)</td>
<td>New knowledge (e.g. theoretical, basic research, developmental research, applied research, production technology)</td>
<td>Others (e.g. proceedings, technical reports, memoranda, government white papers, other print and papers)</td>
</tr>
</tbody>
</table>

Concomitant to these channels/sources and contents is the increased availability of rapid electronic information, which contributes greatly to the increasing volume of information exposed to actors. There is no evidence to suggest that the internet has exacerbated the IO problem. However, evidence suggests that due to open access to the internet, information transfer is done at a fast rate which overloads actors (Edmunds and Morris, 2000; Kwasitsu, 2003). The problem of IO arises when there
are no structures to manage, monitor and control information. This may results in
actors’ exposure to both relevant and irrelevant information through multiple
channels and sources (both electronic and non-electronic). As a result, relevant
available information may go unused (Makri and Warwick, 2010; Wilson, 1996).
Similarly, IO may also come about through rapid increase in information variations
due to work demands (Bawden and Robinson, 2008; Bawden et al., 1999).

As indicated, actors acquire information through the traditional print and archival
sources and open forum. Another important factor that concerns actors’ information
source selection is accuracy and quality. However, since the open web source and
other electronic sources are unregulated and unfiltered, research suggest that
evaluating and selecting a quality source is more of a challenge than ever (Ellis et
al., 2002; Hertzum, 2002). As a result, actors do not necessarily choose sources
based on accurate information provision, but on how easy to acquire and use the
information than the quality and accuracy factors.

Identification of particular information source depends on the source type, context,
relationship between the seeker and the source, and the context of task/project
execution (Xu et al., 2006). Gerstberger and Allen (1968), found that engineers
limitation to selecting good information sources is linked to lack of understanding
they get from majority of engineering literature. This is because of its technical
(sophisticated mathematical content) language composition. They found that lack of
accessibility to specific information contribute to limited use of key information
sources. According to Gerstberger and Allen (1968), engineers will simply not be
attracted by improved quantity or quality of information contained in the library, but
by pushing the library to them (see figure 4.2). They emphasised that channel
quality and accessibility is the most important determinant factor since experience
in the use of a familiar channel enhances its accessibility. Trust, source quality and
accessibility are perceived as dominant factors in actors’ information source
selection rather the cost (Xu et al., 2006; Hertzum et al., 2002).

Actors often use information channels and sources that require the least amount of
effort even if it compromises information quality (Hertzum et al., 2002; Hertzum and
Pejtersen, 2000). It is evident that the least effort principle (Zipf, 1949) underpins
actors' IB/ISBs in task delivery (Courtright, 2007; Hertzum and Pejtersen, 2000; King, 1994). This is an affirmation of the push technology (Edmunds and Morris, 2000; Hertzum, 2008; Lowe et al., 2004) where information is pushed to the actor according to their information needs/profile. The push technology in figure 4.2 depicts the IB/ISB of construction project actors, where there is no integrated and/or coordinated effort of key decision makers to seek or disseminate information during task performance. According to Gerstberger and Allen (1968), this is linked to the premise that engineers want to apply minimum effort to acquire appropriate information. However, the push technology may not guarantee the right amount and quality of information. This is because it eliminates key actors from active information-seeking process. Thus, the push technology focuses on certain personnel (such as information control/coordinator/manager) to manage the information-seeking process however, these personnel may lack knowledge of the context of information required.

![Figure 4.2 The push technology system [adapted from Hertzum (2008)]](image)

### 4.3.3 Characteristics of Construction Project Actors Information-Seeking Approach
The working culture of AEC heavily depends on creating and handling data and information especially during the design process. For example, design engineers explore different design approaches and opportunities, and abandon other versions of design concepts before arriving at the final design. Each of these approaches
require designers to seek, share and use information. Often design engineers spend more time digesting captured information to extract relevant aspects from the bulk. Generally, design engineers spend majority of their time pursuing IB/ISB activities than designing. This contributes to the limited time and speed to successful project delivery process (Robinson, 2010; Aurisicchio et al., 2009; King, 1994). In the extant literature, Robinson (2010), confirmed King’s (1994) affirmation that 40 to 66% of engineers working time is spent processing, communicating and disseminating information. Lowe et al. (2004), revealed that design engineers spend 21% of their working time searching for and absorbing information. These indicates that project actors require context specific information directed to them based on their information-seeking preferences/orientations. For example, a project manager may require up-to-date information about stakeholder requirements, status report, planning details, and performance report. Similarly, a client may require specific information about project progress. Apart from these, an effective project manager needs to have a good knowledge and information about the technical aspects of a project. Hence, if the available information is presented in a well-structured and timely manner, evidence suggests that actors are able to make effective decisions regarding a project (Hanka and Fuka, 2000).

Therefore, synthesis of the IBs/ISBs identified in extant literature of professionals across various occupations and disciplines presents important evidence of ISB categories amongst construction project actors. For example Foster (2004), sees cognitive ISB as contextual interaction during actors information-seeking process. On the other hand, Byström and Järvelin (1995), acknowledges that extant research and literature has however failed to identify these ISB preferences. Hence, this study categorises actors' ISB preferences into Cognitive, Systematic, Associate, Serendipity/Fortuitous and Social Media. Table 4.3 present actors ISB categories. These Information Seeking Behaviour Types (ISBTs) represent actors' information-seeking orientations or preferences through sources/channels influenced by demographic factors (Kwasitsu, 2003; Yitzhaki and Hammerslag, 2004), situational factors (Byström and Järvelin, 1995), intervening variables (Chakrabarti et al., 1983; Pinelli et al., 1991; Wilson, 1999) and quality factors (Eppler, 2006).
Table 4.3 Extracted Project Actors Information-Seeking Behaviour Types (ISBTs)

<table>
<thead>
<tr>
<th>Information-Seeking Behaviour Types (ISBTs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Cognitive ISBT</td>
</tr>
<tr>
<td>ii. Associate ISBT</td>
</tr>
<tr>
<td>iii. Systematic ISBT</td>
</tr>
<tr>
<td>iv. Serendipity/Fortuitous ISBT</td>
</tr>
<tr>
<td>v. Social media ISBT</td>
</tr>
</tbody>
</table>

4.4 SUMMARY
The unique types of ISBs of professionals in different occupations extracted in extant literature are evident amongst actors’ in construction organisations and project environments. This is because of the nature and composition of construction organisations and the information activities of actors’ in this sector. Significant among the identified types of actors’ ISBs are Cognitive, Systematic, Associate, Serendipity/Fortuitous and Social Media. In addition, some important influencing factors that underpin the information-seeking and information use/task performance behaviours of these professionals have been revealed.

The subsequent chapter reviews the ISBTs of actors in the construction sector to reveal their distinguished characteristics and the factors that influence such ISBTs. This forms the foundation for qualitative inquiry, framework conceptualisation, hypotheses formulation, and the main quantitative data inquiry.
CHAPTER 5: INFORMATION-SEEKING BEHAVIOUR TYPES

5.1 OVERVIEW

Emerging themes from the literature review shows that project actors seek information in different ways. Whereas some prefer face-to-face (Associate ISBT) information-seeking, others choose Serendipitous/Fortuitous ISBT. In other situations, actors follow a more traditional (Systematic ISBT) approach to seek information whilst others prefer to rely on their knowledge, memory and intuition (Cognitive ISBT). Similarly, the advancement of technology, demand for big data, behaviour changes and convenience encourages other professionals to use social media sites (Social Media ISBT) to seek information. All these ISB preferences may occur at different phases of the project delivery process depending on task complexity and other factors.

During the PLC, the context, magnitude and quality of required information vary. At the idea conception stage, actors primarily rely on their cognitive capability to seek and create information. Some actors may consult other information sources for verification. Similarly, other actors may employ other information-seeking preferences to investigate different factors (such as environmental, situational, and context) to test the viability of the project idea. This stage requires actors to engage with colleagues and other sources/channels for information. In addition, actors may also use libraries (physical or electronic) or databases or archival materials, the internet, social media communities, and/or accidental or incidental information-seeking approaches to seek third party information. As the project advances through planning, design development and the construction phases, actors’ experiences, skills and knowledge become vital, since both internal and external stakeholders become the primary information sources. Hence, high level of teamwork, collaboration and integrated operations are vital. Systematic information-seeking, Associate information-seeking and Social Media information-seeking approaches may be employed (depending on the complexity of the project) at these stages. This leads to completion and/or termination of the project where other information-seeking preference(s) are employed. Captured information from different phases of the project are consolidated and presented for client consumption. This may require the application of different information-seeking approaches to seek appropriate information to hand over to the client.
Therefore, this chapter presents discussions of the five ISBTs identified amongst construction project actors and the factors that potentially influence such behaviours. A conceptual framework is developed to illustrate the ISB composition of actors in construction organisations. The chapter finally present formulated hypotheses for quantitative inquiry.

5.2 ACTORS INFORMATION-SEEKING BEHAVIOUR TYPES

Project actors seek information for various reasons where they demonstrate different behaviour patterns that influence their ISBs. Traditionally, actors rely on books, library catalogues, trade documents, colleagues/friends, and accidental/incidental approach to meet their information needs. However, extensive review of extant literature show that actors demonstrate varied ISB preferences based on numerous characteristic reasons. For example, actors exposed to the internet via IT systems or gadgets tend to seek all kinds of information from different sources/channels. Similarly, actors who subscribe to social media sites (such as blogs, YouTube, Twitter, LinkedIn, Facebook and others) tend to seek information (both social and professional) to support their daily activities. Environmental and demographic factors may also influence actors’ preference to seek information from these sources/channels. For example, actors who work in teams with experienced colleagues or specialists are likely to consult these colleagues or experts for information. Other group of actors may apply keyword search or Boolean search, visit library catalogues or databases to seek information. This category may work in organisations or environment where information management and information control heavily underpins organisational culture to the extent that they follow a systematic and/or structured approach to seek information. Therefore, during any IB process, actors exhibit different ISB preferences at different phases of the PLC to capture appropriate information.

During these phases, different skills may be required within the context to adopt a preferred ISBT to capture appropriate level of information within a specified period. As actors’ switch into the information-seeking process, they consciously or subconsciously advance through different ISBTs to capture the required information. Whereas an actor may have a unique preference, it is also possible for the same actor to demonstrate other ISBTs during the information-seeking cycle. Therefore,
by profiling actors ISB preferences, organisation would be able to develop strategies, systems and key avenues to support and facilitate actors IB process. This can potentially improve performance, save time, minimise process duplications, and control the problem of IO. The following sections discuss the five ISBTs.

5.2.1 Cognitive Information-Seeking Behaviour Type (CISBT)
The word cognitive originates from Medieval Latin cognitivus, from cognit in the late 16th century, which literally mean ‘known’, from the verb cognoscere. This word has undergone extensive empirical research in the Humanities, Social Sciences, LIS, and Knowledge Management areas. Notable studies include Social Cognitive Theory (Bandura, 2001; Stone, 1993), Cognitive Authority (Wilson, 1983), Cognitive Learning Styles (Rayner and Riding, 1997; Rayner, 2001; Ford et al., 2002), and Cognitive Work Analysis (Rasmussen et al., 1990). These concepts demonstrate actors’ IB/ISB in context and the reasons behind their actions. Most importantly, it focuses on actors mental activities at different phases of the reasons for which they seek information. Cognitive styles are consistent characteristics displayed by actors who adopt a particular information processing strategy (Ford et al., 2002; Thomas and McKay, 2010; Wilson, 1999; Ingwersen, 1996; Ford, 2004).

Other dimensions of cognitive information processing styles identified in literature focuses on peoples learning approaches and decision making process. According to Pask (1988), people use two basic approaches (Holist and Serialist) in their learning process. The holist adopt a comprehensive approach to learning by investigating interrelationships between different subject matters at the initial stages of the learning process to develop a general concept and then narrow the concept to specific detail. The serialist uses their local learning approach to adopt a systematic investigative process to examine one thing at a time whilst concentrating on separate topics and the sequences linking them. Both approaches indicate the use of cognitive information-seeking process at different levels or phases of learning to achieve a required outcome.

Witkin et al. (1977), coined the terms field dependence and field independence styles in their investigation of human activity from basic perception to career choice of global/analytical differences. The field independence cognitive style relate to the
serialist approach, in that it follows a systematic and structured learning approach; whereas the field dependence style rely on direction and guidance from others to achieve the learning process. Ford et al. (2002), posit that actors categorised as field dependent prefer instructor led approach to learning than hypothesis testing approach, which is favoured by field independent learners.

According to Wilson (1983), people generate knowledge in two different ways during the cognitive authority process; (1) based on first-hand experience, and (2) on what they have learned from others (second-hand experience). People’s first hand-experience is interpreted as knowledge conceived intuitively to include their interpretation and understanding of what is around them; whilst second-hand experience relate to knowledge gained through studies, and experiences. Primarily, actors’ first approach to information creation is through intuition/memory/mental activities. Generally, actors conceive new ideas through their thought process to create new knowledge to extract information for use. Hence, cognitive information-seeking is a person centred process that focuses on mental strengths and mental activities to seek and use information through personal knowledge and experience. This is in contrast to the affective phenomena which is also a person centred learning process; however, the latter focuses on affective dimensions (Christopher et al., 2012; Hammond et al., 1987; Borkovec and Ray, 1998; Kuhlthau, 1991). Hence, this study defines Cognitive ISBT as the thought process of seeking through a person’s memory, intuition, knowledge and experience to generate information for a specific need/use.

Thus, cognitive information seekers actively rely on key factors (including skills, experiences, knowledge, pride and the power of the mind) to generate new knowledge and new information. Such actors occasionally consult other information systems or mediums in aid of their cognitive process. They sometimes rely on other channels and sources including personal folders/personal libraries, search engines, catalogues, databases, print materials, and video for verification purposes.
5.2.2 Associate Information-Seeking Behaviour Type (AISBT)

This term emerges from the informal ISB preferences of actors (both internal and external to organisations) who predominantly seek information from colleagues or friends. Thus, Associate ISBT is the act of seeking information from colleagues and/or friends either internal or external to the context of a task or organisation. Actors generally prefer to interact with trusted friends, experienced and/or expert colleagues than those with less expertise (Stefl-Mabry, 2003). This category of information seekers generally work in teams and are very selective with their contacts, network of colleagues/friends, and the kind of interaction that takes place. Knowing that experts are very experienced and have high level of knowledge in the subject context, one might think that experts may require less amount of information from other colleagues or people; however, that is not the case (Scapolo and Miles, 2006; and Hoffman et al., 1995).

Majority of project actors interact with their friends/colleagues or knowledge experts based on some personal and professional characteristics (including trust, knowledge level, qualifications, experience, expertise and other situational factors) in the notion to seek context specific information. Information seekers often know some of these characteristics, whereas others occur consciously or subconsciously during the process. Often, these characteristics are influenced by the circumstance in which the association/friendship is formed. Nonetheless, in a professional environment, demographical, environmental and/or situational factors are paramount to information sources/channels. Hence, organisational confidentiality and information sharing restrictions enforces internal knowledge retention as opposed to external sharing and acquisition. Demographic factors such as level of experience, seniority, qualification, age, and others may also influence the kind of associates/colleagues to contact for information. In addition, environmental and/or situational factors such as condition of work, organisational setup, information culture and management styles in professional settings may also influence the kind of associations to keep and the quality level of information to capture.

In a project environment/team, actors primarily rely on fellow actors for new ideas and new information often outside the range of direct experience (Fisher, 2005; Mackenzie, 2005). According to Mackenzie (2005), line-managers or seniors in
professional context tend to “engage a broad range of information regardless of their area of responsibility or speciality”. For example, different levels of managers tend to maintain some level of rapport or relationship with colleagues, subordinates, superiors and other stakeholders with the view to access and capture all kinds and levels of information. Hence, organisational settings and organisational structures encourages Associate ISB process.

Associate information seekers demonstrate Zipf’s theory of *principles of least effort* to seek information. This is because they seek information from colleagues or friends within the same organisations. Depending on the kind of information required, the level and nature of trust is often influential in the source selection. As a result, relationship between associates develops into an *information community* where social and professional networks are strengthened to enhance information-seeking, sharing and use. Leckie et al. (1996), posits that engineers prefer to meet their fellow colleagues face-to-face to capture needed information than other sources outside their remit. Similarly, Hirsh and Dinkelacker (2004), affirm that although some percentage of software engineers frequently consult external colleagues to seek information, they are reluctant to turn to internal colleagues. According to Pinelli (1991), engineers perceive accessibility as the most important determinant in their information source selection. Chakrabarti et al. (1983), posits that information availability and ease of use are key driving factors behind the information sources of managers, scientists and engineers.

The distinction between the ISBs of engineers, scientists and other occupations in extant literature clearly shows that these actors perceive collaborative information-seeking and sharing as a means to successful information discovery. On the other hand, Fidel et al. (2004), posits that information-seeking by actors in a network or team should only be labelled “collaborative” if the object of the information-seeking/sharing process is common to all parties. Talja (2002), point out that collaborative information-seeking occurs in a social environment or community where the object is to seek information common to solving the tasks or problem at hand. According to Ward (2001), engineers devote their knowledge to practical and commercial ends, whereas for scientists, knowledge itself is the goal for their information-seeking. Ward posits that due to time pressures and other external
pressures, engineers restrict themselves to easily accessible information sources than visiting sources outside their reach.

Characteristically, associate information seekers are actors who despite their knowledge, experiences and skills, actively rely on colleagues or friends to meet their information needs. They may plan who, where and when to ask. Such actors expose themselves to well-qualified, experienced and skilful colleagues, and friends who they trust for reliable information. Associate seekers are task oriented, generally work in a team and always have pressing need for information to meet specific deadline. The channels/sources through which they seek information include face-to-face, telephone, emails, network groups, meetings, video, teleconferences, instant messaging, and other informal/formal encounters.

5.2.3 Systematic Information-Seeking Behaviour Type (SISBT)
Systematic information-seeking is the process of following a structured (or traditional) approach to seek information by employing Boolean, keyword and other bibliographic search methods through library (physical and electronic) catalogues, databases, Common Data Environments (CDE), search engines, archives, folders, and books. With this category, some actors may choose to design a systematic and thematic search plan; others may use Rich Site Summary (RSS) feeds, information pull systems or alert prompts to stay abreast with new, current and/or archival information. Similarly, others may gather information in a more flexible and spontaneous fashion. The reasons behind different information-seeking approaches may be due to a person’s inner processes and needs and the task context (Heinström, 2003).

According to Elis (1989), scientists/researchers IB follows a structured approach where they first identify relevant paper(s) or document(s) either through a keyword search or through a paper already known or recommended within the context of the study, this he termed starting. The seeker advances through a process called chaining to identify references through the citation index. The seeker then narrows the search by browsing relevant journals or sources and works through relevant papers or documents to extract context specific information. These four stages are enhanced to include differentiation. Where the source materials are filtered out to
capture relevant information. The process later advances to the *monitoring* phase by creating information alert or pull systems (automatic information capture) to maintain awareness of new developments in the area of study. Hence, Elis’ stages of actors’ ISB clearly demonstrate a systematic information-seeking approach.

Meho and Tibbo (2003), reviewed Elis’ model in relation to social scientists and discovered additional features such as *accessing, networking, verifying* and *information managing* as vital to establishing sustainable ISB process. According to Meho and Tibbo (2003), the act of information-seeking should not be limited to just *browsing* but information seekers should *network* to form sustainable relationship. They emphasised that information seekers should *access* information to have a feel to understand the context. After accessing, information seekers should *verify* the captured information to ensure its accuracy and quality, and then *manage* the captured information for successful use.

From the extant literature, it is evident that systematic information seekers follow a structured and orderly approach to seek, share and use information. They plan their information-seeking process; define the start, through to finish. Systematic information seekers apply the six stages of Ellis’ (1989) model plus that of Meho and Tibbo (2003). A typical systematic information seeker identifies information through bibliographic databases, personal folders, publisher’s/library catalogues and archives to meet their information needs. They sometimes encounter challenges with information accessibility since majority of their information sources are often dependant on information systems.

**5.2.4 Social Media Information-Seeking Behaviour Type (SMISBT)**

Emerging technologies continue to transform the way actors seek, share and use information. A new approach to actors IB/ISB that has recently taken industry by ‘storm’ due to advancement in technology, cost (cheap), speed (rapid), time, accessibility, convenience and availability is the Social Media information-seeking process. This is considered the future of actors’ information-seeking process in industry, project environment and academia.
Some three decades ago, only the privileged few had access to computers, smart phones, laptops, iPads/tablets and other portable gadgets that could connect to the internet and/or the cloud. Hence, social media networking was limited. The act of professionals seeking or sharing information via such devices through social media networks/communities was discredited in many organisations/institutions. Organisations either blocked or prevented their employees from accessing the internet and/or social media sites during working times (Hsu and Lin, 2008; Kwai Fun IP and Wagner, 2008). Both actors and their organisations were oblivious to the benefits of social media and social networking to their ‘work’. However, the last decade has seen transformational changes at the workplace, requiring a paradigm shift in organisational strategies and practices. A major factor that has made a tremendous impact on actors’ day-to-day IB activities at the workplace is the extensive use of ‘SMART’ information gadgets and ICT to access quick and real-time information. For example, traditionally, surveyors surveyed a large piece of plot by physically visiting the plot to take measurements. However, with SMART technologies, some surveyors use drones, the internet, and Global Position Satellite (GPS) systems to capture needed information for use.

The ubiquitous nature of the internet and GPS technology enhances the availability, ease of use, time and accessibility of information via Social Media. The benefits and understanding of Social Media sites and networks is now prevalent amongst actors to the extent that Social Media information-seeking is now integral to actors’ information-seeking, sharing, storage, control and management. This implies that preventing the use of Social Media amongst actors can be very detrimental to organisational success, process development and performance improvements.

Social Media communities/networks is characterised by information-seeking and sharing activities through which relationships with different groups of actors from different industry sectors are maintained. These groups have a common goal, to seek and share information on similar topics and contexts. According to Meho and Tibbo (2003), participants in a network do not only “build or gather information but also share information with members of these networks”.

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Social Media information-seeking dovetails nicely with theories such as *information grounds theory* (Fisher, 2005; Pettigrew, 1999), and *social capital theory* (Lin, 1999, 2002). Thus, the close proximity of diverse group of actors increases the likelihood to meet other actors from different work or social backgrounds, access to different and presumably better resources and thus, better information where opportunities are available to interact (Fisher et al., 2005). According to Johnson (2005), social capital theory through social networks helps to establish the effect of social structures on actors’ ISBs and the quality of information they access. This provides avenues to understand how social structure affects both information access and information flow between members of social groups or organisations.

Similarly, the ubiquitous nature of the internet is such that information-seeking and sharing occurs rapidly and with ease to the extent that its influence on individuals, organisations and the economy cannot be ignored. The prominent channels/sources used within Social Media information-seeking includes social networks, communities, blogs, YouTube (audio and video), LinkedIn, Twitter, the cloud (such as Google drive, Dropbox), and others. However, the paucity of research undertaken in these areas demonstrates the lack of awareness of the benefits of SMISBT. A recent study by Jones (2015), indicate that only 42% of self-employed construction workers rely heavily on social media sites when it comes to advertising, scouting for new business and seeking information. Jones opined that if the remaining 58% “took the leap to using social media, they will never look back”.

Social Media information seekers are dynamic because of the active environment in which they seek information. This environment is subject to dynamic and rapid updates, contributions and responses from different groups of actors with varied demographic and situational factors. Therefore, Social Media information-seeking is defined as the dynamic and rapid process of actively or passively seeking and sharing information through social network sites including Weblogs, LinkedIn, Twitter, YouTube, social media sites and cloud internet, where information-seeking is monitored and controlled by affiliated members.

Generally, information from social media sites are information ‘leads’ or targeted information. Thus, a piece of context specific information directs/prompts the
information seeker to carry out a wider search about the topic under discussions and the relevant areas to seek further details. Due to the context specific nature of discussions on social media networks, Social Media information seekers tend to form alliances of virtual friendship or information community where similar information interests is shared. This makes it easier to search for specific information that attracts instant responses among actors from different backgrounds, with different experiences and skills.

5.2.5 Serendipitous/Fortuitous Information-Seeking Behaviour Type (S/FISBT)
Another type of ISB process that is gaining momentum in industry and the academic environment is Serendipity/Fortuitous information-seeking. However, the vast majority of serendipitous studies continue to occur empirically outside the LIS, humanities, sciences, and knowledge management studies. Horace Walpole originally discovered the term serendipity in 1754 through literature. The Oxford dictionary defines the term as “the occurrence and development of events by chance in a happy or beneficial way”. This definition is directly associated with the origin of the word itself. Thus, Walpole in satisfying his interest in literature; The Travels and Adventures of the Three Prince of Serendip discovered that the heroes regularly made accidental and sagacious discoveries of things they were not looking for. These heroes were very happy in any discovery made; hence, the serendipity discovery. Other authors have given a descriptive definition to serendipity. Foster and Ford (2003), describe serendipity as “a method of achieving breadth and identifying information or sources from unknown or partially unknown directions”. Case (2006), considers serendipity as “the action of or aptitude for encountering relevant information by accident”. In a broader context, Liestman (1992), identified six approaches to library research serendipitous information-seeking which focuses on expected and unexpected information discovery. The six approaches are:

- **Coincidence**: assumes that a researcher inevitably finds something useful.
- **Prevenient grace** accounts for prior organisation of information as a means toward serendipity.
- **Synchronicity**: this proposes the existence of hidden patterns and unknown forces aiding the researcher.
Perseverance: maintains that thorough researchers are likely to encounter serendipity.
Altamirage: assumes that unique behaviours can cause serendipity.
Sagacity is a pragmatic and applied approach.
Liestman concedes that serendipity information-seeking carries a research because people do not want their discovery to be regarded as per chance or a mere stumble but by way of strategic discovery.

Erdelez (1997, 2005), posit that the acts of serendipity occurs during browsing and environmental web scanning. According to Erderlez, an alternative to accidental information discovery is “information encountering”, which forms a fundamental part of actors’ information-seeking process. Erdelez (1997), identified six functional components of information encountering to include noticing, stopping, examining, storing, using, and returning. She posits that information seekers can be categorised as super-encounters, encounters, occasional encounters and non-encounters.

Foster and Ford (2003), assert that serendipitous discovery can either reinforce existing problem, concept, and solution or create new avenues for research. According to Foster and Ford (2003), “serendipity is widely experienced among inter-disciplinary researchers and that certain attitudes and strategic decisions are perceived to be effective in exploring serendipity when it occurs”. Adams and Blandford (2005), found that information users switch between serendipitous browsing and searching. Makri and Warwick (2010), found a tight coupling between searching and browsing the internet (including other databases).

Connotations associated with serendipitous discovery raises doubts about the emotion of the information seeker. For example, if information seekers truly discover information by accidental means but in a very bad (risk prevailing) or angry mood, will that still be a serendipitous discovery? Alternatively, what if the information seeker discovers unpleasant information (planned or unplanned risk) likely to result in project failure, will that also result in a happy discovery? As a result, the term Fortuitous is used in conjunction with Serendipity in this study to
balance associated connotations with accidental and/or incidental information discoveries.

The Oxford dictionary defines fortuitous as “happening by chance rather than intention”. Therefore, Serendipity/Fortuitous information-seeking in this context is the act of discovering or encountering either planned or unplanned information item by chance without any connotation. This implies, actors can still discover information to make appropriate decisions irrespective of their affective state. In professional environments, serendipitous/fortuitous information-seeking can be accidental or incidental encounters and/or intentional or unintentional information-seeking in context. It can be predictable, unpredictable and/or a random process, which often alters the course and outcome of the process. Human information-seeking process has always been predictable, planned, structured, controlled and guided. However, human behaviour is generally unpredictable, and often transformed by events that occur by chance. Although human IB can be controlled, accidental or incidental information encountering cannot be controlled or planned but can be managed and guided. Professionals sometimes discover information without any prior knowledge or intentions and often, such information tend to be vital. This form of information encounter often occurs by chance or accident.

Similarly, organisational behaviour is such that information encountered by chance is inevitable. In some situations, actors deliberately create opportunities to facilities serendipitous/fortuitous information encounters. For example, actors often attend events (such as conferences, workshops, seminars, and network sessions) or engage in network of teams or colleagues (during casual meeting or breaks) mainly for information browsing, environmental scanning, or information encountering purposes. Often, actors purposefully place themselves in situations to facilitate serendipitous/fortuitous information capture. Thus, they wait for the right opportunity to capture the needed information. Hence, this can also be referred to as opportunistic information seeking/encountering process.

Activities that actors employ during serendipitous/fortuitous information encountering include networking, environmental scanning, and browsing. According to Bawden (1986), browsing occurs in three different kinds; “purposive” browsing -
the deliberate seeking of new information in context; “capricious” browsing - random examination or exploration of information materials without any definite goal; and “exploratory or semi-purposive” browsing – inspirational information-seeking process. These browsing activities range from reading or scanning print/electronic and audio/video materials through networking with friends/colleagues, and laboratory experiments to searching the internet or social media sites. These activities results in the discovery of new and relevant information.

**Synthesis of the Five Information Seeking Behaviour Types**

It has been established in the previous sections that project actors demonstrates unique ISB preferences that can be managed and/or controlled at the different phases of task/project delivery. It has also been established that exhibition of these ISB preferences does not guarantee an effective information-seeking process. However, it presents actors with appropriate avenues to adapt to their preferred method of information-seeking, which directly or indirectly enhances the capture of context specific information.

The extant literatures suggest that the sciences and social sciences employ systematic or cognitive or serendipity/fortuitous information-seeking process to seek information from sources such as catalogue/databases, laboratory and audio/video based discoveries. On the other hand, engineers, managers, and project actors rely predominantly on their colleagues for majority of their information. In addition, there are those groups of actors (including design engineers, architects, surveyors, and consultants) who rely on the internet, social network, blogs, and generally, social media for their information. This argument clearly shows that information seekers have unique preferences to information-seeking process. Thus, different actors may require different system or avenues based on their information requirement profile to facilitate effective ISBs. Table 5.1 present a summary of the characteristics of the ISB types.
### Table 5.1 Summary of the characteristics of the ISB types

<table>
<thead>
<tr>
<th>ISB Type</th>
<th>Dominating Seeking Style</th>
<th>Information Seekers Characteristics</th>
<th>Sources/Channels</th>
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</table>
| Cognitive | Active | • Actively relies on their memory, intuition, knowledge, experience and skills to seek information.  
• Maintains a system/structure to manage personal information | Memory, knowledge, files, library catalogues (both electronic and print), electronic, and print materials (including journals, books, trade documents/magazines, white papers), technical documents |
| Associate | Active and/or Passive | • Actively and/or passively rely on knowledge, experience and skills to seek information  
• Passively and/or actively relies on expert and experience colleagues to seek information. | Colleagues, friends, experts, Internet, personal files, memory, corporate library, conferences (internal & external), professional networks, face-to-face, telephone, emails, electronic, and print (trade documents/magazines, white papers) |
| Systematic | Active | • Relies on their memory, knowledge, experience and skills to follow a systematic plan/structure to seek information.  
• Follows a traditional approach to seek information  
• Create information archive, automatic information capture systems, uses Boolean systems to seek information  
• A step-by-step approach to manage information folders  
• Regularly recycles information to ensure information currency | Personal memory, knowledge, personal information management skills, personal filing/folders, library catalogue (both cooperate/public and online), professional network of friends/colleagues, conferences, expert colleagues, Standard organizations, emails, electronic and print documents (journals, books, trade documents/magazines, government white papers) |
| Serendipity/Fortuitous | Passive | • Relies on opportunities to seek information without prior plan.  
• Regularly attend events such as conferences, seminars, breakfast clubs, coffee breaks, tea breaks, fag breaks, network events and others with the view to seek/solicit information  
• Browsing or environmental scanning to seek information  
• May be referred as opportune information seekers. | Network of friends/colleagues, informal meetings (such as Coffee breaks, fag breaks, sporting event breaks), conferences, seminars, internet, and others. Emails, face-to-face, telephone, electronic, and print materials (including trade documents/magazines, government white papers) |
| Social Media | Passive | • Actively depend on the social media to seek information.  
• Adopts a method or a plan to identify avenues to seek information (such as which media blog to use, who to invite to contribute and where to seek).  
• Joins social media groups/communities to engage in key topical discussions to seek appropriate information. | Social media groups/communities (including LinkedIn, YouTube, twitter, CNBR, Facebook), Internet search engines, network of friends, cloud, personal files, trade magazines and/or organisational standard, emails, telephone, texts. |
As actors’ advance through the information-seeking process, different factors (including situational, environmental, and/or demographic) manifest in the process. Therefore, the following sections present the factors that influence actors’ information-seeking and information use/task performance behaviours.

5.3 INFLUENCING INFORMATION FACTORS

The ever-increasing volume of information due to numerous information sources and channels compromises the quality and use for information. As a result, various solutions have been proposed to deal with the IO problem (Edmunds and Morris, 2000; McMahon et al., 2004). Zhao et al. (2008), posit that as available information increases, its quality becomes important for effective use. In a project centred domain, the primary concern of key actors is to capture or be provided with appropriate information, in the right context, format and quantity, and at the right time to make effective decision. These requirements are underpinned by a variety of factors, which can have both direct and indirect influence on actors’ information-seeking and/or information use/task performance.

Many scholars have identified various factors that influence actors’ ISBs. Mick et al. (1980), identified three categories of factors such as individual attributes, task attributes and work environment attributes. Wilson (1999), identified factors such as psychological, demographic, interpersonal or role-related, environmental and source characteristics as intervening variables to influence actors ISBs. Similarly, Palmer (1991), found key determinant factors that influence scientists ISBs to include discipline, work role and time spent in the subject field and the organisation. Zhao et al. (2007), identified factors such as accessibility, accuracy, availability, context, currency, relevance, timeliness, trust and usability, as key information characteristic factors. Urquhart and Rowley (2007), categorised the factors that influence students’ ISBs into micro and macro factors. Byström and Järvelin (1995), identified demographic information-seeking and information use/task performance factors as situational factors.

In his review, Hepworth (2004), identified factors that affect information experience as environmental data; mental state factors that influence information interaction as psychological data, and factors that indicate demands, wants, needs and
preference for information as *behavioural data*. Similarly, Eppler (2006), identified extensive list of commonly used information quality characteristic criteria factors as presented in table 5.2.

Table 5.2 Information quality criteria factors [adapted from Eppler (2006)]

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<tr>
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<tr>
<td>3. Applicability</td>
<td>27. Essentialness</td>
<td>50. Reputation</td>
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<td>4. Ability to represent null values</td>
<td>28. Privacy</td>
<td>51. Relevance</td>
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<td>5. Existence of meta information</td>
<td>29. Cost</td>
<td>52. Clarity</td>
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<td>8. Availability</td>
<td>32. Error rate</td>
<td>55. Right Amount</td>
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<td>9. Believability</td>
<td>33. Flexibility</td>
<td>56. Rightness</td>
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<td>10. Browsing</td>
<td>34. Helpfulness</td>
<td>57. Robustness</td>
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<td>12. Coherence</td>
<td>36. Interpretability</td>
<td>59. Speed</td>
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<td>13. Completeness</td>
<td>37. Learn-ability</td>
<td>60. Stimulating</td>
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<td>17. Concise representation</td>
<td>41. Objectivity</td>
<td>64. Timeliness</td>
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<td>18. Concurrency of redundant</td>
<td>42. Correctness</td>
<td>65. Convenience</td>
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<td>20. Obtainability</td>
<td>44. Performance</td>
<td>67. Usability</td>
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<td>21. Target group orientation</td>
<td>45. Precision</td>
<td>68. Validity</td>
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<tr>
<td>22. Consistent Representation</td>
<td>46. Price</td>
<td>69. Value-added</td>
<td></td>
</tr>
<tr>
<td>23. Equivalence of redundant</td>
<td>47. Appropriateness of meta information</td>
<td>70. Verifiability</td>
<td></td>
</tr>
<tr>
<td>24. Ease of Manipulation</td>
<td>48. Provability</td>
<td></td>
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</table>

From table 5.2, it can be argued that Eppler (2006), tried to establish information characteristics criteria in relation to information quality hence, the compilation of 70 factors that underpins actors’ ISBs. He later reduced the list to 16 by eliminate the expendable criteria.

Evidence suggests that different factors affect and influence the seeking and use of information and the user in different context (Ellis and Haugan, 1997; Eppler, 2006; Leckie et al., 1996; Wilson, 1999). In comparing the IB/ISB of professionals in
different occupations, conclusions can be drawn that the factors identified by Eppler (2006), are evidential to influence actors ISBs. These factors can be categorised in relation to context of influence during actors information-seeking and information use/task performance. Hence, for the purpose of this research, factors considered vital to influence actors' information-seeking and information use/task performance are presented in table 5.3

Table 5.3 Information-seeking and information use/task performance factors

<table>
<thead>
<tr>
<th>Information-seeking and information use/task performance influencing factors</th>
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<tbody>
<tr>
<td>1. Sources/Channels</td>
</tr>
<tr>
<td>2. Accuracy</td>
</tr>
<tr>
<td>3. Trust</td>
</tr>
<tr>
<td>4. Time</td>
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<tr>
<td>5. Accessibility</td>
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<tr>
<td>6. Effectiveness</td>
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<tr>
<td>7. Efficiency</td>
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<tr>
<td>9. Useable/Usability</td>
</tr>
<tr>
<td>10. Relevance</td>
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<tr>
<td>11. Collaboration</td>
</tr>
</tbody>
</table>

Factors that Influence Actors’ Information-Seeking and Information Use/Task Performance Behaviours

Systematic examination of the information seeking and information use/task performance factors identified in table 5.3 indicates a varied level of influence. Whereas some influences actors’ ISBs, others influence the use or task performance behaviours. Hence, these factors can be categorised into information-seeking factors and information use/task performance factors to show distinctions in the level of influence to actors ISBTs. A third category demographic factors underpins both the information-seeking and information use/task performance factors. Table 5.4 present the categories of the influencing factors.

During information seeking, actors rely on vital factors that influence the process. These factors include sources and/or channels, trust, accessibility, time and collaboration, and some demographic factors including professional role, experience, education, and age, condition of work, organisational setup and sector.
In addition, actors use the captured information to resolve problems or perform key tasks to meet expectations.

### Table 5.4 Information-seeking and information use/task performance factors

<table>
<thead>
<tr>
<th>Information Seeking Factors</th>
<th>Information Use/Task Performance Factors</th>
<th>Demographic Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources/Channels</td>
<td>Effectiveness</td>
<td>Professional role</td>
</tr>
<tr>
<td>Time</td>
<td>Efficiency</td>
<td>Work Condition (team or Independent)</td>
</tr>
<tr>
<td>Trust</td>
<td>Time</td>
<td>Experience</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Currency</td>
<td>Age</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Useable</td>
<td>Sector</td>
</tr>
<tr>
<td></td>
<td>Relevance</td>
<td>Qualification</td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
<td>Organisational setup</td>
</tr>
<tr>
<td></td>
<td>Accuracy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Satisfaction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Context specific</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quality</td>
<td></td>
</tr>
</tbody>
</table>

These are influenced by vital information use/task performance factors such as context specific, effectiveness, efficiency, currency, useable, relevance, reliability, accuracy, satisfaction, quality, and time. In all cases, these factors influence the information-seeking process and/or information use. For the purpose of this research, the demographic factors are embedded into the information-seeking influencing factors, since these factors initiate the information-seeking process.

The following sections present brief discussions of the factors that influence the information-seeking and information use/task performance outcomes.

**Influencing Information Seeking Factors**

**Sources/Channels**

This section highlights the relevance of source/channel as an influencing information-seeking factor. Information sources and channels are generally considered as carriers of information content (Chakrabarti et al., 1983; Kuhlthau, 1999; Morrison and Vancouver, 2000). Different sources contain different information context, and that one source can provide the same information but at different quality than the other. This is affirmed by Marchand et al. (2002), that
making information available through networks and databases does not always make it usable, unless actors are able to agree on shared language, terminology and classification schemes for organising the information sources.

It has been suggested that actors choose information sources based on the “least effort principle” (Gerstberger and Allen, 1968; Zipf, 1949). However, others argue that source quality is the single dominant factor in source selection in interpersonal information-seeking (Yunjie et al., 2006). This implies actors generally face the question of which sources to consult. Similarly, evidence suggest that actors’ ISB affect their social relationship with colleagues, knowledge acquisition, and ability to cope with uncertainty in tasks performance due to selected information sources (Leckie et al., 1996; Morrison, 2002; Vakkari, 2003). For example, information from expect colleagues may be significantly different and perhaps preferred than information from the internet. This notwithstanding, actors rely on other factors to choose their information sources. As actors are exposed to different sources, their choice of source is not restricted. Thus, a combination of other factors may influence the capture of appropriate information through appropriate sources.

**Trust**

It has been established that information-seeking is influenced by trust (Denize and Young, 2007; Hertzum et al., 2002; Hertzum, 2002; Tseng and Fogg, 1999). This is an important factor when it comes to information seeking, sharing, and security, information in transit, timely information, source selection, and use. Marchand et al. (2002), posit that trust is a precondition for sharing information. This is because actors within the same team or organisation may find it difficult to exchange vital information that potentially has negative consequences or information that might make one look better than the other. This may affect required transparency in seeking and sharing sensitive information.

Trustworthiness entails some level of risks, which makes it difficult to attain certainty. The nature of assumed risks is such that trust depends on actors discretion, competence, integrity, and other factors (Sheppard and Sherman, 1998). Similarly, problems encountered during the information-seeking process can be eliminated if actors trust the information sources to establish a consistent
information-seeking process (Kwasitsu, 2003; Liker and Morgan, 2006). Thus, actors have to trust that the source will convey or provide appropriate information to meet their needs. Hence, the level of trust that can be ascribed to the source and the information is vital (Zhao et al., 2007).

Trust underpins the exchange of information between sources (Denize and Young, 2007; Hertzum et al., 2002). This factor may affect personal or impersonal sources since actors generally trust their fellow actors or systems to a certain degree for the right information. Actors seek information that is accessible and perceived as high quality. However, trust become an issue since factors such as quality and expertise are perceived information properties (Tseng and Fogg, 1999). Tseng and Fogg (1999) identified four types of trust that influences information sources;

- first-hand experience (developing trust through interaction with people over time to assess their level of expertise and trustworthiness),
- reputation (a recommendation from a third party colleague),
- simple inspection of surface attributes (assessing people by physical appearance and use of language/the way they communicate),
- general assumptions and stereotypes (trusting that whatever you hear or are told is accurate or the truth).

These types of trust suggest that as actors acquire credible knowledge of a source first-hand, it eliminates any doubts in assessing the trustworthiness of the source.

According to Van House et al. (1998), trust is fundamental to communities of practice, and that the physical distance between people (sources) affects their level of trust. This support the concept of least effort principle since actors prefer to seek information from close proximity sources (internal and personal sources).

**Accessibility**

Accessibility is defined as “capable of being reached, used or seen” (Eppler, 2006). Actors access information due to physical, intellectual and social factors (Burnett et al., 2008). Physical access refers to the process of seeking-information from document sources (Svenonius, 2000). Similarly, intellectual access relates to access to information contained in documents. And social access refers to the theory of normative behaviour (Burnett et al., 2008). Actors have different
perception of accessibility concept in relation to information professionals and perceptual factors (Fidel and Green, 2004). Some actors may access information source due to familiarity with the sources. Others may access a source because of availability. For example, engineers generally seek information from colleagues because they are familiar with them.

Accessibility has been found to significantly influence engineers information source selection (Anderson et al., 2001; Fidel and Green, 2004; Leckie et al., 1996). Zhao et al. (2008), found accessibility to be the highest-ranking information characteristic in information transactions. According to Fidel and Green (2004), different actors have different perception of accessibility concept in relation to information systems. This led to the identification of twelve contributory factors to engineers’ perception of accessibility concept (Fidel and Green 2004, pp. 570-571). Leckie et al. (1996), posit that engineers perceive “ease of use and source familiarity” as source accessibility. Culnan (1985), identified three dimensions of accessibility: physical access to information sources, easy expression of information needs to a language understood by the sources, and physical retrieval of relevant information.

McCreadie and Rice, (1999), identified factors such as physical, cognitive, affective, economic and social to influence accessibility. Choo et al. (2000), consider accessibility as the ease with which actors approach information sources while considering the social, economic and physical cost of use. Gerstberger and Allen (1968), found that lack of accessibility to specific information contributes to the level of source usage. According to Gerstberger and Allen (1968), channel quality and accessibility is the single most important determinant of the overall extent to which information is used, and that experience and familiarity in using certain sources contributes to engineers sources accessibility.

**Time**

Time as a factor, is defined as coming/arriving early or at the right, appropriate or adapted to the event or the time (Eppler, 2006). This factor underpins all aspects of human activities; hence, it can be argued that the factors presented in table 5.4 have some form of relationship with time. In this study, “time” is considered a dynamic factor, since it influences both information-seeking and information
use/task performance behaviours. This is because in both categories of activities, time is essential in determining the outcome.

Savolainen (2006), identified three major approaches to the temporal context of information-seeking: time as a fundamental attribute of context, time as a qualifier of accessibility, and time as an indicator of the information-seeking process. According to Savolainen (2006), the time factor in information-seeking makes the process dynamic, fluid and subject to continuous change. As previously indicated, time delay is highly significant to underperforming projects, construction organisations and performance (Robinson, 2010; KPMG International, 2013). Time pressures on actors vary significantly, depending on how quickly information is required, the amount of sources they are exposed to, the problem of IO, the task complexity or problem under consideration. Sometimes, time pressure mounts because of changes in the information requirements and advances in the project delivery process. Generally, actors need just-in-time information to make quick decisions. However, changes in information needs causes actors to react to time pressures by capturing any available information through limited sources for use. Hence, time is frequently considered a barrier to seeking both oral and written information (Hertzum and Pejtersen, 2000).

Choo (2002), assert that when managers scan their environment for information under severe time pressure, the information-seeking “space” or “environment” becomes narrower. This implies time pressure affects actors’ ability to identify broad range of available information, which affects the quantity and quality. Julien and Michels (2004), suggest that time pressure may lead to less selective approach in actors’ information evaluation process. However, they indicate that information seekers tend to use more information sources when they have endless amount of time. Fidel and Green (2004), point out that “time savings” is one of the factors that influences engineers accessibility of information sources.

**Collaboration**

Collaboration is an essential condition for actors to work freely in a harmonious environment where there is high level of trust and freedom to seek, share and use information. Collaboration requires actors to work together freely to maximise
potential and successfully achieve objectives. This can only be attained when there is mutual trust and mutual dependence, and most importantly, free information exchange (Gray and Hughes, 2001). According to Gray and Hughes (2001), collaboration is by far a richer process than teamwork. In his study of aspects of engineers information-seeking activities, Allen (1984), addressed the role of physical distance in information-seeking. According to Allen (1984), communication amongst engineers decline as a result of the physical distance between them.

Isikdag and Underwood (2010), posits that effective collaboration can only be achieved through effective coordination of information through the process of effective communication between stakeholders. Similarly, Yeomans et al. (2006), assert that collaboration efficiency can be increased by the application of systematically rich information models to share information. Given that projects are bound by time constraints and other factors, a realistic approach to ensure effective information dissemination amongst actors is to aim for a degree of collaboration that enhances creativity and decision-making process. Unresolved design problems often results in increased project duration. However, timely information inputs from variety of collaborative sources tend to limit design problems. Therefore, effective collaboration can allow a free continual exchange of information and knowledge without any barriers (Gray and Hughes, 2001). Kalay (1998), defines collaboration as “the agreement amongst [actors] to share [different] abilities in a particular process in order to achieve [a common] objective”. According to Poltrock et al. (2003), collaboration is the activities undertaken by a group or a team to identify and resolve a shared information need. Anumba et al. (2002), on the other hand describes four different modes of collaboration in terms of space and time. This includes face-to-face collaboration, asynchronous collaboration, synchronous distributed collaboration and asynchronous distributed collaboration. Sonnenwald and Pierce (2000), identified three characteristic approaches to collaboration between participants information discovery to influence task performance success. These includes (i) interwoven situational awareness - shared (and often incomplete) understanding of the situation as it unfolds, (ii) dense social networks - recurrent interactions among participants, and (iii) contested collaboration - the arguments that either stand in the way of progress or help people to understand the nature of the rapidly changing situation. Sonnenwald and
Pierce (2000), state that “individuals must work together to seek, synthesise and disseminate information”. Hence, in the context of this research, collaboration is defined as working together by sharing and seeking information resources with a common goal to achieve a set of outcome(s).

**Demographic Factors**

Demographic factors such as professional role, experience, qualification, age, condition of work (working in a team or independently), sector of employment (private or public) and organisational setup have been suggested to influence actors’ ISBs (Keller and Holland, 1978; Kwasitsu, 2003; Nicholas, 2000; Niu and Hemminger, 2012; O’Reilly, 1982; Wilson, 1999; Yitzhaki and Hammershlag, 2004). Nicholas (2000), posit that actors’ job role has a major influence on their ISB. Hert (1997), identifies organisational settings, roles, projects and tasks as drivers for seeking information. Leckie et al. (1996), recognises work roles and tasks as the primary drivers for information-seeking. In construction organisations, actors’ role is vital to significant decision-making process in day-to-day activities. For example, “designer” is an information-demanding role. Designers rely on high quality, context specific and timely information to make effective decisions. The consequences of poor decisions made by a designer may negatively affect project outcome (delay or failure).

Similarly, Nicholas (2000), posit that information seeker’s experience in the job, and seniority whether in solitary or in a team-based occupation has significant effect on information-seeking. According to Nicholas (2000), highly experienced actors are likely to have high level of knowledge which enables them to spend less time and effort to seek information, and are likely to have good informal communication networks to support them.

Vakkari and Kuokkanen (1997), considered the impact of education and experience levels on actors information-seeking. They indicate that task complexity reflect actors’ experience level; hence, actors perceive tasks to be less complex if they are more familiar with it. Leckie et al. (1996), reported that engineers’ first point of call when faced with work-related decision or problem is to consult their
personal knowledge and experience. According to Leckie et al. (1996), familiarity and accessibility are more important than perceived quality.

Another demographic factor with considerable impact on actors’ ISB is age. Age has a parallel association with experience and seniority. Depending on source proximity and task demands, age tends to make some category of people less mobile. For example, in this internet era, age makes some people less adventurous. According to Nicholas (2000), age appears to influence non-use of IT amongst certain category of actors. Nicholas (2000), posit that middle age journalists are heavy users of the internet, than their younger and older counterpart.

Other demographic factors that influence actors ISB include work condition and sector. These factors relate to actors who work in a team or independently, and whether they work in a private or public sector organisations respectively. Such working arrangement tends to influence the kind of information sources actors approach, proximity of such sources, structures at the organisations and systems that support their ISBs. In construction organisations, majority of actors’ work in teams in either private or public sectors. Actors who work in teams are likely to approach colleagues in the same team for vital information. On the other hand, actors’ who work independently may probably create their own personal information library or information sources. Independent actors are more likely to consult information sources such as internet, databases, journals, trade manuals, and technical specifications, than those who work in teams.

Similarly, the organisational setup factor influences actors’ ISB. This is because the setup of organisations (technologically advanced or not-advanced, and different structures) can imply that actors’ either rely on technology or electronic sources or well setup information management systems or rely on non-electronic or technology for their information. This implies that hierarchical structures influence information-seeking and/or information dissemination process. According to Hert (1997), organisational settings are a key driver for seeking-information. Organisational setup includes the structure and arrangements that exist to facilitate effective information management and IBs of actors. Arrangements such as access to internet systems, shared or common data environment, communications via
emails, exposure to social media and other open sources influences the kind of information sources to approach and the proximity of such sources. Ellis and Haugan (1997), found that engineers heavily rely on internal communications, and when confronted with an unfamiliar field, they tend to contacts actors in their personal networks. They posit that engineers only employ the services of library personnel as intermediaries for literature searches.

**Information Use/Task Performance Influencing Factors**

*Useable/Usability*

Actors’ choice and assessment of information sources such as information systems and virtual agents within Human Computer Interaction (HCI) has received significant attention under the heading of usability. Usability is sometimes narrowly defined and confused with utility (Nielsen, 1994), and other times, with quality in use (Bevan, 1995). Inherent in the definition of usefulness is utility and quality. Thus, usefulness is the quality of having utility and especially practical worth or applicability (Eppler, 2006). However, usability in the context of information generally concerns actors’ ability to apply their knowledge and experience to use captured information within its intended context.

Eppler (2006), defines usability as the characteristic of an information environment to be user-friendly in all aspects (easy to learn, use and remember). ISO 9241-11 (1998), defines usability to consist of three distinct aspects: *effectiveness, efficiency,* and *satisfaction*. In other words, information usability refers to the efficient and effective manner to use information to satisfy its intended purpose. This definition suggests interdependencies between the three factors, which is not the case. In an information retrieval study to measure the relationship between effectiveness, efficiency and satisfaction, Frokjaer et al. (2000), assert that there is weak or no correlation between effectiveness, efficiency and satisfaction. However, Frokjaer et al. (2000), conclude that usability testing of computer systems for complex tasks should include the aspects of efficiency, effectiveness, and satisfaction in order to uncover the measures critical in a particular situation.
**Effectiveness**
The ability for actors to seek and use context specific information to achieve a desired outcome is vital to task performance. Hence, effectiveness as information use/task performance factor is critical to information context and application. Marchand et al. (2002), posit that a disposition to use information effectively requires actors to view information as truthful, accurate and without bias. Hence, effectiveness is the accuracy and completeness with which actors achieve their goal with captured information. This implies, the quality and performance level of the outcome, and the error or failure rate are indicative of effectiveness (Hertzum et al., 2002).

**Efficiency**
Efficiency refers to the accurateness and completeness with which actors’ use information to achieve a set objective and the appropriate resources expended to achieving them. Therefore, efficiency as an information use/task performance factor is the ability to use information to perform a task accurately and completely within a set time frame/target. Indicators of efficiency includes timely completion and learning time (Hertzum et al., 2002).

**Satisfaction**
This factor refers to actors’ comfort and attitude (positive) towards captured information through the seeking process and use to meet expectations. According to Kirakowski and Corbett (1993), actors’ satisfaction can be achieved by measurement of attitude using rating scales. Some indicator of information satisfaction includes using information to meet task requirements beyond expectations.

**Currency**
This factor is very significant in the quality of information. This is because information has a short shelf life (less than five years in many cases and less than two years in the case of computing) (Nicholas, 2000). Although, very old (obsolete) information may still perform the task, it is likely to lose its relevance and longevity. Information currency generally refers to up-to-date and timely information.
irrespective of how far back a search for information is performed. Other factors such as sources, accessibility, quality, and accuracy underpin information currency.

Actors require up-to-date information that is consistent with task requirement and context. This is achieved by filtering, prioritising and sorting to extract current information. Failure to capture up-to-date information tend to lead to delays in task delivery, poor outcomes, inability to complete task to desired target, and the extent to which completed tasks might not stand the test of time. Nicholas (2000), posit that keeping ‘up-to-date’ has its downside, because it requires close support from information systems (computers) to systematically monitor and filter the vast amount of information. Hence, for information to maintain its currency, it must be shared (easy access/circulation) quickly.

**Relevance**

Primarily, actors seek information that is relevant to their needs or tasks. In other words, actors judge the effectiveness of their information-seeking process by the extent to which they succeed in capturing relevant information. Relevance in this context refers to the comprehensive, accurate and clear enough nature of information applicable for its intended use (Eppler, 2006).

Schamber et al. (1990), present three central conclusions from the concept of relevance and its role in actors’ ISBs as:

- a multidimensional cognitive concept whose meaning largely depends on user perception of information and information needs.
- a dynamic concept that depends on user judgements of quality of relationship between information and information needs at a point in time.
- a complex but systematic and measurable concept if approached conceptually and operationally from user’s perspective.

These conclusions provide evidence that, actors attach significant importance to information sources. This demonstrates the importance of the ‘relevance’ in the quality and context of captured information.
Quality
Actors generally determine information quality by its effective use. Tseng and Fogg (1999), posits that quality is a perceived property of information. Hence, actors require good quality information to make effective decisions. However, information duplication, information that lacks technical details, information that is irrelevant to the context, and insufficient information are all characteristics of poor quality. Hertzum et al. (2002), suggest that actors achieve perceived information quality if they place trust in the source or information. Hence, actors’ require trusted information sources/channels in order to capture quality information. ISO9000 BSEN (2000), defines quality as “the degree to which a set of inherent characteristics fulfils requirement”. Hence, for the purpose of this research, quality is an information item that is fit for purpose and meets specifications, expectations and user requirement. In construction, quality information refers to an information item rich with technical details, which does not lose its meaning in transit.

Context Specific
In the design development stages of a project, actors require detailed information to make effective decisions. The information required at these stages must be rich, specific, timely, useful, and user friendly; hence, “context specific” is critical to information source/channel selection. This factor comprises of both technical and contextual information. According to Allard et al. (2009), technical information includes documentation of technical solutions and results, whereas contextual information includes indexed data archives on the context of design process where it may be searchable.

Eppler (2006), defines context as the sum of occasion, ideas, assumptions and preconceptions that influence information interpretation, the situation of origin or application of the information. Context specific information is a detailed piece of information that influences easy interpretation and application. As actors identify the context of required information, they focus on key sources that are relevant to the context specificity of the needed information. This implies less time seeking information from relevant/irrelevant sources. Thus, context specific refers to information that is rich in technical details and meets the quality requirement for its intended purpose. This factor can be interrelated with the quality factor. In that,
both factors represent the level of technical details contained in information. However, the ultimate goal on applying such detail to satisfy task requirement depend on other factors.

**Reliability**
Factors such as information sources, quality and accuracy underpin reliable information. This is because actors require information that is consistent, from a trustworthy source, of good quality and accurate details. This implies source reputation is vital to reliability of the information. Reliability in this context refers to a piece of information that is easily accessible, context specific, consistent, stand the test of time, of good quality and usable. Some indicators of information reliability include proximity to source, and consistency in information from the source.

**Accuracy**
As information underpins human activities, it is subject to movement at all time and through different channels and sources. The meaning of information in transit changes over time. This implies certain details (including date, time, context, currency, and speed) of the information changes; hence, the information loses its accuracy. This makes information accuracy a very important factor in actors' information-seeking and information use behaviours. According to Eppler (2006), accuracy is the degree of conformity of a measure to a standard or a true value. In this context, accuracy refers to context specific information that is susceptible to change in meaning and context. Indicators of information accuracy include sources, trust, and reliability.

From the extant review of actors ISB preferences, it is evident that the ISB preferences (such as cognitive, systematic, associate, serendipity/fortuitous and social media) are inherently influenced by the information-seeking and the information use/task performance factors. Therefore, for the purpose of this research, it feasible to classify actors' ISBTs as dependent variables that varies from task to task. On the other hand, it is probable to classify the information-seeking and information use/task performance factors as independent variables. This is because these factors underpin the environmental and situational characteristics in project organisations. These factors together with the ISBTs are
used to formulate hypotheses to be tested in the quantitative study to establish the level of relationships and influence. Figure 5.1 shows a conceptual representation of the influencing information seeking and information use/task performance factors and the ISBTs. This present an understanding of the association of actors’ ISBTs with the influencing factors.

Figure 5.1 Conceptualising the development of the ISBT model

5.4 CONCEPTUALISING ACTORS INFORMATION-SEEKING BEHAVIOURS

Perspective of actors’ ISB can be attributed to the recognition that information-seeking is rarely an end in itself. This is because actors’ ISB forms part of a process; as a result, actors require information that is current, accurate, high quality, relevant, context specific and useful to make effective decision. During the information-seeking process, independent factors such as sources/channels, time, quality, accessibility, reliability, trust, context specific and the demographic factors can have direct or indirect influence on the captured information and outcome of the task. Generally, actors seek information to make decisions, solve problems or provide solutions, which must satisfy a certain performance requirements. With this in mind, it is important to establish the association between the independent factors that influences the dependent (ISBTs) factors during task delivery.

Whereas some actors may have distinct ISBT(s) or preference(s), it is also possible for actors to demonstrate other ISBTs during the information-seeking cycle.
However, the importance of actors' ISBs can be realised if its relationship with the influencing factors are established. Hence, it is essential to conceptualise a model to establish the relationship between actors' ISBTs and the influencing information-seeking and information use/task performance factors. The does not imply that the influencing factors cause actors' ISBs but rather, to establish the degree of interactions with the ISBTs. This is affirmed by Case (2012), that it is difficult to establish causation in human behaviour research where such behaviours are underpinned by factors that cannot be observed.

In chapter 3, several graphical models of IB/ISB research were examined to establish a broader understanding of the problem under investigation. These models have helped to focus the research and to explain actors’ ISB orientations and the influencing factors. Models can be graphical or theoretical; where graphical models represent visual logic which underpins theoretical models (Fellows and Liu, 2009). Graphical models are widely used to represent actors IBs/ISBs in this area of research and they are common in construction research (Fellows and Liu, 2009).

Jarvelin and Wilson (2003), posits that a conceptual model provides a working strategy and a scheme containing major concepts and their interrelations that orientate research towards specific sets of research questions. Similarly, Bates (2005), argues that models are useful at the description and prediction stages of understanding a phenomenon. In addition, Case (2012), assert that models guide research design and development. Therefore, to respond to research objective six (6), a conceptual model of actors' ISBTs is formulated to establish the relationships between actors' ISBTs and the information-seeking and information use/task performance influencing factors. Figure 5.2 present a conceptual framework of actors' ISBT and information-seeking and information use/task performance factors. This model underpins the design of a research tool for hypotheses formulation, data collection, result testing and data analyses, discussions of findings and conclusion.

The conceptual model of actors ISBTs comprehensively captures the information needs in relation to the task. The need(s) triggers actors' ISB, where the actor adopts a preferred ISBT based on personality orientation/circumstantial factors.
The information-seeking factors actively influence the information-seeking process. Similarly, the information use/task performance factors passively influence the ISBT(s). This model embraces Elis’ model of information-seeking stages. Thus, the actor at the information-seeking stage consciously or subconsciously applies the starting, browsing, chaining, monitoring, differentiating, extracting, verifying and use phases to capture appropriate information.

Figure 5.2 Conceptual model of actors ISBTs

The by-directional arrow that links the information use/task performance influencing factors to the ISBTs indicates the relationship between the information-seeking process, the kind of information to capture, as well as the use of the information. The actor uses the captured information to deliver the task. The process is repeated during any task performance. Hence, the cyclic nature of actors’ information-seeking process.

5.4.1 Research Hypothesis
The overall aim of this research is to establish empirically, the extent of construction project actors’ ISB preferences. However, it has been established that several key factors influences actors ISB preferences. Hence, the need to test hypotheses between the ISBTs and the influencing information-seeking and information use/task performance factors to draw conclusions that support the principle of least effort theory. As a result, the following hypotheses generated from the conceptual framework responds to the research questions.
Information-seeking behaviour type(s) preference
Null Hypothesis H1: There is no preferred ISBT amongst construction project actors
Alternate Hypothesis H1: There is a preferred ISBT amongst construction project actors

ISBTs and Information-seeking behaviour factors
Null Hypothesis H2: There is no relationship between Associate ISBT and (i) information sources/channels, (ii) organisational set-up, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.
Alternate Hypothesis H2: There is a relationship between Associate ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.

Null Hypothesis H3: There is no relationship between Cognitive ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.
Alternate Hypothesis H3: There is a relationship between Cognitive ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.

Null Hypothesis H4: There is no relationship between Systematic ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.
Alternate Hypothesis H4: There is a relationship between Systematic ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.

Null Hypothesis H5: There is no relationship between Serendipity/Fortuitous ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.
Alternate Hypothesis H5: There is a relationship between Serendipity/Fortuitous ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.
Null Hypothesis H6: There is no relationship between Social media ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.
Alternate Hypothesis H6: There is a relationship between Social media ISBT and (i) information sources/channels, (ii) organisational setup, (iii) trust, (iv) accessibility, (v) collaboration, (vi) time.

**ISBTs and key Information use/task performance factors**

Null Hypothesis H7: There is no relationship between Associate ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.
Alternate Hypothesis H7: There is a relationship between Associate ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.

Null Hypothesis H8: There is no relationship between Cognitive ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.
Alternate Hypothesis H8: There is a relationship between Cognitive ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.

Null Hypothesis H9: There is no relationship between Systematic ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.
Alternate Hypothesis H9: There is a relationship between Systematic ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.

Null Hypothesis H10: There is no relationship between Serendipity/Fortuitous ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.
Alternate Hypothesis H10: There is a relationship between Serendipity/Fortuitous ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.

Null Hypothesis H11: There is no relationship between Social Media ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.
Alternate Hypothesis H11: There is a relationship between Social Media ISBT and (i) effectiveness, (ii) efficiency, (iii) quality (iv) currency, (v) useable, (vi) relevance, (vii) reliability, (viii) accuracy, (ix) satisfaction, (x) context specific, (xi) time.

**Demographic factors**

Null Hypothesis H12: There is no relationship between Associate ISBT and (i) professional role, (ii) experience, (iii) qualification (iv) working condition (v) age.
Alternate Hypothesis H12: There is a relationship between Associate ISBT and (i) role, (ii) experience, (iii) qualification (iv) working condition (v) age.

Null Hypothesis H13: There is no relationship between Cognitive ISBT and (i) professional role, (ii) experience, (iii) qualification (iv) working condition and (v) age.
Hypothesis H13: There is a relationship between Cognitive ISBT and (i) role, (ii) experience, (iii) qualification (iv) working condition (v) age.

Null Hypothesis H14: There is no relationship between Systematic ISBT and (i) professional role, (ii) experience, (iii) qualification (iv) working condition and (v) age.
Alternate Hypothesis H14: There is a relationship between Systematic ISBT and (i) role, (ii) experience, (iii) qualification (iv) working condition (v) age.

Null Hypothesis H15: There is no relationship between Serendipity/Fortuitous ISBT and (i) role, (ii) experience, (iii) qualification (iv) working condition (v) age.
Alternate Hypothesis H15: There is a relationship between Serendipity/Fortuitous ISBT and (i) role, (ii) experience, (iii) qualification (iv) working condition (v) age.
Null Hypothesis H16: There is no relationship between Social Media ISBT and (i) professional role, (ii) experience, (iii) qualification (iv) working condition and (v) age. Alternate Hypothesis H16: There is a relationship between Social Media ISBT and (i) role, (ii) experience, (iii) qualification (iv) working condition (v) age.

5.5 SUMMARY
In an effort to establish project actors ISBTs, and to identify the factors that influence these behaviours, a review of the extant literature was presented. This revealed unique traces of ISBs of construction project actors that reflects the ISBs identified in other occupations. Synthesis of the ISBs resulted in the categorisation of the five ISBTs (such as Cognitive, Systematic, Associate, Serendipity/Fortuitous and Social Media) exhibited by project actors in the construction sector.

Discussion of the factors that influence actors’ information-seeking and information use/task performance behaviours led to identification of 22 factors. These factors (include professional role, experience level, qualification level, age, condition of work, employment sector, organisational setup, context specific, effectiveness, efficiency, currency, useable, relevance, reliability, accuracy, satisfaction, quality, sources/channels, trust, accessibility, collaboration, and time) were categorised into information-seeking and information use/task performance influencing factors.

A conceptual model of actors' ISBT(s) was formulated to present the association of the influencing factors and the ISBTs. The model presents a systematic approach for assessing the presence of the five ISBTs in construction organisations and the project environment and their associations with the identified factors. The model proposes that actors’ ISB preferences are underpinned by the key factors that influence their information-seeking and information use/task performance. Hence, the hypotheses provide evidence-based justification. In general, the conceptual framework represents an imperative advancement of this research towards bridging the gap between actors’ ISBTs and the factors that influence such behaviours. Empirical verification of the conceptual framework requires a research design that specifies data collection and analysis approach, strategy of inquiry and the underpinning philosophical positions.

The next chapter present the research design that underpins this research.
CHAPTER 6: RESEARCH METHODOLOGY

6.1 OVERVIEW

This research focuses on the social aspect of project actors’ IB in the AEC sector in order to define their ISB orientations and the factors that influence their information-seeking and information use/task performance behaviours. The object is to develop strategies to enhance actors' ISBs in order to align their preparedness in an integrated and collaborative project environment and organisation management.

The systematic review in the previous chapters resulted in identification of five ISBTs and the key factors that influence actors ISBs. This resulted in a conceptual framework from which hypotheses were formulated to enable empirical investigations of the knowledge gap. Therefore, this section presents an overview of the adopted research design for the empirical investigation.

A sequential exploratory strategy (Creswell, 2009; Knight and Ruddock, 2008) was adopted for this study. This strategy employs qualitative data collection and analysis approach followed by quantitative data collection and analysis to build on the results of the qualitative inquiry. Hence, this research employed the mixed method research design to investigate project actors' ISBs. This approach was chosen to explore and establish the current IB/ISBs of construction project actors and the factors that underpin their ISBs. This helped to develop a quantitative instrument to capture the main data for this study.

A sequential exploratory study to investigate the IBs/ISBs of project actors in construction organisation was carried out first. This involved semi-structured interview with purposefully selected professionals from UK construction companies, followed by a quantitative inquiry. A robust research design to investigate and verify the conceptual framework of actors' ISB and the influencing factors was defined. This chapter partially addresses research objectives three, four, five and six.

6.2 RESEARCH DESIGN

Research designs are plans and procedures that detail decisions and assumptions to which a research is conducted to provide answers to research questions (Creswell, 2009). It presents detailed plan on methods of data collections and
analysis, and decisions involved in the research. As mentioned earlier, this research started initially with a systematic literature review and an exploratory study of actors’ IBs/ISBs, the outcome of which resulted in five ISB types and the influencing factors. Creswell (2009), posits that the selection of appropriate research design should be framed around intersection of three key elements: *philosophical worldview, strategy of inquiry* and *research methods*. This reveals the sequences of activities that underpin a research. Figure 6.1 present the research framework for this study.

![Figure 6.1 Framework for research design](adapted from Creswell (2009))

The three main research types (*qualitative, quantitative* and *mixed methods*) (Creswell, 2009; Bryman, 2012; Saunders et al., 2011; Fellows and Liu, 2009) in social research forms the basis for this study. These methods are commonly adopted by construction management researchers (Dainty, 2008; Knight and Ruddock, 2008). A brief discussion of the philosophical lenses, strategic approaches and research methods to explore the approaches to data collection and analyses is presented in the following sections.

**6.2.1 Philosophical Paradigms**
Philosophical ideas have always influenced research practice though they remain hidden; hence, they need to be identified to justify the foundation for a research (Slife and Williams, 1995). Easterby-Smith et al. (2008), identified three main reasons why an understanding of philosophical paradigms are useful in a research.
(1) They clarify research design by providing answers to questions under investigation. (2) It helps to recognise appropriate workable designs from non-workable designs in order to identify limitations to a particular approach. (3) It helps to identify and create unique designs outside the domain of expertise.

**Epistemological Worldview**

This concerns a set of assumptions that helps to enquire about the worldview of context in a study (Knight and Ruddock, 2008). Easterby-Smith et al. (2008), consider epistemology as the general set of assumptions about the best way of inquiry into the nature of the world. Hence, epistemological worldview helps to acquire knowledge, justify the knowledge and interpret findings to establish a desired certainty. There are many aspects of epistemology; however, for the purpose of this research positivism and interpretivism are considered.

**Positivism**

According to Bryman (2012), positivism is “an epistemological position that advocates the application of methods of natural sciences to study social reality and beyond”. The positivist assumes that a researcher begins with a conceptual idea, transforms the idea into a theory, collects data that either support or refute the theory and then makes revisions to further test the theory (Creswell, 2009). This assumption holds true for many forms of traditional science and social science research. The positivist lean more towards a quantitative research approach than qualitative approach (Creswell, 2009; Bryman, 2012).

According to positivists, the researcher should be objective and detached from the research (Bryman, 2012). The positivist considers the properties of the social world to be measured through objective methods, rather than inferred subjectively through sensation, reflection or intention since the social world exist externally (Easterby-Smith et al., 2008). With this approach, the reality of the research is captured using research instruments such as questionnaires and experiments. The positivist believe that social science procedures should mirror as near as possible, those of the natural sciences (Blaxter et al., 2010; Saunders et al., 2012). They believe that knowledge is autonomous of human beings and can be captured using some different means. The positivist paradigm provides wider coverage of the
range of situations; it can be fast and economical, particularly when statistics are aggregated from large samples (Easterby-Smith et al., 2008).

On the down side, the positivist paradigm can be inflexible and artificial to the extent that it can be ineffective in understanding the processes or the significance people attach to actions, and not helpful in generating theories. This is because the focus on what is or what has been, makes it difficult for policy makers to infer what changes and actions should take place (Easterby-Smith et al., 2008). There are different methods of positivism research approach, the common one being quantitative approach where questionnaires are used to capture data and statistics and/or experiments are used to analyse the data. Hence, epistemological positivism underpins the philosophical view of this research.

**Interpretivism**
The interpretivist considers culture and history (past event) to interpret the social world in a social research. The interpretivist researcher demonstrates a good understanding of conducting research between objects and people and a clear understanding of the role of people as social actors. The interpretivist tries to understand the world view of research participants from their point of view which is often difficult to establish (Saunders et al., 2012). They lean more towards a qualitative research approach than quantitative approach which is in direct contrast epistemologically to positivism (Bryman, 2012).

Whilst the positivist sees reality as something that can be studied, observed and modelled, an interpretivist sees reality as something that can only be interpreted. With interpretivism, the researcher interprets the social action of participants in accordance with their knowledge and experience of the context under study. Interpretivist rely on participant observation (reality) and transcript analysis to establish a good understanding of the details of human interactions in context. Some variants of interpretivism include hermeneutics, phenomenology and symbolic interactionism (Blaxter et al., 2010).
6.3 ADOPTED RESEARCH PARADIGM

The adoption of a particular research paradigm concerns with whether the research outcome is based on facts rather than impressions (Saunders et al., 2012). It also depend on whether the research responds to central research questions and/or hypothesis testing (Creswell, 2009). In addition, a conceptual framework tends to steer the researcher to be pragmatic about the type of research instrument to adopt and the variables to include. Hence, the philosophical paradigm adopted in this research is the positivist, which is generally designed as a quantitative strategy. The fundamental principle of positivism is to identify regularities and relationships in collected data to create law-like generalisations of the research outcome. This implies the reasoning behind this research is the deductive approach. This is an epistemological worldview where the social actions of people are interpreted in relation to their values and meanings, knowledge and experience on the context of their work. The positivist approach is undertaken in a ‘value-free way’, where the researcher is independent of the data and maintains an objective stance.

Although this study adopts the quantitative approach to collect the main empirical data, it was imperative to explore qualitatively, the IBs/ISBs of actors in construction organisations to establish a good insight into their ISB activities. This is also due to a dearth of IB/ISB research in this arena. In addition, the intent for undertaking explorative qualitative inquiry at the initial stages of this research was due to the lack of significant literatures or theories defining construction project actors ISB. This presented a primary view about the IBs/ISBs of actors in construction project organisations. Synthesis of the outcome of the initial exploratory study with literature findings helped to categorise the characteristics of construction project actors’ IB activities into the five ISBTs and to identify the key factors that influence such ISBTs during task performance.

According to Creswell (2012), sequential mixed method procedure facilitates a structured view of meaning of the phenomenon and allows a generalisation of research findings to a population. With this approach, a researcher may begin a research with a qualitative interview for exploratory purposes and then follows up with a quantitative survey to a population. Alternatively, a researcher may begin with a quantitative method (in which a theory or a concept is tested), followed by
qualitative method involving detailed exploration (Creswell, 2009). Therefore, the sequential exploratory study was applied at the initial phase of this research to investigate the ISBs of construction project actors where an initial qualitative inquiry (semi-structured interview) was undertaken followed by the main quantitative inquiry (questionnaire survey).

Therefore, the sequential mixed method research strategy was adopted for this study. This research approach has been applied in different arenas in academia, more importantly in construction sectors. For example, Manu (2012), used this approach to investigate the Health and Safety activities of construction professionals. Similarly, Ankrah (2007), used it to investigate the impact of culture on construction project performance. Others such as Al-Muomen (2009), and Mohamed-Arraid (2011), used this approach to investigate the IBs/ISBs of professionals in LIS and healthcare sectors.

6.4 RESEARCH METHODS AND STRATEGIES
The leading research strategies among social researchers are qualitative and quantitative, which are often presented as two competing alternatives. According to Creswell (2009), they should not be viewed as two polar opposites or dichotomies since they present different perspectives to the research context. Other writers argue that the differences between qualitative and quantitative research is based on their epistemological foundation (Blaxter et al., 2010; Bryman, 2012). A third paradigm, which is mixed methods, tends to combine or extract elements of both qualitative and quantitative forms. Figure 6.2 shows the three types of research design methods which dominate in construction management research (Dainty, 2008; Knight et al., 2008). A clear distinction between quantitative and qualitative is often the data collection approach and type of data collected. Whereas qualitative method is framed in terms of using words and/or open-ended questions (qualitative interview questions); the quantitative method is framed using numbers or closed-ended questions (quantitative hypotheses).
6.4.1 Quantitative Research Method
Quantitative research refers to an empirical research which employs experimental and survey research strategies to collect data in the form of numbers. According to Creswell (2009), quantitative research explores different dimensions of testing objective theories by examining the relationship between collected data. This data is then measured and tested using developed instruments/tools to determine the ‘how’ and ‘what’ questions, and then analysed using statistical approach (Creswell, 2008; Easterby-Smith et al., 2008). The validity of quantitative research is often linked to the sample size (often on a large-scale) to represent the set of data. Blaxter et al. (2010), argues that quantitative research is perceived or presented as the gathering of ‘facts’ which is fairly true, since numbers presents factual and vivid outcome of a study. A distinct characteristic of this method of research is that, the researcher remains independent and detached from the process (Coombes, 2001).

6.4.2 Qualitative Research Method
In contrast, qualitative research refers to an empirical research where the collected data is in the form of words, with much emphasis on theory generation (Bryman, 2012). This is affirmed by Blaxter et al. (2010), as a form of research concerned with collecting and analysing information in many forms in a non-numeric way as possible. Qualitative research is therefore a means of exploring and analysing the cognitive understanding of individuals to a social or human problem (Creswell, 2009). With this method of research, the researcher is involved closely with an individual or group of individuals in the process (Coombes, 2001). This method of research continues to grow in popularity due to the flexible nature of its outcome,
which is often based on the cognitive interpretation of the researcher. Creswell (2009), posit that researchers who engage in this form of research support the inductive style, which focuses on individual meaning, and the importance of rendering the complexity of the situation. Table 6.1 presents differences between qualitative and quantitative research methods.

Table 6.1 Difference between qualitative and quantitative research methods [adapted from Blaxter et al. (2010) and Bryman (2012)]

<table>
<thead>
<tr>
<th>Qualitative paradigm</th>
<th>Quantitative paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductive: generation of theory</td>
<td>Deductive: testing of theory</td>
</tr>
<tr>
<td>Concerned with understanding behaviour from actor’s own frames of reference</td>
<td>Seeks the facts/causes of social phenomena</td>
</tr>
<tr>
<td>Interpretivism</td>
<td>Natural science model, in particular positivism</td>
</tr>
<tr>
<td>Naturalistic and uncontrolled observation</td>
<td>Obstructive and controlled measurement</td>
</tr>
<tr>
<td>Constructionism and subjective</td>
<td>Objectivism</td>
</tr>
<tr>
<td>Close to the data: the ‘insider’ perspective</td>
<td>Removed from the data: the ‘outsider’ perspective</td>
</tr>
<tr>
<td>Grounded, discovery oriented, exploratory, expansionist, descriptive, inductive</td>
<td>Ungrounded, verification oriented, reductionist, hypothetic-deductive</td>
</tr>
<tr>
<td>Process-oriented</td>
<td>Outcome-oriented</td>
</tr>
<tr>
<td>Valid: real, rich, deep data</td>
<td>Reliable: hard and replicable data</td>
</tr>
<tr>
<td>Un-generalizable: single case studies</td>
<td>Generalizable: multiple case studies</td>
</tr>
<tr>
<td>Holistic</td>
<td>Particularistic</td>
</tr>
<tr>
<td>Assumes a dynamic reality</td>
<td>Assumes a stable reality</td>
</tr>
</tbody>
</table>

6.4.3 Mixed Method Research
This research approach integrates elements of qualitative and quantitative research methods. According to Creswell (2009), it involves philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both. This method goes beyond simply collecting and analysing data from two different approaches. It ensures a ‘richer’ and greater ‘strength’ in outcome of analysed data than either qualitative or quantitative research. Table 6.2 compares the three main research methods.
Table 6.2 Qualitative, Mixed and Quantitative methods [adapted from Creswell (2009)]

<table>
<thead>
<tr>
<th>Qualitative Methods</th>
<th>Mixed Methods</th>
<th>Quantitative Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging methods</td>
<td>Both pre-determined and emerging methods</td>
<td>Pre-determined</td>
</tr>
<tr>
<td>Open-ended questions</td>
<td>Open &amp; closed-ended questions</td>
<td>Instrument based questions</td>
</tr>
<tr>
<td>Interview, observation, document, &amp; audio-visual data</td>
<td>Multiple forms of data drawing on all possibilities</td>
<td>Performance, attitude, observational &amp; census data</td>
</tr>
<tr>
<td>Text and image analysis</td>
<td>Statistical and text analysis</td>
<td>Statistical analysis</td>
</tr>
<tr>
<td>Themes, pattern interpretation</td>
<td>Across databases interpretation</td>
<td>Statistics interpretation</td>
</tr>
</tbody>
</table>

6.5 RESEARCH THEORIES

Research theories provide in-depth knowledge of how to design a research question, guide the sample group selection and relevant data to acquire. It provides the basis for data interpretation and helps to define causal factors. Robson (2011), defines theory as a proposed explanation of a phenomena or a set of occurrence. However, Creswell (2009), states that a theory is an “interrelated set of constructs or variables formed into proposition, or hypothesis, that specify the relationship among variables”. Thus, theories provide a comprehensive conceptual analysis of events or activities that lack formation. Theories tend to explore two main approaches in relation to how experience influences behaviour. This is relevant to deductive and inductive theories (Bryman, 2012; Schwandt, 2001).

Gray (2013), posit that deductive and inductive theories help to establish whether a theory should be the outcome or the originator of a research. According to Bryman (2012), deductive theory is applied when a derived research outcome is logically true. On the other hand, inductive theory is applied when conclusions support the identified research gap (Bryman, 2012). Table 6.3 presents differences between these theories.
Table 6.3 Comparison of deductive and inductive theories [adapted from Bryman (2012)]

<table>
<thead>
<tr>
<th>Logic</th>
<th>Deduction</th>
<th>Induction</th>
</tr>
</thead>
<tbody>
<tr>
<td>In a deductive inference,</td>
<td>In a deductive inference, when the premise are true,</td>
<td>In an inductive inference, known premises are used to generate untested</td>
</tr>
<tr>
<td>when the premise are true,</td>
<td>the conclusion must also be true</td>
<td>conclusions</td>
</tr>
<tr>
<td>the conclusion must also be</td>
<td></td>
<td></td>
</tr>
<tr>
<td>true</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generalisability</td>
<td>Generalising from the general to the specific</td>
<td>Generalising from the specific to the general</td>
</tr>
<tr>
<td>Use of data</td>
<td>Data collection is used to evaluate propositions or hypothesis related to</td>
<td>Data collection is used to explore a phenomenon, identify themes and</td>
</tr>
<tr>
<td></td>
<td>an existing theory</td>
<td>patterns and create a conceptual framework</td>
</tr>
<tr>
<td>Theory</td>
<td>Theory falsification or verification</td>
<td>Theory generation and building</td>
</tr>
</tbody>
</table>

**Deductive Theory**

With deductive theory, the researcher acquires specific information from general information. The researcher deduces a theory (through literature review) at the initial stages of the research and then designs a strategy to test and validate the theory (Bryman, 2012; Gill and Johnson, 2010). This includes developing research questions or hypothesis and testing the theory for validity (Bryman, 2012; Gray, 2013). Deductive theory is associated with quantitative research method where the focus is on using data to test theory (Bryman, 2012; Saunders et al., 2012). Figure 6.3 shows the process of deductive theory where the researcher proposes a theory, and then deduces a hypothesis on the bases of knowledge discovered throughout the research processes.

![THEORY Diagram](image)

**Figure 6.3 Deductive approach [adapted from Bryman (2012)]**

This leads to empirical analysis before drawing conclusions about the validity of the hypothesis and the theory. Hence, this study employs the deductive theory approach to conceptualise actors' ISB framework and the factors that influences
such ISBs. This theoretical approach is used to collect empirical data, analyse the data and then test the framework for validity.

**Inductive Theory**

Figure 6.4 presents the inductive theory, where the researcher collects data to explore a phenomenon and then produces a theory or a conceptual framework to confirm the outcome of the data (Bryman, 2012). The inductive researcher tends to recognise the reality within the context of study, and then formulate a theory out of the collected data. Due to the constraints of the researcher, the inductive approach tends to use a small sample for the study than the deductive approach. Inductive approach leans towards qualitative method and uses a variety of methods to collect data in order to establish different viewpoints.

![Figure 6.4 Inductive approach [adapted from Bryman (2012)]](image)

### 6.6 RESEARCH STRATEGIES OF INQUIRY

Although this research leans towards the sequential mixed method, there is the need to identify the specific research strategy of inquiry. A strategy refers to a plan of action to achieve an outcome. A research strategy in this context refers to the specific type of qualitative and quantitative design that offers direction and simplicity for the research design process. Discussion of some relevant strategies of inquiry adopted for this research is presented in the subsequent sections. These strategies are summarised in Table 6.4.
Table 6.4 Alternative strategies of inquiries [adapted from Creswell (2009)]

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Mixed Methods</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Experimental designs</td>
<td>➢ Sequential</td>
<td>➢ Narrative research</td>
</tr>
<tr>
<td>➢ Non experimental designs</td>
<td>➢ Concurrent</td>
<td>➢ Phenomenology</td>
</tr>
<tr>
<td>(such as surveys)</td>
<td>➢ Transformative</td>
<td>➢ Ethnographies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>/observation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Grounded theory studies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Case study</td>
</tr>
</tbody>
</table>

6.6.1 Quantitative Research Strategies
Quantitative research strategy is based on numerical attributes and objective measurements to provide relevant answers to research questions. With this type of research, the researcher formulates theories or hypothesis and then tests them to draw specific conclusions. Quantitative research examines the relationship between measured and analysed variables with the help of statistical tools and techniques to validate its relevance. It generally uses questionnaires (close-ended questions) to collect instrument-based data and then apply statistical tools and techniques to analyse the data and draw relevant conclusions. For validity, credibility and acceptance, large and representative samples often form the basis for which data is collected and analysed. Quantitative research is philosophically attune with the positivist paradigm especially when used in conjunction with predetermined and structured data collection methods (Saunders et al., 2012).

The research approach applied here is deductive, where a relationship is established between the research (data) and theory with emphasis on theory testing. According to Bryman (2012), quantitative research present a social reality view as an external objective reality. Experimental and survey research strategies are the principal strategies associated with quantitative research. These strategies are briefly discussed below.

Experimental Research
This strategy determines whether a specific behaviour affects an outcome by providing specific treatment to one party and withholding treatment for the other party before determining the performance of both parties on the final outcome (Creswell, 2009). Experimenters often use hypothesis rather than research
questions to test the impact of treatment of the outcome. This strategy is often used in exploratory and explanatory research to answer the ‘what’, ‘how’ and ‘why’ questions (Saunders et al., 2012). Experiment features strongly in the physical and social sciences however; it originates from the natural sciences where laboratory-based research and field-based experiments are linked to physical and social sciences respectively. Different experiments such as true experiments and quasi-experiments may be used, each with different advantages and disadvantaged in relation to control variables and confounding variables (Saunders et al., 2012).

**Survey Research**
A survey strategy is associated with deductive research approach. It uses numeric description of behaviour, attitudes, trends or opinions of a population by studying a sample of that population (Creswell, 2009). This comprises of longitudinal and cross-sectional studies employing questionnaires or structural interviews for collecting data, with the intent to generalise the outcome from a sampled population (Creswell, 2009). Cross-sectional surveys collect data at the same time and in a short-term period, whereas longitudinal survey collects data over a long period.

The use of questionnaires allows standardised data to be collected from a sizeable population, which is very economical and allows easy comparison. The collected data helps to establish possible reasons for patterns or relationships between variables, and to produce models of the relationships. However, this strategy is perceived to be very authoritative and is both comparatively easy to explain and understand (Saunders et al., 2012). Survey strategy is largely used to answer the ‘what’, ‘who’, ‘where’, ‘how much’ and ‘how many’ questions (Saunders et al., 2012).

**6.6.2 Qualitative Research Strategies**
Qualitative strategy lays much emphasis on words and the meaning ascribed to a phenomenon rather than quantification in data collection and analysis. This strategy is associated with the interpretive philosophy. This is because researchers tend to make sense of the subjective and socially constructed meanings expressed about the phenomenon under study (Saunders et al., 2012). Qualitative researchers often operate in a naturalistic setting or within the research context in order to establish trust, participation, access to meaning and in-depth understanding of the process.
Qualitative research strategy employs the inductive approach to establish the relationship between theory and research, with much emphasis placed on theory generation (Bryman, 2012).

Many qualitative research strategies share a common ontological and epistemological roots and common characteristics with specific emphasis and scope and set of procedures. Some of these strategies include case study research, ethnography/participant observation, grounded theory, phenomenological research, and narrative research (Creswell, 2009; Saunders et al., 2012).

**Case Study**

Case study is an empirical strategy of inquiry that investigates a contemporary phenomenon in depth and in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2009). With this strategy the researcher explores in depth; a program, event, activity, process, or one or more individuals (Creswell, 2009). Researchers often use a case study strategy because it helps to understand real-life phenomenon in context. Cases are time and activity bound, and a variety of data collection procedures are used to collect data over a sustained period. Yin (2009), provides a detailed treatise on case study research design, methods and implementation strategies.

**Ethnography/Participant Observation**

Ethnography which is described as participant observation by some researchers due to its similarities is simply used to study groups (Bryman, 2012; Saunders et al., 2012). With this strategy, the researcher studies an intact cultural group in a natural setting over a prolonged period by collecting primarily; observational and interview data (Creswell, 2009). The researcher observes behaviour, listens to what is said in conversations, and ask questions (Bryman, 2012). Typically, both ethnography and participant observation strategies gather further data through interviews and documents. The ethnography strategy is very flexible and evolves contextually in response to the lived realities encountered in the field setting (Creswell, 2009).
**Grounded Theory**
With this strategy, the enquirer derives a general abstract theory of a process, action, behaviour or interaction grounded in the views of participants in the study (Creswell, 2009; Knight and Ruddock, 2008). This process involves multiple stages of data collection and the refinement and interrelationship of categories of information (Creswell, 2009). This strategy constantly compares data from emerging categories and theoretical sampling of different groups to maximise the similarities and differences of information (Creswell, 2009).

**Phenomenological Research**
With this strategy, the researcher identifies the essence of human experience about a phenomenon as described by participants (Creswell, 2009). The researcher studies the ways of participants to understand their worldview of their environment and the context in which they operate. The researcher remains neutral in terms of knowledge, and tries to understand the experiences of participants. This process makes phenomenology a philosophy as well as a method. The procedure involves studying small number of people through extensive and prolonged engagement to develop patterns and relationships of meaning (Creswell, 2009).

**Narrative Research**
This form of qualitative research inquiry present a story of a personal account to interpret an event or sequence of events (Saunders et al., 2012). With this strategy, the researcher studies the lives of individuals and asks one or more individuals to provide stories about their lives (Creswell, 2009). The researcher presents the gathered information into a narrative chronology. The narrative combines views from the participants' life with those of the researchers' life in a collaborative narrative (Creswell, 2009).

**6.6.3 Mixed Methods Research Strategies**
This approach of inquiry combines both qualitative and quantitative strategies in a single study (Creswell, 2009; Saunders et al., 2012). Research programmes where the problem(s) under investigation are such that both qualitative and quantitative data are required, mixed method strategy tend to offer in-depth strength to the study rather than a qualitative or quantitative research (Creswell, 2009). It involves
the amalgamation of philosophical assumptions, use of qualitative and quantitative approaches, inductive or deductive theories and the mixing of both approaches in a single study (Creswell, 2009; Saunders et al., 2012). Three general mixed method strategies are presented below.

1. **Sequential Mixed Method**

   This strategy comprises of more than one phase of data collection and analysis. The researcher relies on the findings of one method in order to expand or elaborate on the initial set of findings (Creswell, 2009; Saunders et al., 2012). The researcher may begin the study with a qualitative interview for exploratory purposes and then follow-up with a quantitative, survey method with a large sample and then generalise results to a population (Creswell, 2009). Alternatively, the researcher may commence the study with a quantitative method (questionnaire survey) to test a theory or a concept, followed by a qualitative method (interview) involving detailed exploration with few cases or individuals (Creswell, 2009). In both scenarios, the researcher explores the views of participants with the intent of building on these views with either quantitative or qualitative research to explore with a large population sample.

   Hence, this study employed the sequential mixed method strategy where a qualitative interview was conducted with purposefully selected professionals from UK construction organisations to explore their IB/ISB activities. Synthesis and analysis of findings from the exploratory inquiry with the systematic literature review findings resulted in extracting the five key ISBTs and the 22 key influencing factors. Based on these ISBTs, a quantitative survey instrument (see appendix C-2) was developed. The questionnaire was deployed to collect empirical data in order to test the five ISBTs and the influencing factors.

2. **Concurrent Mixed Method**

   With this strategy, the researcher converges or merges qualitative and quantitative data to provide a comprehensive analysis of the research problem (Creswell, 2009). The researcher collects data in a single-phase research, analyses the data and then integrates the information to interpret the overall results. This provides a richer and more comprehensive response to the research questions. In some
cases, the researcher embeds a smaller form of data in larger data collection in order to analyse different types of questions (the qualitative addresses the process while the quantitative addresses the outcomes) (Creswell, 2009).

3. **Transformative Mixed Method**

This strategy employs a theoretical lens as an overarching perspective within a design that contains both quantitative and qualitative data. The theoretical lens provides a framework for topics of interest, methods for data collection, and anticipated outcomes or changes (Creswell, 2009). Other data collection methods that involve a sequential or concurrent approach may be present in this lens. This method is not widely used due to the paucity of research on this strategy; hence, there is little guidance on how to use the theoretical lens to guide the methods. Table 6.5 present distinctions between qualitative, quantitative and mixed method approaches.
### Table 6.5 Distinction between qualitative, quantitative and mixed method approach [adapted from Creswell (2009)]

<table>
<thead>
<tr>
<th>Typically... Uses these philosophical assumptions</th>
<th>Qualitative approaches</th>
<th>Quantitative approaches</th>
<th>Mixed methods approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses these philosophical assumptions</td>
<td>Constructivist/advocacy/participatory knowledge</td>
<td>Positivist/Post-positivist knowledge claims</td>
<td>Pragmatic knowledge claims</td>
</tr>
<tr>
<td>Employs these theories</td>
<td>Inductive theory</td>
<td>Deductive theory</td>
<td>Either deductive or inductive theory</td>
</tr>
<tr>
<td>Employs these methods</td>
<td>Open-ended questions, emerging approaches, text or image data</td>
<td>Closed-ended questions, predetermined approaches, numeric data</td>
<td>Both open-ended and closed-ended questions, both emerging and predetermined approaches, and both quantitative and qualitative data and analysis</td>
</tr>
<tr>
<td>Uses these practices of research as the researcher</td>
<td>✓ Positions him-or herself ✓ Collects participant meanings ✓ Focuses on a single concept or phenomenon ✓ Brings personal values into the study ✓ Studies the context or setting of participants ✓ Validates the accuracy of findings ✓ Makes interpretations of the data ✓ Creates an agenda for change or reform ✓ Collaborates with the participants</td>
<td>✓ Tests or verifies theories or explanations ✓ Identifies variables to study ✓ Relates variables in questions or hypotheses ✓ Uses standards of validity and reliability ✓ Observes and measures information numerically ✓ Uses unbiased approaches ✓ Employs statistical procedures</td>
<td>✓ Collects both quantitative and qualitative data ✓ Develops a rationale for mixing ✓ Integrates the data at different stages of inquiry ✓ Presents visual pictures of the procedures in the study ✓ Employs the practices of both qualitative and quantitative research</td>
</tr>
</tbody>
</table>
6.6.4 Adopted Research Strategy

Since there is no right or wrong research strategy to adopt, it is practical for researchers to ensure that any chosen strategy is appropriate to address the research problem(s) under investigation. The choice of a research strategy is often split between positivist and interpretivist philosophies or between quantitative and qualitative methods. The combination of both, results in the mixed method strategy (Creswell, 2009). However, it is suggested that researchers should consider the philosophy adopted as a multi-dimensional set of continua rather than separate position (Saunders et al., 2012). Where such a continua can identify answers to questions such as (a) what is the nature of reality (ontology)? (b) what is considered acceptable knowledge (epistemology)? (c) what is the role of value (axiology)? Although philosophies are multidimensional set of continua it is still paramount for researchers to identify their position even though it might not be realistic to do.

Despite the suitability of qualitative and quantitative research approaches, it may be necessary for a researcher to combine both approaches with the view to acquire a deeper understanding of the research problem(s). Hence, a sequential mixed method strategy is the adopted strategy for this study. The inductive aspect of qualitative strategy and the deductive aspect of quantitative strategy make the mixed method more suitable for this kind of research. This research initially explored project actors’ IB/ISB activities in UK construction organisations and IB/ISB literature to extract key ISB types and influencing factors to formulate a conceptual framework. This exploration led to the development of research instrument, which was administered to a purposefully selected sample population (construction organisations) to capture quantitative data. The object of the quantitative data was to measure and test the ISB types and the influencing factors in relation to the conceptual framework. The outcome of which is to diagnose construction project actors’ ISB preferences, and the extent to which the key factors influence actors’ information-seeking and information use/task performance behaviours in project organisations. Figure 6.5 presents the research implementation plan overarching the sequential mixed method strategy.
The research plan demonstrates the sequential activities undertaken to accomplish the research. This plan is in line with current researches undertaken in construction management, which advocates for methodological pluralism. This methodological approach helped to broaden the understanding of actors ISBs in the context of construction organisation management and project delivery process. The initial exploratory qualitative approach was used to better understand actors’ ISB activities followed by the quantitative approach to measure the extent of actors’ orientation towards the ISBTs. The design of the research implementation plan comprises of deskwork, exploratory study, detailed empirical study and solution provision to address differences and complementary aspect of the study. Hence to achieve the overall research aim and respond to the research questions (figure 6.6), the qualitative and quantitative inquiries postulated by the overall research implementation plan (figure 6.5) now need to be undertaken.
6.7 QUALITATIVE INQUIRY

This stage of the research focused on investigating the IB/ISB activities of professionals in construction project organisations. The investigation was particularly aimed at understanding actors’ information-seeking, sharing and use behaviours during task performance. A qualitative exploratory approach is used in a research when there is limited amount of knowledge about the topic (Fellows and Liu, 2008). This tends to guide the researcher to ask open questions to discover and seek responses to what and how things happens or are done, and to gain insight about the problem under investigation. Qualitative inquiry is exploratory and explanatory in nature, in that investigations responds to questions relating to why and how and presents outcomes by describing responses to the how and the why questions (Creswell, 2009). As such, qualitative inquiry relies on different types of interviews to investigate the research problem. Commonly used qualitative
interview types include structured, semi-structured and unstructured. These define the extent to which responses are captured to the problem under investigation. The use of qualitative inquiry to investigate the IB/ISB related studies of professionals in different industry sectors is common among doctoral researchers (Al-Muomen, 2009; Barakat, 2009; Mohamed, 2011; Al-Dousari, 2009).

This section presents details of the exploratory qualitative inquiry to seek real answers to why and how construction project actors’ seek information, the channels and sources they use, and the factors that influence such behaviours. A semi-structured qualitative interview was used to investigate the IBs/ISBs of actors’. Characteristics of the three types of qualitative interviews are presented in table 6.6. This establishes the rational for selecting the semi-structured interview type.

6.7.1 Interviews
Interviewing involves the interviewer (the researcher), and the interviewee(s), where the researcher ask questions and hopes for answers from interviewees. This is the appropriate method of choice for qualitative researchers in both sociology and psychology disciplines (Robson, 2011; Saunders et al., 2012). Interviews can be used as a primary or the only approach in a study as in a survey or grounded theory studies (Robson, 2011). There are three main types of interviews; structured, semi-structured and unstructured interviews. A key distinction between these types is based on the degree of structure or standardization of the interview process including the questioning, composition and participants. Table 6.6 present the key characteristics of the three interview types.
Table 6.6 Characteristics of interview types [adapted from Robinson (2011) and Saunders et al., (2012)]

<table>
<thead>
<tr>
<th>Interview Types</th>
<th>Key Characteristics</th>
</tr>
</thead>
</table>
| Structured      | ➢ Uses predetermined questions with fixed wording.  
                  ➢ No room for flexibility in probing responses and questioning  
                  ➢ Uses high level open response questions  
                  ➢ Responses are recorded on a standardized schedule.  
                  ➢ Often used to collect quantifiable data |
| Semi-structured | ➢ Uses both formal and informal style of questioning  
                  ➢ Interviewers uses interview guide to serve as a checklist of topics (themes) to be covered  
                  ➢ Order of question tends to be varied depending on responses/flow of conversation.  
                  ➢ Interviewer is flexible with questioning  
                  ➢ Responses are open and flexible with questioning  
                  ➢ Follow up questions are asked based on what interviewee says  
                  ➢ Audio-recording devices or note taking are used to capture responses |
| Unstructured    | ➢ Informal style of questioning is used (no predetermined list of questions)  
                  ➢ Interviewer has general area of interest and concern but lets the conversation develop in this area.  
                  ➢ Interviewees respond in any order they like with no guidance/structure  
                  ➢ Interviewers tends to record or take notes of responses  
                  ➢ It is sometimes called informant interview because it is the interviewer’s perceptions that guide the interview process. |

From table 6.6, conclusions can be drawn that both semi-structured and unstructured interviews are widely used in flexible research designs. Both cases allow researchers to be flexible with their questions and investigations, whereas structured interview limit the researcher to a strict questioning style. Hence, this study adopts the semi-structured interview approach, as this allows the researcher to dig deep into the IBs/ISBs of construction actors' and seek flexible responses. Whilst it allows free flow of information from interviewees, it also allows the interviewer to have a guide note to help the questioning and the interview process.
**Preliminary Semi - Structured Interviews**

AEC activities heavily depend on creating and handling information at different stages of the construction PLC. More importantly, the information culture during the design development process is very critical to the outcome of the project. This rests on the IBs/ISBs and decision making processes of key actors involved during the design development phases. Hence, acquiring the right information at the right time is critical.

As previously noted, project actors’ spend about 40 to 66% of their working time processing, communicating and disseminating information (King, 1994; Lowe et al., 2004; Robinson, 2010). It has also been established that majority of construction projects fail because of delays associated with human behaviour activities (KPMG International, 2013). Hence, a phenomenologically driven semi-structured interview of purposefully selected construction professionals was conducted to seek professional opinion, knowledge, and experience in the project environment. The interview explored the nature of information-seeking, information sharing, and information use behaviour activities of these professionals to help validate literature findings.

To conduct the semi-structured interviews successfully, an interview schedule (see appendix B-3) was developed to support the interviewer in the process. The exploratory nature of the semi-structured interview was such that interviewees were given the freedom to express themselves whilst being guided on the themes of the problem under investigation. The industry professionals were questioned about their ISB preferences or orientations and the factors that influence their information-seeking and information use/task performance behaviours. Responses from these experts suggested that construction project actors’ clearly exhibit distinct ISB types (such as Cognitive ISB, Systematic ISB, Associate ISB, Serendipity/ Fortuitous ISB and Social Media ISB) that are influenced by key demographic, situational and/or environmental factors. The professionals indicated that their ISBs were influenced by certain key factors during the process. These discoveries confirm literature findings about actors’ ISBs in other sectors and occupations.
**Participant Selection for Exploratory Study**

Construction project delivery is such that key actors’ (including client, architects, designers, engineers, quantity surveyors, project managers, construction managers, and others) make important decisions at key stages of the Project Life Cycle (PLC). Capturing the right information at the right stage of the project is vital for successful decision-making. As indicated in the RIBA plan of works, the information intensive phases of the PLC include the preparation, concept design, design development, technical design and specialist design. Hence, interview participants were purposefully selected because of their experience and involvement in these phases of the project delivery process.

According to Creswell (2009), qualitative research combines perspectives and expert experiences. Hence, a semi-structured (face-to-face and telephone) interview was adopted because participants could not be observed directly due to their availability and scheduling issues, permit restrictions, and other ethical constraints. The semi-structured interview gave the interviewer control over line of questioning, and participants the freedom to provide historical information about their activities. Experts from prominent construction companies in the UK were purposefully targeted for the exploratory study.

A purposeful snowball sampling approach was adopted to select interview participants. This approach is very useful when there is difficulty in identifying members of a population (Bryman, 2012; Creswell, 2009; Saunders et al., 2012), which was the case in this study. In total, nine industry professionals were identified and selected for the exploratory semi-structured interview. Table 6.7 presents the demographic information of the participants. Prior to the interview, a pilot interview was conducted with two purposefully selected participants (an architect and a PhD construction management researcher). The pilot study was intended to check the duration/length of the interview, clarity and technical context of the questions, and response viability. The pilot study helped to refine and structure interview questions to follow a logical sequence, maintain an appropriate level of technical language usage, and to establish interview duration.
Table 6.7 Demographic information of participants

<table>
<thead>
<tr>
<th>No.</th>
<th>Role of participant</th>
<th>Years of experience</th>
<th>Employment Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design Engineer</td>
<td>15</td>
<td>Private</td>
</tr>
<tr>
<td>2</td>
<td>Civil Engineer - structures</td>
<td>4</td>
<td>Private</td>
</tr>
<tr>
<td>3</td>
<td>Planning Manager</td>
<td>11</td>
<td>Private</td>
</tr>
<tr>
<td>4</td>
<td>Project Manager</td>
<td>7</td>
<td>Private</td>
</tr>
<tr>
<td>5</td>
<td>Associate - Costing Commercial BIM Lead</td>
<td>11</td>
<td>Private</td>
</tr>
<tr>
<td>6</td>
<td>Construction Manager</td>
<td>28</td>
<td>Private</td>
</tr>
<tr>
<td>7</td>
<td>Senior Consultant (Project management, planning manager and Programme Manager)</td>
<td>30</td>
<td>Private</td>
</tr>
<tr>
<td>8</td>
<td>Quantity Surveyor</td>
<td>15</td>
<td>Public</td>
</tr>
<tr>
<td>9</td>
<td>Deputy Director - Facilities and Estate Management</td>
<td>28</td>
<td>Public</td>
</tr>
</tbody>
</table>

Average years of experience 16.6

From table 6.7, it can be seen that seven of the participants belong to private sector organisations whilst only two work in the public sector. The average years of experience is approximately seventeen (17). This indicates the credibility of the views of participants to this study. Not all nine participants were obtained at once.

Six interviews were initially conducted, where data was audio-recorded and transcribed verbatim. Analysis of data from the six interviews showed comparable but significant differences in responses. Hence, two additional interviews (seventh and eight) were conducted. At this point, there were no significant variations in responses, indicating a point of data saturation. However, since prior arrangement had already been made with the final participant, the final interview (the ninth) was conducted. In all, nine interviews were conducted to a desired data saturation point. Therefore, the limited number of participants interviewed was sufficient to establish significant parallels and differences in actors' ISBs in the project environment. On average, each interview lasted approximately 60 minutes (the point where all questions in the research instrument were answered). Interviews were audio recorded, transcripts were transcribed verbatim immediately after each interview. The entire interviews were conducted from November 2013 to February 2014.

During the interviews, participants were asked about their ISBs and the factors that influence such behaviours. The collected data was analysed thematically from
which five significant types of project actors’ ISBs emerged. Several other significant influencing information-seeking and information use/task performance factors were also identified during the interview process. These findings were compared to the literature review findings to establish the foundation for this research. Some aspects of these findings are published in Dzokoto et al. (2014).

6.7.2 Analysis of Interview Data
The emphasis of qualitative data generally rest on people’s (interviewees) lived experience. This forms the basis for establishing fundamental meanings, perceptions, assumptions, and judgements they place on events, processes and structures of their working lives; and how these meanings links to the social world around them (Miles and Huberman, 1994). Due to the exploratory nature of this phase of the research, the focus of the data analysis was to obtain themes and specific statements or patterns from participants. Bryman (2012), posit that theme provides a researcher with the basis for a theoretical understanding of data that can make a theoretical contribution to the literature relating to the research focus. According to Boyatzis (1998), a theme is a pattern found in the information that at minimum, describes and organises the possible observations and at maximum, interprets aspects of the phenomenon. Boyatzis (1998), posit that thematic coding is a process for encoding qualitative information.

Similarly, Robson (2011), posits that thematic coding is often used as a generic approach to qualitative data analysis. Some writers consider a theme as a code whereas to others, it transcends to a single code and is built up out of groups of codes (Bryman, 2012). Creswell (2009), identified six steps to qualitative research data analysis as linear and hierarchical approach. Hence, due to the exploratory nature of this phase of the research, analysis of the interview data followed Creswell’s (2009) hierarchical approach to qualitative interview data analysis where the first four steps was applied as detailed below:

- Step 1: Organise and prepare the data for analysis.
- Step 2: Thorough reading of the data to establish a general sense and overall meaning of the information.
- Step 3: Begin detailed analysis with a coding process (i.e. organise transcripts into segments before bringing meaning to information).
Step 4: Generate description of the setting or themes.

The coding process involves organising interview materials into segments of texts before bringing meaning to information (Creswell, 2009). According to Creswell (2009), the coding process can be achieved on (i) the basis of emerging information collected from participants, (ii) use predetermined codes and then fit the data to them, (iii) use common combination of predetermined and emerging codes.

In social science research, the traditional approach is to allow the codes to emerge during the data analysis. However; in health sciences, the popular approach is to use predetermined codes (Boyatzis, 1998) based on the theory being examined. In all cases, coding can be achieved through manual coding (by using colour code schemes, to cut and paste text segments). This type of coding is often useful when the volume of data is manageable, than by using qualitative software programmes (such as QSR NVivo, Atlas.ti, MAXqa, etc.), which is useful when the volume of data is large (Creswell, 2009; Miles and Huberman, 1994). Hence, for the analysis of the interview data, manual colour coding was applied since the volume of data from nine transcripts was manageable.

The audio-recorded data was transcribed verbatim, organised and re-read iteratively to capture events, realities, meanings and key themes. The extracted themes were put together into wider thematic segments to represent categories to establish key variations and parallels in interviewees' IBs/ISBs. The outcome of the thematic analysis of interview data was compared to emergent themes from literature to result in the classification of actors' ISBs into five main ISB types.

**Reliability and Validity of Qualitative Findings**

Although validation of findings occur continuously throughout the hierarchical qualitative analysis, it is important to establish some degree of accuracy and credibility in the findings and conclusions drawn. According to Gibbs (2007), qualitative validity is the process where the researcher employs certain procedures to check for accuracy of the findings, whilst qualitative reliability indicates a consistent approach across the process. Gibbs (2007), suggest several reliability procedures as applied to this research to include:
Check transcripts to ensure obvious mistakes are removed. This was achieved through thorough iterative re-reading of interview transcripts to correct any mistakes during transcription.

Ensure there is no drift and shift in the meaning of defined codes. This was also achieved by sticking to the systematic coding process and the emerging themes by avoiding any biases. And several validity procedures to include:

- Triangulate different data sources of information by examining evidence from the sources and using it to build a coherent justification for theme. This was achieved by comparing the qualitative findings to literature findings to ensure coherence and synthesis of the identified themes.
- Use member checking to determine the accuracy of qualitative findings. This was achieved through supervisors’ reading and feedback on the findings.
- Use rich, thick description to convey findings. This was achieved by describing and providing detailed discussions of the findings from different perspectives about themes to make the findings more realistic and richer.

Hence, the overall validity and reliability of the qualitative findings was achieved by comparing and amalgamating the qualitative findings with literature findings to establish the five types of actors’ ISBs, and the twenty-two (22) influencing information-seeking and information use/task performance factors (see chapter 4).

### 6.7.3 Ethical Considerations

In any research, it is vital to adhere to ethical issues by ensuring that appropriate steps are taken to protect respondents/participants during and after data collection. Hence, since this research involved participation of professionals, an ethical clearance checklist was completed (see appendix B-1) in accordance with Loughborough University guidelines. This document ensured that the research adhered to the principle of informed consent where participants were made aware of the purpose of the research, the nature of involvement, and voluntary participation. Participants were assured of confidentiality of their responses and personal details. In addition, the research was unbiased towards participant backgrounds, ethnicity, and sexual orientations in relation to the use of language.
6.8 SUMMARY

The object of this chapter was to justify the chosen procedure to collect and analyse the qualitative data. This is consistent with the chosen research philosophy (positivist research strategy), the research strategy (deductive approach), and the nature of data collection (semi-structured interview), which helped to verify the initial conceptual framework. Thus, a qualitative exploratory study was used to capture preliminary empirical data, which was then analysed thematically to arrive at the five main types of actors’ ISBs, and the factors that influence such behaviours as conceptualised in chapters 5. This chapter also set the scene to form the basis for the design of quantitative data collection instrument for the next phase of the research. Hence, this research employed a *sequential exploratory mixed method* research design with an initial qualitative exploratory inquiry followed by an in-depth quantitative inquiry. This is because the process of triangulation presents corroboration between qualitative and quantitative data, which enhances the validity of findings. By this corroboration, any limitation of each approach is neutralised while building on the strengths of each approach leads to a stronger inferences. Thus, both qualitative and quantitative methods were used at different stages of the research to avoid limitations of understanding project actors’ ISB activities that might not be captured by the use of one method.

The succeeding chapter focuses on the qualitative inquiry and the development of the quantitative inquiry. This affirms the identified types of actors’ ISBs and the influencing factors. The findings of the qualitative exploratory study are presented in the next chapter. It presents how these findings link to the development of the quantitative instrument.
CHAPTER 7: QUALITATIVE FINDINGS AND DEVELOPMENT OF QUANTITATIVE INQUIRY

7.1 OVERVIEW

This chapter presents the outcome of the qualitative inquiry and the development of the quantitative inquiry. It partly addresses research objectives three, four and five in terms of developing quantitative instrument to collect empirical data to measure the extent of actors’ ISBTs and how these behaviours are influenced by key factors during task performance in the project environment. This leads to verification of the conceptual model of actors’ ISBTs.

7.2 RESULTS OF THE QUALITATIVE INQUIRY

A critical incident technique was adopted where interviewees were asked to reflect on any task(s) or project(s) they have executed or been part of in the past two years and use their experience of seeking and using information to respond to the questions under consideration. Interviewees were all at different stages of diverse construction projects comprising of house building, refurbishment, through to infrastructure projects.

The findings from the analysis of the semi-structured interviews showed important variations and many parallels in actors’ ISBs in construction project organisations. It was established that interviewees rely on both formal and informal, and external and internal information sources and/or channels to meet their information needs and requirements. Interviewees indicated that where tasks/projects had been executed before, they usually seek information from different sources and/or channels both internal and external to their organisations including colleagues, internet, databases, extranet or common data environments, and other social media sources. However, for new tasks/projects where similar tasks had not been executed before, they rely on primary information (i.e. site visits, create new materials, rely on knowledge, experience and skills, information from client, other relevant stakeholders) and other sources/channels to meet their information needs.

In general, interviewees indicated that their first point of call when seeking information of any kind is to consider their knowledge, experiences and skills (i.e. cognitive ISB) to map-out information-seeking strategies in order to identify the
"where", "who" and "how" before initiating the search process. They also indicated that they follow “stages of appraisal” to ensure that correct procedures are followed to identify appropriate information channels/sources to help capture context specific information.

In general, interviewees agreed that they use both formal and informal information sources and channels (including accidental/incidental, personal or intrapersonal, face-to-face, structured or unstructured, and social media) both internal and external to their organisations to obtain appropriate information. Interviewees indicated that they try every means possible to capture the required and needed information; hence, “time” (i.e. delays are inevitable) is a major factor in their information-seeking and information use behaviours. They indicated that sometimes, it takes as long as possible (more than a week) to get the appropriate information to make decisions. Factors such as trust, accessibility, information quality, reliability, relevance, and context were considered to influence their information sources/channels selection, and the way they seek information for use.

The subsequent sections present details of interviewees’ responses under the five key headings (see appendix B-3 for interview guide). In general, interviewee responses reinforce literature findings and the conceptual ISB model in chapter 5.

7.2.1 Information Behaviour Characteristics
The IB/ISB process is a prime activity of project actors’ in Construction; therefore, by understanding these processes, a true representation can be established to help capture accurate responses to answer the research questions posed. The picture painted by interviewees suggests significant variations and some parallels in their ISB processes. Under this category, the question posed was “how do you meet your information needs to achieve the task(s) or project(s) at hand?”

This question was intended to capture actors’ opinions about how they meet their day-to-day information needs/requirements in the project organisation. From interviewee responses, it was established that actors’ meet their information needs/requirements in different ways. This depends on the type of project (infrastructure or housing or refurbishment and others), the stage of the project (design, implementation, termination/end and services). It also depends on project
complexity, size and structure of organisation, how advanced the organisation is in terms of information management systems/technology, and the sector (private or public) in which the organisation operate. Thus, actors’ ISBs are influenced by a variety of factors hence, the difficulty in establishing causal factors. However, they indicated that accessibility to information such as to attend briefing meetings, rely on formal/official specification documents, as built information, personal knowledge and experiences, experienced colleagues, the internet, and key stakeholders involved in the project was vital to meet their information needs. 

...generally, information channels/sources are indicated in the project delivery document which makes it easily accessible and often you tend to find out as and when the need arise …[Architect]. This was a comment from one interviewee that reflects the opinion of several others.

7.2.2 Personal/Situational Characteristics
This section was intended to capture the influence of demographic factors on interviewees’ ISBs. It was evident from interviewee responses that certain factors (i.e. demographic and situational) influence their ISBs. Factors such as experience, qualifications, and role were fundamental to the type of task/project they execute. These tend to influence the information channels/sources. Interviewees were asked to respond to the question “How does your qualification and experience influence the way you seek information to execute the task/project?”

Majority of interviewees indicated that their experience, knowledge and network of contacts were vital to how they seek information and the channel/sources they rely on. One interviewee stated that:

“...whenever I am faced with a task, because I am quite experienced and would have probably done such a task before, I usually rely on my knowledge and experience to try and execute the task to my abilities. I believe I’m able to do this because I have been in this position for well of 25 years and I know people and I have people who work with me to contact for any information that I need to get things done…” [Project Manager]

On the other hand, less experienced interviewees indicated that they rely on their knowledge and experiences however, they mostly rely on expert
colleagues or formal documents (such as specifications, design documents, and others) to meet their information needs.

“...I tend to rely on my experience and knowledge to try and execute the task. However, I always seek the opinion of expert and experienced colleagues to ensure that I have the appropriate level of information and that what I have done is correct in their opinion and conform to specifications. This tends to give me assurance and boost my confidence in the way I perform...” a response from an interviewee [Design Engineer].

Both responses indicate that demographic factors (such as experience, knowledge, qualification and role) influence actors’ ISBs and task performance. In addition, it was found that situational factors (such as task complexity, proximity and network of colleagues and other sources/channels) influence actors’ ISB preferences. The general response from interviewees reflects the views identified in literature (King, 1994; Kwasitsu, 2003; Robinson, 2010).

The construction process is heavily dependent on teams however; other roles and tasks require individuals to perform. Hence, interviewees were asked: “How does your working conditions (i.e. working in a team or working on your own) influence the way (i.e. sources and/or channels) you seek information for use?” This question was intended to understand whether situational factors such as condition of work and employment sector influence actors’ ISBs.

Responses from majority (i.e. three quarters) of interviewees indicated that their condition of work influences the way they seek information, the sources and channels they approach and the amount of time they spend doing so.

“...we always have team briefings where information about the task/project is shared amongst team members. In addition, since there are structures in the team, you always get the chance to ask a senior or a colleague for information regarding a challenging but difficult or a minor task. Working in a team always helps because you know there is always someone to ask for information. You get easy accessibility and very quick responses; hence I prefer to work in a team than on my own...”[Design Engineer – architect].

Similarly, another interviewee posits, “...working in a team challenges you to be creative and seek new knowledge and information from other colleagues and
sources since you always want to prove to the team members that you are capable and can do the task. There are always new information and new ideas from the team. I also seek information from the internet, technical documents and/or trade magazines and others, since these sources are freely available and easily accessible. I always rely on my knowledge and experience for most of my information to perform the task…” [Quantity Surveyor].

Other responses from interviewees who work on freelance basis indicate that since they work on their own, they are forced to try every available avenue to seek the needed information to execute the task. One interviewee stated, “…time is a critical factor hence, I'll pick up the phone and stay on the line until I get the needed information to perform my task. I will call a certain source (often many different sources) because I know and trust that they are capable of helping hence I will stay on the line until they help with the requisite information…” [Health and Safety officer]. This view was shared by another interview (a Facilities Manager).

Another interviewee posits “…if I try all avenues and I don’t get response, I normally go there in person (depending on the proximity and the urgency) to meet with the information sources face-to-face to get any information required to execute the task…” [Quantity Surveyor]. These findings are consistent with extant literature (King, 1994; Kwasitsu, 2003; Robinson, 2010).

7.2.3 Information Creation/ISB Orientations
Questions under this section were intended to establish the different information-seeking orientations interviewees’ exhibit during the information-seeking processes. In general, interviewees indicated that before initiating any information-seeking activity, they consider their knowledge (cognitive process) and experiences to map-out an information-seeking strategy to identify the where, who and how to search with the view to capture the right information within appropriate time frame. They also indicated that they go through “stages of appraisal” to ensure that the right procedure is followed. However, they emphasised that experience is very important to capturing the right information in time. For instance, interviewees’ were asked to respond to the question; “To what extent do you rely on your knowledge, (i.e.
memory, intuition, intelligence), experience and skills to meet your information needs for the task at hand?”

Responses from interviewees affirmed that personal knowledge (i.e. reliance on own intelligence, memory, and intuition), and experience is very important in project design and delivery process since it is expected for actors to act and behave as professional with credible knowledge to perform. Hence, they always rely on their own personal knowledge (cognition) first before consulting other information sources or channels or experienced colleagues for support.

An interviewee indicated that, “…I always try to get other members of the team to share my knowledge and vision of the task at hand and how I intend to approach it before proceeding in order to ensure that I have made the right decision since my professional integrity is always on the line…” [Architect]. This view was shared by other interviewees, which suggest that actors’ working in a team, more or less rely on their colleagues as much as they rely on their cognition for all kinds of information irrespective of level of knowledge and/or experience levels. These responses reflects cognitive information-seeking behaviour orientation.

Further, interviewees were asked to respond to the question: “To what extent do you rely on formal meetings, briefings, memos, official documents, company extranet, common data environment (including shared areas, personal libraries, or online catalogues/databases, and others) to meet your information needs for the task at hand?”

This question was intended to establish whether interviewees follow a systematic or a structured approach to seek information. Some interviewees stated that they sometimes consult physical and online libraries, trade magazines, journals, standards (BSI) and/or policy documents for specific details (e.g. to verify or validate) pertaining to the kind of project (mostly infrastructure projects) as stipulated in the briefing document. Thus, they apply a systematic or structured approach to verify and seek appropriate information.

“…I believe that if I spend time to seek the right context of information, I will be in a good position to effectively and efficiently execute the task successfully…” [Architect] a response from an interviewee.
Another interviewee stated that links to standardised information (such as regulations/policy documents/ RIBA document/BSI) requirement is often stated or identified in the procurement document which tends to suggest the kind of information management strategies to adopt and the sources/channels to consult for the right information. However, this is usually not adhered to, and most often result in problems.

Interviewees also indicated that they often capture some of their information from regular formal meetings, memos, databases, online catalogues, and personal emails. However, they indicated that information from meetings is mostly concerned with progress updates and other new materials.

Two interviewees indicated that though meetings are very important to the progress of the project, it could also be costly in terms of time wasting, due to repetition/duplication of proceedings. An interviewee indicated that meetings/networking at the initial stages of the project is vital since it helps to establish their information needs, information sources, information requirements and expectations of other stakeholders.

“There was this project where we had to have a weeklong team bonding meeting/exercise before the start of the project. In these meetings, our focus was on meeting the information requirements, overcoming language barriers, interoperability, and all other expectations of the clients and other stakeholders. Hence, we discussed all avenues and systems/processes available to ensure efficient and effective communication in order to achieve our targets. These meetings happened on regular bases (to review progress, address issues, etc.) throughout the duration of the project and I must say the project was successfully delivered…”[Construction Manager]. Other interviewees echoed this view.

In terms of the use of formal and informal channels/sources for seeking and disseminating information, interviewees agreed. They indicated that, regular meetings were held to disseminate new information, new ideas and to discuss issues relating to the project. It was evident in their responses that the use of common data environment, online catalogues/ search engines, emails, telephone, print materials, other information channels/sources, and most importantly face-to-
face channels for information was common in both private and public sector organisations.

Interviewees from the public sector indicated that they generally do not have effective information management systems; hence no effective strategies for managing their ISB process. However, they indicated that they often meet their information needs by going to the sources (e.g. field/site/stakeholder) to capture the raw data themselves or asking colleagues or specialists for the needed information. They indicated that urgent information is mostly captured via face-to-face meetings and/or through telephone calls, emails or formal request whereas non-urgent information is mostly captured though emails. Others indicated that they consulted personal information library or organisation information library to seek information.

In terms of information sources used, it was surprising to note that interviewees in general do not rely much on external sources (sources outside the project organisation such as the journals, trade magazines, web, social media and other professional social network) for their information.

Extant literatures suggest that engineers who work in teams predominantly rely on colleagues (i.e. associates) for majority of their information. Hence, in order to establish whether construction project actors exhibit similar ISB orientations, interviewees were asked to respond to the question: *To what extent do you rely on your colleagues and/or friends either internal or external to your organisation for vital information for task/project delivery?*

Responses from interviewees confirmed that project actors’ (who work in teams) mostly rely on their colleagues’ to seek information. Interviewees from both private and public sectors were in agreement on associate (i.e. face-to-face/colleagues) information capture. They indicated that it is the best form of seeking the right information. However, they were quick to point out that this process can be time consuming, costly to the project delivery process and not entirely guaranteed. This is because it depends on the source availability and accessibility. It was suggested that face-to-face information-seeking could be expensive and unreliable in that the information provider (the source) has to relieve themselves from their specific
duties to provide the needed information to the seeker. Hence, in situations where they (the source) are not available, it means the project/task cannot be achieved. An interviewee indicated that “…I always walk up to a colleague or pick the phone to call a colleague for majority of the information that I cannot get myself. This is because I trust that colleague because of his experience and knowledge. However, due to his busy schedule, I do not get him at all times and this can be very frustrating…” [Mechanical Engineer].

Similarly, interviewees were asked to respond to the question: “To what extent do you capture relevant information from informal or casual meetings (such as breaks, conferences, seminars, lectures, network sessions, team bonding exercises, and others) for use?” This question is in relation to the suggestion that the structure and composition of construction organisations encourages serendipity/fortuitous information encounters (i.e. Serendipity/Fortuitous ISB orientation). Responses from interviewees were quiet astonishing and supportive of the concept. Thus, some interviewees indicated that the only way to capture some kind of innovative and creative information is through serendipity/fortuitous encounters/discoveries. Responses from interviewees suggest that actors’ in the private sectors are more likely to orientate towards serendipity/fortuitous information-seeking than those in the public sector.

Private sector interviewees indicated that even though they may have centralised information management system, they favour other informal (e.g. search engines, social media, face-to-face, telephone, emails, networking, and others), formal (Request For Information (RFI), meetings, memo, and others) and other avenues for their information. They indicated that, they tend to attend events (i.e. conferences, workshops, lectures, seminars, and others) with the view to capture appropriate information, and trending concepts/ideas (e.g. BIM, and others).

“I have subscribed to institutions who update me with upcoming events and my company encourages us to attend such events because they believe and I believe it helps to develop and bring new knowledge and new insight into the way I work…” [Structural Engineer] This is a comment from one of the private sector interviewees. A design engineer from a public sector organisation shared this view as well.
“Often when I am faced with creating new designs or new documents, I tend to rely on the internet, social media (e.g. YouTube), and other websites with an open mind with the view to capture any accidental discoveries/encounters. This kind of information discovery is mind blowing, it happens anywhere and everywhere and it’s less stressful since you have zero expectations and the outcome is always serendipitous.” Another comment from a private sector interviewee, [Design Engineer-architect].

Another ISB orientation that has emerged in recent years amongst actors’ in information rich environment is the Social Media ISB. Thus, behind the hype about big data, fast speed internet, SMART gadgets and exposure to a plethora of information sources and/or channels is the confusion regarding actors’ use of this Social Media in their professional capacities. Hence, interviewees were asked to respond to the question: “To what extent do you freely visit social network sites such as LinkedIn, Twitter, YouTube, Facebook, blog/bloggers, and other social community centres to capture relevant information for use on the task delivery?” This question was intended to understand whether technology including SMART gadgets such as mobile phones, PDAs, tablets, notebooks and others linked to the internet influences actors’ ISB orientations towards Social Media and/or Serendipity/Fortuitous information seeking orientations.

A design engineer indicated that he often discovers serendipitous information through social media and that this avenue of information-seeking is less stressful, and can be done anywhere. Other responses suggest that actors’ use social media sites (such as YouTube, LinkedIn, twitter, and blogs) depending on the required information context, and the need for quick variety of responses for validation. For example, a designer indicated that he once posted a design on a bloggers site to solicit the views of people on the ‘network’ in order to make final decision and this helped to get quick and constructive responses.

Other interviewees also indicated that they do not consciously seek specific information from social media; however, through random search for general information from such sites, they encounter vital information for use. Some interviewees also indicated that they join bloggers, and other network communities
to share, seek and discuss other relevant topics. For example, “...I am currently in a group where we regularly debate and discuss issues with BIM implementation and how the entire BIM processes is catching up...” [Supply chain Manager].

Other interviewees did not use social media for their information-seeking process. One interviewee indicated, “I do not subscribe to these things. I generally rely on my knowledge, experience, documents, standards, textbooks, manuals, and the library to seek whatever information I require. I have always succeeded in doing so; hence, I do not see the point in using social media. But I must admit that I know colleagues who use it and my organisation encourages its use” [Project Planner].

7.2.4 Information Seeking Sources/Channels
This section of the interview was to establish actors’ information-seeking orientations/preferences. Hence, interviewees were asked to respond to the question: “Which channels and/or sources (e.g. colleagues, face-to-face, telephone, video conference, mails, cloud systems, extranet, internet, social media, library, journals, peer reviewed articles, meetings, trade magazines, technical documents, etc..) do you rely on for majority of your information and why?”

Responses from interviewees were generally, a reflection of the five key ISB orientations already established from extant literature and from responses to earlier questions. Interviewees indicated that formal meetings were generally held to disseminate new information, discuss new ideas and issues relating to the project/task. They indicated that channels/sources such as emails, telephone, common data environments, shared network areas, and extranet are routinely used on day-to-day basis to seek or share information. They also indicated their preference to internal sources or formal sources and channels of communications for information to external sources.

Interviewees stated that they sometimes consult trade magazines/journals/standards and/or policy documents for specific details pertaining to the kind of project (e.g. infrastructure projects). They sometimes consult information library for key reference checks. One interviewee stated that “…standardised information (such as regulations/policy documents) requirement are often stated in the type of procurement employed which tends to suggest the kind of information management
strategies to adopt and the sources to consult for the right information, however; this is usually not adhered to, and most often result in problems…” [Civil Engineer]. On the other hand, interviewees indicated that they rely on both print and electronic means to capture information. Interviewees from the private sector indicated that they scan and save any captured print format information as a Portable Document Format (PDF) document onto a shared area. In contrast, public sector interviewees did not bother much on transferring print documents onto electronic system (due to lack of systems). Interviewees were in agreement with face-to-face information capture. They indicated that this type of information-seeking and dissemination could be expensive and/or unreliable due to the availability and accessibility of the information provider.

**Information Management Systems**
Responses from some interviewees in the private sectors indicated that their organisations invest heavily in information management systems. They emphasised that, time is critical hence, they would rather spend less time capturing, sharing, retrieving and storing information; however, this is always not the case. In contrast, interviewees from the public sector suggested a lack of effective central information management systems. Actually, they indicated that individuals would protect their information on their private or personal systems (e.g. computers, storage devices, cloud, etc.) for use by themselves. Some private sector interviewees also shared this view.

**Information Library Systems**
The interviews revealed that majority of organisations do not subscribe to information library systems. However, some organisations have information cabinet or archival (i.e. internal libraries – both physical and electronic) where majority of documents/information are kept for references and other support. It was revealed that organisations subscribe to relevant trade magazines, publications, and industry standards, online catalogue services, online journals/articles or internet search engines (such as Google) and other social network sites (i.e. YouTube) to enhance information capture. For example, one interviewee indicated that whilst working on a specific environment and utility project (wind turbine project); it was mandatory to seek context specific information from special organisations/agencies to ensure
that the right information is captured to avoid any future events or delays. Some interviewees also indicated that they subscribe to personal and private information sources for use.

7.2.5 Information-Seeking and Information Use/Task Performance Behaviours

Factors

It was found through extant literature that actors’ IBs/ISBs are influenced by key factors (including demographic, situational, and environmental). Hence, to establish consistency in order to measure the extent to which these factors influence actors’ information-seeking and information use/task performance behaviours, interviewees were asked to respond to the question: “What essential factors influence your information seeking and/or information use activities to ensure that the appropriate information is captured for use?”

General responses from interviewees indicate that they approach their information-seeking activities with care and caution to ensure that reliable, context specific, and accurate information is captured. They indicated that trust is not an issue since they need any information they can get relating to the task especially due on the stage of the project (initial stages). However, they indicated that accessibility and quality of information is imperative. Hence, they ensure that information sources and channels are very credible and that the captured information is reliable.

Majority of interviewees indicated that factors such as trust, quality and accuracy become a major issue when it comes to sharing information with external actors. They explained that if the information shared is not “copy right” protected (i.e. security protected); these recipients sometimes tend to edit the information (such as drawing document, calculations, estimation documents, and others) and use it as if it was their own for their benefit.

Interviewees also indicated that due to time and high cost to create information, they tend not to share unprotected information with other actors’ who are not directly involved with the project team and/or the project organisation. Hence, this may delay information sharing and impact on project delivery however; they believe they have to follow the appropriate protocols to ensure security of information.
Other interviewees indicated that if a drawing document is sent to a contractor or even a consultant after they (the interviewees) have spent a lot of effort on their calculation sheets, which has been prepared to do the structures. The contractors end up using that same information for a different project, and this causes confusion about ownership of the drawings, the calculations, and duplication of designs and processes. Hence, if the information is not copyright protected then these problems do occur where you could pass information to a contractor/consultant/client and they use the information as if it was theirs.

Interviewees from private organisations revealed that they generally share information through central folders (such as CDEs) on a network system for ease of access, reliability and quality. They indicated that since they are all responsible for putting information on the system and using that same information, they ensure that the right information is always kept in the shared area. However, some public sector interviewees indicated that they tend to keep their information on individual/personal systems (e.g. Personal library) and share the information as and when it is needed or requested by someone.

Interviewees were in agreement with the use of cloud internet/systems, emails, telephone, face-to-face and other channels/sources for information sharing/seeking. They indicated that these are effective and efficient means of information transfer. Especially, “...if you urgently want information from someone and the information is not on the system; then the best thing to do is to pick up the phone and call for the information or just send them a mail or walk up to them if that someone is very close to you...”[Project Manager].

One interviewee stated, “...I needed a large document on a huge international infrastructure project where the document required was in a different country and the only means of getting the information secured, intact and at good quality and in time was through personal courier or via DropBox, and the DropBox was chosen to save cost...”[planner]. Other interviewees supported this statement. Some interviewees suggested that they have successfully used Google drive to seek and disseminate information on several occasion and it is very effective and efficient.
All interviewees agreed on the need to continue to use print documents for information capture and dissemination since it makes it easier to carry and to use as a discussion tool. However, they indicated that it can be difficult to store, bulky to maintain, and where the print document is damaged; it tend to create a lot of inconvenience. They indicated that the cost of reproduction to the entire project document could be very laborious and expensive. Some interviewees (architects-designers from the private sector) indicated that the use of electronic gadgets such as IPad/tablets and other PDA systems makes it easier to access some real time information on a shared system/extranet/CDE on site with minimum or no difficulty. Hence, they would prefer to limit the use of print documents and move towards ‘SMART’ electronic information management systems.

Reflections on all responses suggest that time is vital in the day-to-day activities of interviewees and it depend on other factors (such as accessibility, quantity, quality, context, and accuracy). However, they indicated their lack of control over the ‘time’ factor. On the other hand, an interviewee indicated that often, when seeking new information, time becomes irrelevant since it takes a long time to get the appropriate information [Quantity Surveyor].

7.2.6 General Remarks
It has been established that where projects/tasks has been executed before, actors’ from private organisations rely on information captured and stored in a shared environment or on a network system where everyone on the project can access. Interviewees in the private sector indicated that their organisations have central information management systems (bespoke systems) accessible to actors’ in different office or co-locations. These interviewees indicated that they have access to systems where any information relating to the project can be accessed, updated and saved whilst maintaining the original copy. They stated that the systems are always updated to ensure that original copies of vital information are kept and readily available for use. Some interviewees indicated that their organisations have “document controls” in charge of managing the information systems to ensure up-to-date versions of information at all times. In addition, private sector interviewees suggested that where the project has not been done before; they often capture information from the project information documents, visit the sites or sometimes
engage the services of specialists to capture the needed information. They indicated that captured information is processed and stored as PDF documents on the shared network system for use by all.

Interviewees revealed that information captured at the initial brief development and design stages of new projects could be very intensive, costly and time consuming. This is because clients might not be sure of what they want, designers might not understand what clients want, and information might be flowing from plethora of sources and channels with no coordination. They indicated that the level of information required at the brief and design stages is very important. “…not too detailed information is required at this stage”…, an interviewee indicated.

Another interviewee suggested “…you want the right amount (not too) of information regarding what the client want in order to produce the brief and to formulate the project design….”. Interviewees indicated that cost, time, and resource availability were key factors when capturing new information for a project. They emphasised that where new information is captured for the first time, reliability, quality and trust issues determines who to engage in the process. Actors on infrastructure projects indicated some difficulties (such as time delays, getting the right information, meeting regulators, standards, and others) are often encountered when dealing with policy makers, councils, government, and environmentalist. For example, one interviewee indicated, “…it is time consuming and very laborious process especially where you have to engage the services of other specialists and/or policy makers/regulators from other firms to help capture or meet a certain standard requirement…”[H&S Manager].

It was also revealed that construction actors within the project environment rely often on the project manager or the lead architect for most information. Thus, when there is a need for any kind of information, the lead architect or the project manager engages the services of other professionals (experienced/expert actors) to capture the needed information, process it and keep it in the shared area for use. Interviewees indicated that in situations where wrong information is saved as ‘new’ or ‘current’; they inform the IT expert who go through the systems to delete the
wrongly saved documents and make available the correct backdated document for use (a private sector interviewee indicated).

Similarly, interviewees from the public sector indicated that majority of public sector organisations do not have an effective information management system central to all in project organisations. They suggested that where information is needed for any specific task, they mostly have to contact colleagues within their network of friends or physically visit the project information or visit the site or employ specialists' professionals to capture the needed information. They suggested that whether a similar project has been executed before or not, they had to go through the process of information capture again to acquire the needed information for the task. They also suggested a lack of a central information management system(s) to manage their information, check for duplications, monitor information storage and dissemination process. Hence, Information captured by themselves or specialist is often stored on individual (personal libraries) storage systems where they share among themselves as and when it is needed or required by other actors. They specified that they generally rely on the telephone to capture information. However, depending on urgency and the proximity of the information sources, they sometimes have to visit in person to capture the needed information. For example, one interviewee said “…if I need any information, all I had to do is to pick up the phone and just ask them for what I need and I will get it…”

In order to understand the ISB activities of professionals’ in construction organisations, an exploratory qualitative inquiry was undertaken; the outcome of which shows that project actors exhibits distinct ISBs during their information acquisition processes. From the qualitative inquiry and the above findings, conclusions can be drawn that construction project actors definitely exhibits unique ISB orientations. This has been confirmed by findings from literature, and is represented in the conceptual framework. In addition, it has been affirmed that certain key factors influences actors’ information-seeking and information use/task performance behaviours. Hence, there is the need to measure these ISBs in the wider construction sectors to define the ISBs of project actors and the factors that influence such behaviours. It is noted that the limited number of interviewees does not give a true representation of actors ISB processes in construction organisations.
Revelations shows that the ISB process of actors' throughout the project organisation is dynamic in nature and follows a close loop system. This is due to the dynamic and repetitive nature of the project delivery process. In addition, the level of detail of information required by actors varies with respect to the phases of the project. At the concept design and brief production stages, detailed information is not necessary. However, at the construction, closeout, operation and maintenance stages, information required must be very detailed and context specific.

7.3 DEVELOPMENT OF THE QUANTITATIVE INQUIRY
According to Creswell (2009), quantitative research is a means of testing formulated objective theories by examining the relationship among variables. This is achieved by using developed instruments to measure significant variables so that numbered data can be analysed using statistical procedures. Thus, a quantitative inquiry provides a quantitative or numeric description of trends, attitudes, or opinions of a population from which the outcome can be generalised or claims can be made about the population (Creswell, 2009). The object of this phase of the research is to develop and apply a measurement instrument (questionnaire survey) to
i. assess the extent to which actors’ exhibit distinct ISBTs in the project organisation,
ii. assess the factors that influence the information-seeking and information use/task performance behaviours of these actors'.

Hence, quantitative survey instrument was deemed appropriate for this kind of study. Survey instrument has been used in similar kinds of research (Aurisicchio et al., 2012; Kwasitsu, 2003; Manu, 2012; Tuuli, 2009) and particularly in ISB research (Mohamed, 2011; Al-Dousari, 2009). Hence, this affirms the suitability of why the use of questionnaire survey is the appropriate strategy to adopt.

7.3.1 Unit of Analysis
Unit of analysis often relate to the fundamental problem of defining what is under investigation. According to Babbie (1973), unit of analysis for a survey is typically a person however, it can be anything under study. Hence, since this research aims to define project actors’ ISB orientations and the factors that influence their
information-seeking and information use/task performance behaviours, the appropriate unit of analysis is the project actors under investigation. As a result, a questionnaire survey (see appendix C-2) was used to measure the extent of construction project actors' ISBs and the factors that influence such behaviours in project organisations.

7.4 QUESTIONNAIRE DEVELOPMENT

The questionnaire is the main instrument for collecting quantitative data for the research; hence, the aim is to ensure that questions are designed to follow a standard format in order to answer the research questions posed. To achieve this, a self-administered Web-based or internet questionnaire survey (administered online) was adopted for data collection. The questionnaire was designed to get the cooperation of respondents, elicit accurate information and to provide a valid measure of the research questions.

As stipulated in the previous section, the unit of analysis is the project actors hence; the purpose of the survey was to capture their experiences, skills and expertise in project environment to give a practical representation of the population. The questionnaire was designed to focus on seven key items:

i. The extent to which project actors’ lean towards cognitive ISB.
ii. The extent to which project actors’ lean towards systematic ISB.
iii. The extent to which project actors’ lean towards associate ISB.
iv. The extent to which project actors’ lean towards serendipity/fortuitous ISB.
v. The extent to which project actors’ lean towards social media ISB.
vi. The factors that influence actors’ information seeking and/or information use/task performance behaviours in the project environment.
vii. The demographic factors.

The questionnaire is categorised into seven sections, the first five sections focuses on capturing data concerning the five ISB orientations as presented in table 7.1. Thus, professionals were asked to make a judgement using a 5-point Likert scale to respond to the generic question: to what extent does your information-seeking activities in task(s) delivery or solution provision relate to the five types of ISBs mentioned (see questionnaire in appendix C-2). The extent to which participant
agree or disagree to the questions was measured with a 5-point Likert scale with 5 as the highest score and 1 the lowest score (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree).

Table 7.1 The five Information-Seeking Behaviour Types

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<tr>
<th>Number</th>
<th>Information-Seeking Behaviour Types (ISBTs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cognitive Information-Seeking Behaviour</td>
</tr>
<tr>
<td>2</td>
<td>Systematic Information-Seeking Behaviour</td>
</tr>
<tr>
<td>3</td>
<td>Associate Information-Seeking Behaviour</td>
</tr>
<tr>
<td>4</td>
<td>Serendipity/Fortuitous Information-Seeking Behaviour</td>
</tr>
<tr>
<td>5</td>
<td>Social Media Information-Seeking Behaviour</td>
</tr>
</tbody>
</table>

The sixth section focuses on the factors that influence actors’ information-seeking and information use/task performance behaviours. Professionals were asked to indicate the extent to which their ISBs are influenced by the influencing factors. This was also measured using a 5-point Likert scale (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree) (as shown in table 7.2).

The seventh section focuses on general demographic information-seeking factors including academic qualification, experience, professional role, age, and work condition and employment sector. This information is necessary to help investigate the interrelationships they pose with the five ISB orientations, and to help categorise the ISBs into hierarchical levels of preferences. These sections were put together to form a three page self-administered internet survey instrument administered online. This survey instrument was developed using the Bristol Online Survey (BOS) tool (a copy of which is shown in appendix C-2).
Table 7.2 Influencing information-seeking and information use/task performance factors

<table>
<thead>
<tr>
<th>Number</th>
<th>Independent information seeking influencing factors</th>
<th>Number</th>
<th>Independent information seeking influencing factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accuracy</td>
<td>12</td>
<td>Effectiveness</td>
</tr>
<tr>
<td>2</td>
<td>Relevance</td>
<td>13</td>
<td>Efficiency</td>
</tr>
<tr>
<td>3</td>
<td>Reliability</td>
<td>14</td>
<td>Context specific</td>
</tr>
<tr>
<td>4</td>
<td>Currency</td>
<td>15</td>
<td>Organisational set-up</td>
</tr>
<tr>
<td>5</td>
<td>Usability</td>
<td>16</td>
<td>Sources/channels</td>
</tr>
<tr>
<td>6</td>
<td>Satisfaction</td>
<td>17</td>
<td>Experience</td>
</tr>
<tr>
<td>7</td>
<td>Time /duration</td>
<td>18</td>
<td>Qualification</td>
</tr>
<tr>
<td>8</td>
<td>Quality</td>
<td>19</td>
<td>Collaboration</td>
</tr>
<tr>
<td>9</td>
<td>Accessibility</td>
<td>20</td>
<td>Age</td>
</tr>
<tr>
<td>10</td>
<td>Trust</td>
<td>21</td>
<td>Professional Role</td>
</tr>
<tr>
<td>11</td>
<td>Sector</td>
<td>22</td>
<td>Work Condition</td>
</tr>
</tbody>
</table>

The first page of the survey contained the introductory page. This page presents information about the aim and objectives of the study and instructions about how to complete the questionnaire, the number of sections and the estimated completion time. The second page contains all the questions in the sections and the third page presents a thank you message to the respondents. All the data was collected at one point in time; hence, the entire survey was cross-sectional (Creswell, 2009).

### 7.4.1 Questionnaire Pre-testing and the Pilot Study

This is a trial run of the questionnaire to check that the basic aspects of the design and procedure work. It is also checks whether participants understand the stipulated instructions and the validity of the measures. Sapsford and Jupp (2006), posit that a pilot investigation is a small-scale trial before the main investigation, which is intended to assess the adequacy of the research design and the instrument (Bryman, 2012; Sapsford and Jupp, 2006). Bryman (2012), on the other hand state that a pilot study allows the researcher to determine the adequacy of instructions to respondents completing a self-completion questionnaire.

However, before the final pilot study, reliability and dimensionality of key questions in the draft questionnaire were pre-tested using Cronbach’s alpha (Braceet al., 2009). This is done to check the impact of each question and consistency of the questions to the scale. This also checks the impact responses from participants will
have on the captured data. Inconsistent items on the scale were rephrased or deleted to maintain consistency. This test helped to rephrase questions that had poor impact bearing on responses.

The pilot study was split into three phases; the first phase was the early draft phase to check the structure, content, use of language, length of questions and time for completing the survey. The second was the pre-test phase where reliability of questionnaire items (questions) was tested. In addition, the third phase was the main pilot study to confirm viability and readability of the questions. The questionnaire was electronically designed because of easy accessibility, cost savings, wider and quick distribution reach and response rate. The questionnaire was created in two electronic formats, a fillable Portable Document Format (PDF) and an online version, which was designed using the BOS instrument. The BOS instrument was hosted on the BOS website at www.survey.bris.ac.uk. Both questionnaires formats were administered to respondents personal email addresses. The web link to the online version of the survey was sent together with the fillable PDF version directly to the personal emails of the respondents.

At phase one of the initial pre-draft, the questionnaire was piloted by inviting five professionals (comprising of three PhD researchers and two industry professionals) whose background is in construction. Participants were mandated to respond to both formats of the questionnaires, and to provide feedback to help address its viability. The participants recorded the time they took to respond to each questionnaire, they critiqued the content, use of language and format of the questions. These responses helped to confirm the estimated time for completing the questionnaire, which was set at 15 minutes. The outcome of the pilot study resulted in minor changes to questions in the demographic section and rephrase some questions the respondents had difficulty understanding. Hence, feedback from five participants from the pilot study helped to revise the questionnaire for the final pilot study.

The final pilot study was conducted with twenty (20) professionals involved in construction design development and decision making roles (including design engineers, architects, consultants, project managers, and researchers). These
professionals were randomly selected from UK construction companies and institutions. They were selected on the bases of their experience, job role and expertise. Since there is no organised database for these professionals freely available, a viable means was adopted to access their details. Construction companies (such as contractors) were identified from UK Kompass online business database. Moreover, since majority of construction professionals join professional AEC institutions (such as RIBA, ICE, ECI, CIOB, RICS, APM, and others), Google search engine was used to capture their details through the databases of these AEC institutions. Thus, the contact information of the participants selected for the final pilot study were retrieved from the online directory of companies identified from the UK Kompass.

Both versions of questionnaires were directly sent to the personal email address of each of the 20 participants. Respondent were given the option to complete either of the questionnaires. The pilot study was lunched 19th May 2014 and ended 28th May 2014. Responses from the respondent were monitored via BOS website. Participants were sent reminders after the first week of administering the questionnaire due to slow response rate.

Results of the Pilot Study

The final pilot study yielded five (5) responses (two electronic PDF versions and three online versions) giving a response rate of 25%. This compares favourably with the responses (20% response rate) achieved in the pilot survey reported in Ankrah (2007), and Xiao (2002) and 22% reported in Manu (2012). Hence, the achieved response rate is significant to make final decisions before the final lunch of the main survey. The five participants comprised of design engineers, an architect, a project manager and a quantity surveyor. The average experiences between the respondent is 12 years in the construction industry in various capacities with minimum and maximum experience in roles being 6 and 20 years (with a std. Dev. = 5.657). The results of the pilot study indicate that the questionnaire showed clarity and no ambiguity to the targeted population, requiring no further changes. The average time used by the five participants to respond to the questionnaire confirmed that up to 15 minutes was needed to complete the survey. The questionnaire was re-read iteratively to check any spelling mistakes,
repetitions, layout and clear representation. Overall, the pilot study confirmed that it was appropriate to use the questionnaire in the main survey.

### 7.4.2 Sampling for the Main Survey

Czaja and Blair (2005), define sampling as a “selection of elements, following prescribed rules, from a defined population”. Population on the other hand is a full set of cases from which a sample is taken (Bryman, 2012). As mentioned in chapter 1, the information critical phase of the PLC indicated by RIBA is the design development phases. As a result, AEC professionals involved in the design development and decision-making process in project organisations were the targeted source for data collection. They form the sample, hence construction organisations forms the population for quantitative data collection. However, it is important not assume that any sample will be representative of this population since this can lead to wrong conclusions.

In order to generalise the outcome of the collected quantitative data from the sample to the population, it is necessary to establish a representative sample of the wider population. In general, the sample should ideally be the total number of professionals in the UK construction sector. However, since there is no available database to confirm the total number of professionals working in the sector, it was difficult to define the sample size. This problem meant that it was practically impossible to establish the population of UK construction professionals. Hence, UK construction companies were used as the targeted population. According to BIS (2013), there are about 280,000 construction companies in the UK. However, as it will be impracticable to collect data from all the companies, sampling was used. This is because sampling is more efficient and less expensive (Czaja and Blair, 2005). In addition, it is important to define the sampling frame. This resource contains elements of the defined population. Therefore the adopted sampling frame for selecting the sample is the number of construction companies identified on the UK Kompass online database (Kompass, 2014). Bryman (2012), posits that with all samples, it is important to estimate a large enough sample size to provide a necessary confidence in the data. Therefore, in order to estimate a large enough sample size, a formula from Czaja and Blair (2005) and Creative Research Systems (2014), was used, as shown below:
Where:

\[ n = \frac{t^2(p \times q)}{d^2} \]

\( n \) = The sample size
\( t^2 \) = The squared value of the standardised deviation
\( p \) = The percentage category for which the sample size is being calculated
\( q = 1 - p \)
\( d^2 \) = The squared value of one-half the precision interval around the sample estimate (i.e. confidence interval).

The formula has three components, from which the values for two components (i.e. probability level \( p \) and confidence interval \( d \)) are calculated and the third value (the variance) is approximated (Czaja and Blair, 2005). A confidence interval for a numeric variable is a range of values above and below the sample estimate that should contain the population value. As with most researches, this research set a probability – for example 90% or 95% - that the confidence interval includes the true population value (Czaja and Blair, 2005; Field, 2013). Therefore, a confidence interval of 95% was assumed. So for 95% confidence interval (significant level of the sample values \( p = 0.05 \)), its score (standard deviation) \( t = 1.96 \). In order to accurately estimate the sample size to enable the analysis at an acceptable level of detail, and to ensure that the margin of error is within acceptable limits, a confidence interval (i.e. \( d \pm 10\% \)) was assumed for the research. In addition, the assumed percentage category for the sample size \( p \) was 50% or 0.5. Hence, based on these assumptions, the sample size was calculated as follows:

\[ n = \frac{1.96^2 \times 0.5(1 - 0.5)}{0.1^2} = 96.04 \]

This value indicates that the number of construction companies required to respond to the survey is 96. However, to refine the sample size estimate, Czaja and Blair (2005), proposes another formula as:

\[ \text{New } N = \left(1 - \frac{n}{N}\right) \times \frac{t^2(p \times q)}{d^2} \]

Where \( N \) = the size of the eligible population
Therefore the new sample size is:
The new sample size remains approximately 96 construction companies; however, it is assumed that in academic studies involving individuals or organisations, response rate of approximately 50% and/or 35% to 40% are reasonable. Similarly, Takim et al. (2004), indicate that a response rate of 20% to 30% is acceptable in construction research. Moreover, since this research is both academic and industry based, it was practical to adjust the sample size to accommodate for non-responses. Therefore assuming a response rate of 20%, then the appropriate sample size to be surveyed from the population is calculated as:

\[
N = \left(1 - \frac{96.04}{280,000}\right) \times \frac{1.96^2 \times 0.5(1 - 0.5)}{0.1^2} = (0.999657)(96.04) = 96.007
\]

Survey \( n = \frac{\text{new } n}{\text{response rate}} = \frac{96.007}{0.2} = 480.035 \) Construction companies would be sampled.

The survey sample size is now 480 (i.e. realistic size). Hence, in an effort to obtain a good response rate, the figure was approximated to 500 construction companies (Bryman, 2012). Thus, a random selection of construction companies from UK Kompass online database was performed to generate a list of 500 construction professionals using SPSS statistical package. It must be emphasised that although construction companies were identified as the target population from UK Kompass, the sample was made up of professionals (including architects, designers, quantity surveyors, structural engineers, civil engineers, project managers, construction managers, and all key decision makers) involved in the design development phases.

As a means of identifying and cross checking the genuineness of the contact details of the professionals, Google search engine (www.google.com) and the online databases of AEC institutions was used. This helped to retrieve and verify the contact details of participants to facilitate the main survey. The aim of the survey was to capture responses about the ISBs of professionals involved in construction project delivery and the factors that influence their ISBs in the process.
7.4.3 Main Survey
The sample used for the main survey was drawn from the online database of UK Kompass; however, the contact details (names and email addresses) of the participants were crosschecked through Google search engine and the databases of AEC professional institutions. In all, 500 questionnaires were administered electronically to 500 construction industry professionals. Both versions of the questionnaires (fillable PDF and the BOS) were administered to participants through personal email addresses. The emails contained cover letter (see appendix C-1 for details), a fillable PDF questionnaire and the link to the online version host at BOS website at www.survey.bris.ac.uk. The cover letter introduced the research briefly and its purpose and instructions on how to fill or respond to the questionnaire, and requested their participation. The participants were given the option to complete either the fillable PDF questionnaire version or the online version. Importantly, it was stated in the email that both versions of the questionnaires contained the same material, however; in case there was a problem in accessing either one (due to organisational security settings) then the other can be used and return to the administrator. The choice of disseminating the survey electronically via emails as opposed to postal or hand delivery was based on logistics, time constraints, limited access to postal addresses, costs, and ease of use of the electronic version and convenience.

The survey was carried out from June 1st 2014 to August 30th 2014. The survey instrument contained 45 questions dispersed in seven sections resulting in a three-page document (see appendix C-2). The online survey was monitored via BOS website, whilst the PDF version was monitored via the administrator’s email. Response rate was low during the first two weeks of administering the survey. Hence, to ensure a good response rate, courtesy email reminders were sent to participants to encourage them to respond to the survey. As suggested by Creswell (2009), follow-up reminders ensures high response rate. Limitations to resources meant that only one follow-up reminder was sent to participants. All follow-up reminders contained the attached cover letter and both versions of the electronic surveys.
Response Rate
In total, 159 responses out of 500 administered questionnaires was received or recorded by the close of the survey (on August 30th 2014). This generated a response rate of 31.8%, which indicates a good response rate. As suggested by Bryman (2012), for academic research involving individuals or organisations, response rate of approximately 50% and 35% to 40% respectively are reasonable. Whereas Takim et al. (2004), indicate that 20% to 30% is normal response rate for questionnaire survey in construction research. Table 7.3 present a breakdown of responses from both versions of the survey.

Table 7.3 Breakdown of questionnaire response rate

<table>
<thead>
<tr>
<th>Mode of questionnaires administration</th>
<th>No. of administered questionnaires</th>
<th>No. of responses received</th>
<th>Percentage response rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol Online version</td>
<td>500</td>
<td>150</td>
<td>30.0%</td>
</tr>
<tr>
<td>Fillable PDF version</td>
<td>500</td>
<td>9</td>
<td>1.8%</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>159</td>
<td>31.8%</td>
</tr>
</tbody>
</table>

Table 7.3 shows that the online version of the survey yielded a better response rate. This suggests that online surveys are fast, easy to access and quicker to respond to than the fillable PDF version.

Data Screening
The 159 responses from participants was initially transported onto Microsoft Excel 2010 version to ensure that all the data had been put together on a single platform and to facilitate management and screening. At this stage, the researcher was looking for discrepancies in responses, missing data and incomplete questions in the questionnaires. Incomplete questionnaires or missing data are common occurrence in this kind of research. Often, this is based on different reasons (such as accidental, deliberate, optional questions, and exertion of rights not to answer questions) (Field, 2013). This does not mean a rejection of the data (i.e. missing value). A missing value analysis can be performed where a value is chosen to represent the missing data point. According to Field (2013), this value tells SPSS that there is no recorded value for a participant for a certain variable. Therefore, to ensure an accurate data set for the data analysis, the data was screed using IBM
SPSS Statistic version 21.0 to assess the extent of missing data and to determine whether any actions can be taken if necessary. The SPSS version 21.0 Missing Value Analysis option was used to perform the missing value analysis. Analysis revealed only one (1) case had excessive missing data (i.e. more than 50% of the questions in the questionnaire unanswered or abnormal answers). Hair et al. (2006), posit that, in cases where missing value data level is excessively higher (in order of 50% or more), the case can be removed or rejected. Hence, one (1) case was removed from the data set. Therefore, the effective sample size was reduced to 158 responses representing 31.6% response rate. Further analysis to validate the data after the exclusion revealed no missing value in the effective sample size. Hence, the data was ready for analysis.

7.5 QUANTITATIVE DATA ANALYSIS STRATEGY
In view of the adopted quantitative inquiry for this research, various statistical tools were used to analyse the quantitative data in order to achieve the research objectives of classifying actors' ISB types and establishing the factors that influence these ISB’s during task performance.

7.5.1 Questionnaire Analysis
Analysis of the quantitative data was based on five main types of statistical tests: *Descriptive statistics, Friedman’s ANOVA test, Factor Analysis, Correlation Analysis,* and *Multiple Regression.*

*Descriptive Statistics*
Descriptive statistics helps to develop a thorough understanding of the extent of the data collected by means of calculating the averages (means, median and mode), the frequencies and percentages of responses. Hence, several descriptive statistics were obtained for the demographic factors and all other factors included in the dimension of the conceptual model. Furthermore, Likert scores were calculated for statements related to actors’ ISB orientations and the influencing factors. The Likert scores were calculated by multiplying the number of responses for each preference by the score of each statement.
Factor Analysis

Factor analysis was used to identify and confirm the clusters of questionnaire items that facilitates actors’ ISB orientations. This statistical technique was used to identify the ISB types that were measured in the questions. This analysis yielded five classifications of the ISBTs thereby confirming the validity of the five ISBTs as already identified through literature and the exploratory study.

Exploratory factor analysis or simply, factor analysis helps to explore whether there is an underlying structure in the pattern or correlations between a number of variables. According to Field (2013), this technique has three main uses;

i. to understand the structure of a set of variables,

ii. to construct a questionnaire to measure an underlying variable; and

iii. to reduce a data set to a major manageable size while retaining as much of the original information as possible.

For these reasons, exploratory factor analysis was undertaken using the Principal Component Analysis (PCA) technique to identify cluster of actors' ISB orientations with Varimax rotation. Various indicator of factorability of the data were good, and the residuals indicated that the solution was good. The Kaiser-Meyer-Olkin (KMO) measure was used to verify the sampling adequacy for the analysis. KMO is a test of the amount of variance within the data that could be explained by factors (Field, 2013). KMO statistics varies between 0 and 1. Where a value of 0 indicates that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion in the pattern of correlation (hence, factor analysis is likely to be inappropriate). A KMO values close to 1 indicates that the patterns of correlations are relatively compact and so factor analysis will yield distinct and reliable factors (Field, 2013). Thus, the analysis produced a KMO=.78 which is good and all values for individual items were greater than .70, which is well above the acceptable limit of .5 (Field, 2013).

Friedman’s ANOVA Test

Friedman’s test is used for testing differences between more than two conditions where the same cases have provided scores in all conditions (Field, 2013). Therefore, the Friedman’s test was used to compare the confidence levels of
respondents’ orientations to the ISB Ts (comparing groups of independent scores from same entity). This helped to establish actors’ preferences to either of the ISB Ts and to rank their preference in a hierarchical order.

**Correlation and Regression Analysis**

These two statistical techniques were applied to assess the extent of relationships between the five ISB Ts and the influencing factors. The correlation and regression analyses were used to test the hypothesised relationships between the ISB orientations and the information-seeking and/or information use/task performance factors.

**Correlation Analysis**

The level of predictability between two variables about the relationship between them determines the level of correlation. It measures the degree of relationship between related variables (often two). There could be a third variable which tends to explain the association between the two variables under investigation. A test of correlation provides a measure of strength and direction of relationships between variables under investigation. However, a crude measure of the relationship between variables is the covariance (Field, 2013). In order to overcome the problem of dependence on the measurement scale, the covariance is standardised to get the Pearson’s correlation coefficient (denoted as \( r \) - thus Pearson’s \( r \) requires interval or ratio data). However, since the data for this research is ordinal data (i.e. non-parametric), Spearman’s correlation (denoted as \( r_s \)) was used.

Spearman’s correlation is a non-parametric statistics based on ranked data which is very useful to minimise effects of extreme scores or effects of violations of assumptions (Field, 2013). By standardising the covariance, a correlation coefficient value of \( \pm 1 \) is calculated. According to Field (2013), a \( +1 \) coefficient indicate that two variables are perfectly positively correlated. Thus, as one variable increases, the other increases by a proportionate amount. Similarly, a \( -1 \) coefficient indicates a perfect negative relationship. Thus, as one variable increases, the other decreases by a proportionate amount. A zero (0) coefficient
indicate no linear relationship at all and so if one variable changes, the other stays the same.

To measure the degree of relationship (strength and direction) between the ISBTs and the information-seeking and information use/task performance factors that influence actors’ behaviours, the Spearman’s correlation (\( r_s \)) test was applied. The Spearman’s correlation analysis works by first ranking the data and then applying the Pearson’s equation to compute the correlation coefficient which according to Field (2013), is given by:

\[
 r = \frac{\text{cov}_{xy}}{s_x s_y} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{(N-1)s_x s_y} = \text{Pearson’s Equation, and Where:}
\]

\[
r = \text{Pearson’s product Correlation coefficient}
\]

\[
\bar{x} \text{ and } \bar{y} = \text{are the means of the sample } x \text{ and } y \text{ respectively}
\]

\[
x_i \text{ and } y_i = \text{are any pair of data points whose correlation is being sought}
\]

\[
s_x \text{ and } s_y = \text{the standard deviations of the first and second variables respectively}
\]

\[
N = \text{is the sample size}
\]

Since the Spearman’s correlation analysis is being used, the equation below is what was used:

\[
 r_s = \frac{\text{cov}_{xy}}{s_x s_y} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{(N-1)s_x s_y} = \text{Spearman’s Equation}
\]

Where:

\[
r_s = \text{is the Spearman’s correlation coefficient}
\]

**Multiple Regression Analysis**

Regression analysis is a statistical technique that is used to fit a linear model to a data-set and to predict values of an outcome variable (dependent variable) from one or more predictor variables (independent variables) (Brace et al., 2012; Field, 2013). When one predictor variable is used, the technique is sometimes referred to as simple regression, and when several predictors are used in the model, the technique is referred to as multiple regression.

Multiple regression is a statistical technique in which one variable (dependent variable) is predicted on the basis of two or more other variables (independent
variables) (Brace et al., 2012). According to Brace et al. (2012), human behaviour is inherently noisy (actions, thoughts, and emotions) and impossible to produce accurate predictions, but multiple regression enables the identification of predictor variables which together provide a useful estimate of participant’s likely score on a dependent variable. The independent variable(s) can be measured using a range of scales (although at interval or ratio level), but the dependent variable is measured using ratio or interval scale (Brace et al., 2012). Generally, the regression analysis (simple regression) is based on the linear model.

\[ y_i = (b_0 + b_1X_{1i}) + \epsilon_i \]

However, for multiple regression analysis, the generic equation is given as:

\[ Y_i = (b_0 + b_1X_{1i} + b_2X_{2i} + \cdots + b_nX_{ni}) + \epsilon_i \]

Where:
- \( Y_i \) or \( y_i \) = is the outcome/dependent variable
- \( b_0 \) = is the intercept or constant
- \( b_1 \) = is the coefficient of the first predictor \( X_{1i} \)
- \( b_2 \) = is the coefficient of the second predictor \( X_{2i} \)
- \( b_n \) = is the coefficient of the \( nth \) predictor \( X_{ni} \), and
- \( \epsilon_i \) = is the error for the \( ith \) participant (difference between the predicted and observed value for \( Y \))

Each of the regression coefficients (i.e. \( b_0, b_1, \ldots b_n \)) added to the model estimates the relationship between that predictor and the outcome.

As with correlation analysis, multiple regression does not imply causal relationships unless variables have been manipulated. Brace et al. (2012), posit that the advantage of applying multiple regression instead of several bivariate correlations (between dependent and each of the independent variables) is that multiple regression corrects the correlations among the predictor variables. Therefore, multiple regression was applied in this research to identify information-seeking and information use/task performance factors (independent variables) that contribute towards predicting actors’ ISBTs (dependent variable).

Several methods of multiple regression (such as forced entry or standard, hierarchical or sequential, and stepwise or statistical) have been identified to
contribute to the predictor variables. The methods vary in relation to how variance shared by predictor variables is treated, and the order of which variables are entered to determine the regression equation.

With forced entry or standard method, the researcher specifies the set of predictor variables into the model simultaneously, where each predictor is assessed on what variance it explains (Brace et al., 2012). This method relies on good theoretical reasons for including the chosen predictor variables. This method is considered as the only appropriate method for theory testing (Brace et al., 2012). This is because the stepwise technique is influenced by random variation in the data and seldom give replicable results if the model is retest.

There are several stepwise methods (forward, forward and stepwise methods) (Brace et al., 2012; Field, 2013). With the stepwise methods, decisions about the order in which predictors are entered into the model are purely based on a mathematical criterion. The model is determined according to the strength of their correlation with the criterion variable and not according to any theoretical rationale (Brace et al., 2012). Whereas with the hierarchical method, predictors are selected based on previous work and the researcher decides which order to enter the predictors into the model (Field, 2013). Field (2013), posits that the general rule for the hierarchical method is that known predictors (from other research) should be entered into the model first in order of importance in predicting the outcome. Based on these reasons, the Standard or Forced entry method was used. This is because the predictor variables (i.e. the information-seeking and/or information use/task performance factors) have already been described in previous IB/ISB models and by various researches (see chapter 5) as factors that influence actors’ ISBs. The influencing factors are also practical predictors, because logically, they influence actors’ ISBs in general.

**Assumptions of the regression model**
The regression analysis produces an equation that is correct for the observed values (the research). However, for researchers to generalise their findings outside the sample, some underlying assumptions ought to be considered. Field (2013), state that cross validation of the model can occur if the test shows that the model
does generalise. Some of the assumptions that needs to be met as stated in Field (2013), include:

**Additivity and Linearity**
Regression modelling generally assumes a linear relationship between the outcome variable and any predictor variables, where the combined effect of several predictors can be fitted to a linear model. However, if this assumption is not met, then the model is invalid though variables can be transformed to make their relationship linear.

**Independent Errors**
This assumes that for any two observations, the residual terms should be uncorrelated (independent). Hence, if the assumption of independence is violated, the confidence intervals and significance tests will be invalid as well. However, in terms of the model parameters, the estimates using the method of least squares will still be valid but not optimal (Field, 2013). This assumption can be tested using the Durbin-Watson test, for serial correlations between errors. The test statistics can vary between 0 and 4, with a value of 2 meaning that the residuals are uncorrelated. A value greater than 2 indicates a negative correlation between adjacent residuals, whereas a value below 2 indicates a positive correlation. Values less than 1 or greater than 3 are cause for concern, whereas value closer to 2 may still raise some concerns depending on the sample and the model (Field, 2013).

**Homoscedasticity**
This assumes a constant variance of residual terms at each level of the predictor variable. Thus, residuals at each level of the predictor(s) should have the same variance (homoscedasticity). However, when the variances are very unequal, it is said to be heteroscedasticity. Hence, violating this assumption invalidate the confidence intervals and significance test. However, estimates of the model parameter ($b$) using the method of least squares are still valid but not optimal. Weighted least squares regression can be used to overcome this problem.
Normally Distributed Errors

It is assumed that residuals in the model are random, normally distributed variables with a mean of 0. This implies the difference between the model and the observed data are most frequently zero or very close to zero and the difference much greater than zero happens only occasionally. In small samples, a lack of normality will invalidate confidence intervals and significance tests; in large samples, it will not, because of the central limit theorem.

Table 7.4 present a brief summary of the main non-parametric statistical tests used to analyse the data and the rationale for their use. The IBM SPSS version 21.0 was used to perform all the statistical analysis presented.

**Table 7.4 Summary of statistical tests used in the research**

<table>
<thead>
<tr>
<th>Statistical Test</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptive statistics</td>
<td>Calculates the averages (means, median and mode), the frequencies and percentages of responses</td>
</tr>
<tr>
<td>Factor analysis</td>
<td>Identifies and confirms the clusters of questionnaire items (variables) that are related to establish the ISBTs</td>
</tr>
<tr>
<td>Friedman’s ANOVA test</td>
<td>Compares the confidence levels of respondents orientation to the ISBTs</td>
</tr>
<tr>
<td>Kruskal-Wallis test</td>
<td>Compares multiple groups (i.e. different roles) when they contain independent scores. Thus to look for differences between groups of scores when the scores come from different entities</td>
</tr>
<tr>
<td>Correlation analysis</td>
<td>Measures the degree of relationship (strength and direction) between ISBTs and information seeking factors, and the information use and task performance factors.</td>
</tr>
<tr>
<td>Regression analysis</td>
<td>Identifies variables that significantly contribute to predicting the patterns of respondents ISBT</td>
</tr>
</tbody>
</table>

**7.6 RELIABILITY AND VALIDITY**

According to Field (2013), reliability indicates that a measure (questionnaire items) consistently reflects the construct that it is measuring. Whereas validity indicates
whether an instrument actually measures what it sets out to measure. According to Sapsford (2007), reliability is “the stability of the measure to the extent to which repeated measurement yields constant values”. Hence, reliability of the whole set of items in the questionnaire relating to actors’ ISB orientations and factors that influence their information seeking/task performance behaviours were checked by calculating the Cronbach’s alpha.

The Cronbach’s alpha is a measure of average inter-item correlation, and it varies between 0 and 1. Field (2013), states that a value of 0.7 to 0.8 is an acceptable value for Cronbach’s alpha; but substantially lower values indicates an unreliable scale. However, Kline (1999), posits that although the generally accepted value of 0.8 is appropriate for cognitive tests such as intelligence tests, the cut-off point for ability test is 0.7. Hence, Cronbach’s alpha helps to test the extent to which items in the questionnaire form a coherent scale. In this research, the internal consistency for the Likert scales used in actors’ ISB orientations and factors that influence their ISBs was measured by calculating the Cronbach’s alpha using SPSS 21.0. The overall consistency for scales used in the questionnaire had high reliabilities, with Cronbach’s $\alpha = .82$ as shown in table 7.5. Hence, the overall consistency of scales used in the questionnaire represent a high level reliability as indicated by Kline, (1999).

**Table 7.5 Reliability statistics**

<table>
<thead>
<tr>
<th>Cronbach’s Alpha</th>
<th>Cronbach’s Alpha Based on Standardized Items</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.826</td>
<td>.822</td>
<td>25</td>
</tr>
</tbody>
</table>

7.7 SUMMARY
This chapter presented the research strategies of inquiry. It highlighted how sequential exploratory mixed method strategy was applied to collect and analyse qualitative data whose findings affirmed the five types of actors' ISB orientations and the factors that influence such behaviours. The findings from the qualitative inquiry also confirmed the ISB conceptual model for this study. The findings
indicate that the conceptual model truly depicts actors ISB processes in construction project organisations.

The chapter also presented development of quantitative instrument to collect empirical data to measure the extent of project actors ISB orientations and the key factors that influences these behaviours during task performance. The chapter presented the phases of quantitative data collection process where questionnaire survey instrument was developed and lunched electronically to 500 professionals in construction organisations. In all, 158 effective response rates was achieved representing 31.6% of the sample. Hence, after data screening, the data was ready for analysis.

The succeeding chapter present the results of statistical analyses of the screened data to establish the extent to which actors’ orientate towards the five ISBTs and the factors that influence their information-seeking and information use/task performance behaviours.
CHAPTER 8 : QUANTITATIVE FINDINGS I: ACTORS INFORMATION SEEKING BEHAVIOUR ORIENTATIONS

8.1 OVERVIEW
This chapter presents detailed analysis of the quantitative data obtained from the sample of construction professionals. IBM SPSS version 21.0 was used to analyse the data. The initial phase of the analysis presents descriptive statistical analysis (including frequencies, central tendencies and measure of dispersion) to reveal the experiences, expertise and the main trends and sample distributions of the respondents. This is followed by assessment of actors’ ISB orientations. Exploratory factor analysis using critical component analysis technique is conducted to affirm the ISB orientations of actors. The factors analysis initially revealed seven factors with eigenvalues over Kaiser’s criterion of 1 extracted (i.e. eigenvalues>1). However, after careful analyses of component loadings, five key factors were retained to confirm the five ISB orientations. Friedman’s test was used to rank actors’ ISBTs into hierarchies and to establish actors’ ISBT preferences. Correlation analysis was performed to test the proposed hypotheses in order to determine the degree of associations between actors’ ISBTs and the influencing factors. This analysis helped to establish the key factors that had significant relationships with actors’ ISBTs. To reduce the length of this chapter, majority of the figures and tables (except those related to descriptive statistics, Friedman test, Kruskal-Wallis tests, and Factor analysis) can be found in Appendix D.

8.2 EVALUATION OF DEMOGRAPHIC INFLUENCING FACTORS
To obtain the overall picture of construction professionals who participated in this research, various aspects of the demographic factors captured in the questionnaire survey were assessed and this is presented in the succeeding sections. The key demographic factors that were captured include employment sector, working condition, qualifications, experience levels, professional role, and age category.

8.2.1 Demographic Factors
Tables 8.1 to 8.7 present demographic information captured from respondents through the questionnaire survey. This provides an overview of interpersonal factors possessed by the respondents. This information is intended to generate credibility and substantiate the research findings. In addition, the demographic
factors are key influencing factors to actors ISBs. Hence, Kruskal-Wallis test was performed to establish any differences in ISBT orientations and the demographic factors between the various groups. Kruskal-Wallis tests uses chi-square to represent the test statistics.

**Employment Sector**

The construction industry is dominated by private sector organisations however; there are some public sector organisations as well. Although this research sought to sample participants from both sectors, the random nature of sampling could not prevent the dominance of private sector respondents. Table 8.1 present a summary of respondents in both private and public sectors. It can be seen that most of the respondents (i.e. 90.5%) work in the private sector, whereas the remaining 9.5% work in the public sector. Result from the Kruskal-Wallis test (see appendix D-1i) found no significant difference between respondents orientation towards the five ISBTs and employment sectors.

<table>
<thead>
<tr>
<th>Employment Sector</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>143</td>
<td>90.5</td>
</tr>
<tr>
<td>Public</td>
<td>15</td>
<td>9.5</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Condition of Work**

Actors' generally work either independently or in teams. Moreover, since the construction process employs both forms of working conditions, this factor is considered vital in actors’ ISBs. Respondents were asked to state their condition of work. Table 8.2 present a summary of “condition of work” of respondents. It can be seen that majority of the respondents (92.4%) work in teams whilst the remaining 7.6% work on their own. This is not surprising since the construction process largely rely on teams to ensure a cohesive organisation management and project delivery process. A Kruskal-Wallis test (see appendix D-1ii) showed a significant
difference between respondents’ orientation towards Associate ISBT and Condition of Work ($X^2 = 7.042, df = 1, \rho = .008$).

Table 8.2 The working condition of respondents

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team</td>
<td>146</td>
<td>92.4</td>
</tr>
<tr>
<td>Independent</td>
<td>12</td>
<td>7.4</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100.0</td>
</tr>
</tbody>
</table>

On the other hand, figure 8.1 present the distribution of respondents’ professional roles and sector of employment.

Figure 8.1 Distribution of professional role and sector of employment

It can be seen that 6% of Civil and structural engineers work under the public sector whereas 1% of architects, 1% of M&E engineers and 1% of design engineers work in the public sector. Thus, majority of the respondents (three
quarters) work in the private sector. This demonstrates the proportion of respondents who work in the private and public sectors.

**Professional Roles**

Individual roles of the respondents were captured with the view to establish any difference between professional role and ISBT orientations. Table 8.3 shows that majority of the respondents (32.9%) were civil and structural engineers, whereas architects and facility and services managers were 4.4% each. The remaining 2.5% was made up of planning engineers and planning managers.

<table>
<thead>
<tr>
<th>Professional Roles</th>
<th>Number of respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architects</td>
<td>7</td>
<td>4.4</td>
</tr>
<tr>
<td>Quantity Surveyors</td>
<td>19</td>
<td>12.0</td>
</tr>
<tr>
<td>Construction &amp; Site Managers</td>
<td>10</td>
<td>6.3</td>
</tr>
<tr>
<td>M&amp;E Engineers</td>
<td>14</td>
<td>8.9</td>
</tr>
<tr>
<td>Civils &amp; Structural Engineers</td>
<td>52</td>
<td>32.9</td>
</tr>
<tr>
<td>Design Engineers</td>
<td>25</td>
<td>15.8</td>
</tr>
<tr>
<td>Planning Engineers</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>Facilities &amp; Service Managers</td>
<td>7</td>
<td>4.4</td>
</tr>
<tr>
<td>Health &amp; Safety &amp; others</td>
<td>20</td>
<td>12.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>158</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Similarly, figure 8.2 presents distribution of professional roles and condition of employment. About three quarters of the respondent work in teams. This outcome demonstrates the extent of construction professionals who work independently. It also presents the opportunity to understand how this category seeks information and the factors that influence their ISBs and task performancet.

Result from the Kruskal-Wallis test (see appendix D-1iii and D-1iv) shows statistically, a significance difference between respondents’ orientation towards Associate ISBT and Social Media ISBT and professional role factor.

- The study found a significant difference between respondents’ orientation towards Associate ISBT and Professional role ($X^2 = 18.286, df = 8, p = .019$).
The study found a significant difference between respondents’ orientation towards Social Media ISBT and Professional role ($X^2 = 15.637, df = 8, p = .048$).

Figure 8.2 Distribution of professional role and condition of employment

**Years of Experience**

Table 8.4 and 8.5 present a summary of respondents’ years of experience in their professional role. Table 8.5 shows that the mean average years of experience between the respondents is approximately 10 years (with Std. Deviation=8.32).

**Table 8.4 Summary of respondents experience levels**

<table>
<thead>
<tr>
<th>Years of Experience</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 3 yrs</td>
<td>49</td>
<td>31.0</td>
</tr>
<tr>
<td>4 – 6 yrs</td>
<td>17</td>
<td>10.8</td>
</tr>
<tr>
<td>7 – 10 yrs</td>
<td>33</td>
<td>20.9</td>
</tr>
<tr>
<td>11 – 15 yrs</td>
<td>15</td>
<td>9.5</td>
</tr>
<tr>
<td>16 – 20 yrs</td>
<td>11</td>
<td>7.0</td>
</tr>
<tr>
<td>21 - 25 yrs</td>
<td>30</td>
<td>19.0</td>
</tr>
<tr>
<td>Over 25 yrs</td>
<td>3</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100.0</td>
</tr>
</tbody>
</table>
The minimum and maximum years of experience translate to between 1.5 to over 28 years (table 8.5) respectively. Table 8.5 presents further breakdown of the years of experience of the respondents. This indicates that 31% of the respondents have up to 3 years’ experience, whereas 7.0% have up to 20 years’ experience and about 3% have over 25 years experiences. Results from the Kruskal-Wallis test (appendix D-1v to D-1x) revealed no significant difference between the five ISBTs and years of experience.

**Table 8.5 Measure of central tendency of respondents’ level of experience**

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Years of Experience in Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of respondents</td>
<td>158</td>
</tr>
<tr>
<td>Mean</td>
<td>10.08</td>
</tr>
<tr>
<td>Median</td>
<td>8.50</td>
</tr>
<tr>
<td>Mode</td>
<td>1.5</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>8.32</td>
</tr>
<tr>
<td>Minimum</td>
<td>1.5</td>
</tr>
<tr>
<td>Maximum</td>
<td>28</td>
</tr>
</tbody>
</table>

**Level of Qualifications**

Table 8.6 presents a distribution of highest level of qualifications attained by the respondents.

**Table 8.6 Breakdown of highest qualification of respondents**

<table>
<thead>
<tr>
<th>Level of Qualification</th>
<th>Number of Respondent</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A level</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>University Degree</td>
<td>114</td>
<td>72.2</td>
</tr>
<tr>
<td>MSc/EngDoc./PhD</td>
<td>12</td>
<td>7.6</td>
</tr>
<tr>
<td>CEng &amp;Professional Qualifications</td>
<td>9</td>
<td>5.7</td>
</tr>
<tr>
<td>HNC/D</td>
<td>13</td>
<td>8.2</td>
</tr>
<tr>
<td>BTEC NVQ/ONC &amp; Others</td>
<td>8</td>
<td>5.1</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100.0</td>
</tr>
</tbody>
</table>

From the table, majority of the respondents (72.2%) have a university degree, whereas 5.1% have other forms of BTEC level qualifications. Results from the Kruskal-Wallis test (see appendix D-1xi) show statistically, a significant difference
between respondents’ orientation towards Social Media ISBT and Level of Qualification ($X^2 = 16.295, df = 5, p = .006$).

**Age Category**
The “age category” factor is considered vital to actors’ ISBs. Hence, this was captured through the questionnaire and this is presented in table 8.7. It can be seen that 32.9% of the respondents fall between the range of 21 to 30 years, 31.6% fall between 31 to 40 years, 14.6% fall between 41 to 50 years, 15.2% fall between 51 to 60 years, and 5.1% are regarded as over 60 years old. One respondent was just 20 years old. Results from the Kruskal-Wallis test (appendix D-1x to xiv) reveals no significant differences between the five ISBTs and Age.

**Table 8.7 Age distribution of respondents**

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 20 years</td>
<td>1</td>
<td>.6</td>
</tr>
<tr>
<td>21 – 30 years</td>
<td>52</td>
<td>32.9</td>
</tr>
<tr>
<td>31 – 40 years</td>
<td>50</td>
<td>31.6</td>
</tr>
<tr>
<td>41 – 50 years</td>
<td>23</td>
<td>14.6</td>
</tr>
<tr>
<td>51 – 60 years</td>
<td>24</td>
<td>15.2</td>
</tr>
<tr>
<td>Over 60 years</td>
<td>8</td>
<td>5.1</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Distribution of Professional Role and Highest Qualification**
Table 8.8 presents a spread of professional roles of respondents’ highest academic qualifications. A substantial number of civils and structural engineers (32.91%) hold a university degree. This is a testament to the technical detailing and numerical aspects of civils and structural engineering profession. Similarly, design engineers, quantity surveyors and health and safety officers and managers have significant proportions of professionals with some form of university degree qualification. In general, this information demonstrates the calibre of participants for this study and the credibility in their responses to the study. It also, demonstrates level of experience, in addition to how the factors that influence their day-to-day information-seeking activities during project delivery.
<table>
<thead>
<tr>
<th>Professional Role</th>
<th>Highest Qualification Level</th>
<th>Number of Respondents</th>
<th>Percentage Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A level</td>
<td>BSc Degree</td>
<td>MSc/EngDoc/PhD</td>
</tr>
<tr>
<td>Architects</td>
<td>0</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Quantity Surveyors</td>
<td>0</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Construction &amp; Site Mangers</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>M&amp;E Engineers</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Civils &amp; Structural Engineers</td>
<td>1</td>
<td>37</td>
<td>4</td>
</tr>
<tr>
<td>Design Engineers</td>
<td>0</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Planning Engineers</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>F&amp;S Managers</td>
<td>0</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>H&amp; S &amp; others</td>
<td>0</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>114</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 8.8 Cross tabulation of professional role against highest qualification level
8.3 PROJECT ACTORS ISB ORIENTATIONS TYPES
As mentioned in chapter 5, five different ISBTs were identified through literature reviews and the exploratory study. These ISBTs were tested among respondents to elicit their ISB orientations. Hence, this stage of the analysis, which comprises of five sections in the questionnaire, presents the extent of respondents ISB orientations.

A five point Likert scale was used to measure the extent to which respondents “strongly agree” or “strongly disagree” to questions in the questionnaire. The options of responses available for respondent to choose from included: “strongly agree, agree, neutral, disagree, and strongly disagree”. According to Sapsford (2007, p.237), it is important to decide the positive and negative poles of a scale and adjust items to score in the same direction. Hence, responses were designed in a way to enable respondents to achieve a high score if they agreed with the questionnaire item and a low score if they disagreed. Therefore, each of the questions were given a score where “5=strongly agree”, “4=agree”, “3=neutral”, “2=disagree”, and “1=strongly disagree”. The subsequent sections presents the result of the calculated Likert scale scores of actors’ responses to the questionnaire items.

8.3.1 Actors’ Orientations towards Cognitive ISBT
This section of the questionnaire captures respondents’ perception on the extent to which they rely on personal knowledge, experience and skills to seek information. Respondents were asked to respond to five questionnaire items relating to cognitive information-seeking. Overall descriptive statistics of actors’ orientation towards Cognitive ISBT shows that 80.84 % (see figures 8.3 to 8.7) of the respondents with overall average Likert score of 4.042 (see table 8.9) rely on their cognitive ability to seek information. This is a strong indication that project actors’ predominantly rely on their own memory, intelligence, intuition, perception, skills and experience to seek information. Table 8.9 presents details of the average Likert scores of actors’ orientation towards cognitive information-seeking.
### Table 8.9 Likert scores related to orientation towards Cognitive ISBT

<table>
<thead>
<tr>
<th>Statement</th>
<th>Number of Respondents</th>
<th>Likert Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>I rely on my knowledge, experience and skills to create information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>4.42</td>
</tr>
<tr>
<td>I rely on my intuition, memory and mental ability to create information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>3.99</td>
</tr>
<tr>
<td>In addition to my memory, I occasionally rely on library catalogues, electronic and print databases to seek information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>4.27</td>
</tr>
<tr>
<td>I rely on my intelligence to create information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>3.97</td>
</tr>
<tr>
<td>I rely on my perception to create information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>3.56</td>
</tr>
<tr>
<td><strong>Average Cognitive ISB Likert Score</strong></td>
<td>158</td>
<td><strong>4.042</strong></td>
</tr>
</tbody>
</table>

**Descriptive statistics for Cognitive ISBT questionnaire items**  
*Rely On My Knowledge, Experience and Skills*

Respondents’ were asked to rate the extent to which they rely on their personal knowledge, experience and skills to seek information for use. As presented in figure 8.3, out of 158 respondents, 93% with a mean Likert score of 4.42 “agreed to strongly agree” that they rely on their personal knowledge, experience and skills to seek information for use. Only 2% with a Likert score of 3.56 to 3.97 disagreed to using their intelligence and perception to create information for use.
Rely On My Intuition, Memory and Mental Ability

Respondents were asked to respond to the question “I rely on my intuition, memory and mental ability to create information to perform a task or provide solutions to problems”. Majority of the respondents (79%) with a Likert score of 3.99 indicated their agreement to the statement. Figure 8.4 present the descriptive statistics of responses to the questionnaire item.

Reliance on Memory and Library Catalogues, Electronic and Print Databases

Respondents were asked to respond to the question “In addition to my memory, I occasionally rely on library catalogues, electronic and print databases to seek information to perform a task or provide solutions to problems”. With this question,
majority of the respondents (87%) with a Likert score of 4.27 “agreed to strongly agree” with the question. This questionnaire item had the second highest Likert score; hence an indication that actors, do not only rely only their cognitive ability but also they support such ability with information from both electronic and print databases. Figure 8.5 present descriptive statistics of responses.

![Figure 8.5](image1)

**Figure 8.5** Reliance on memory, library, printed and electronic databases to seek information

*Reliance on Intelligence to Create Information*

Majority of respondents (76%) with a Likert score of 3.97 “agreed to strongly agree” that they rely on their intelligence to create information to perform a task or provide solutions to problems. Figure 8.6 present descriptive statistics of responses.

![Figure 8.6](image2)

**Figure 8.6** Reliance on my intelligence to seek information
Reliance on Perception to Create Information

This statement relates to the extent to which actors rely on their perception to create information to perform tasks or provide solutions to problems. Just over half (53%) of the respondents with a Likert score of 3.56 “agreed to strongly agree” to the statement. Figure 8.7 presents descriptive statistics of responses.

Figure 8.7 Reliance on perception to seek information

8.3.2 Actors’ Orientations towards Systematic ISBT

The questionnaire items in this section were intended to establish the extent to which actors’ follow a systematic approach to seek information. Respondents were asked five different questions centred across information-seeking through variety of systematic information sources and channels including personal information management systems (personal libraries, folders, and databases), automatic information capture (setting up alert systems) into information folders and shared areas. In addition, meetings, documents, trade magazines/reports/journals, company standards, company protocols, specifications, and government documents, and application of Booleans to seek information all fall under this category. Figures 8.8 to 8.12 and table 8.10 presents descriptive statistics of the five questionnaire items relating to the extent to which actors’ orientate towards Systematic ISBT. Notable amongst the responses to the questionnaire items is the question in relation to “the extent to which actors’ create and maintain automatic information capture into folders to support their information seeking activities”.

243
Table 8.10 Likert score related to orientation towards Systematic ISBT

<table>
<thead>
<tr>
<th>Statement</th>
<th>Number of Respondents</th>
<th>Likert Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I maintain personal information management systems including information archiving and recycling in order to reuse information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>4.08</td>
</tr>
<tr>
<td>I create and maintain automatic information capture into folders to support my information seeking activities.</td>
<td>158</td>
<td>3.17</td>
</tr>
<tr>
<td>I follow a step-by-step approach to acquire information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>3.68</td>
</tr>
<tr>
<td>I like to capture information from memos, letters, formal meetings, official documents, and standardised documents for use on tasks or to provide solutions to problems.</td>
<td>158</td>
<td>3.86</td>
</tr>
<tr>
<td>I use internal and external information sources such as technical documents, trade magazines, trade reports, trade journals, company standards, company protocols, specifications, and government documents to seek information for use on a task or provide solutions to problems.</td>
<td>158</td>
<td>4.22</td>
</tr>
<tr>
<td><strong>Overall average Systematic ISB Likert Score</strong></td>
<td><strong>158</strong></td>
<td><strong>3.80</strong></td>
</tr>
</tbody>
</table>

From figures 8.8 to 8.12, and table 8.9, it can be seen that 76.04% of the 158 respondents with an average Likert score of 3.802 indicate that they apply some systematic approach to seek information. This figure is well above the average Likert score, and it is a notable discovery amongst construction project actors’ ISBs.

**Descriptive Statistics for Systematic ISBT Questionnaire Items**

**Maintain Personal Information Management/Library Systems**

The statement “I maintain personal information management systems including information archiving and recycling in order to reuse information to perform a task or provide solutions to problems” had an agreement responses of 80% with a Likert
score of 4.08. Only 14% were neutral and 6% disagreed to strongly disagree.

Figure 8.8 present descriptive statistics of responses.

![Figure 8.8 Maintains personal information management system to capture information](image1)

**Create and Maintain Automatic Information Capture into Folders**

With this question, majority of the respondents (42%) with a Likert score of 3.17 “strongly agreed to agree” to the statement “I create and maintain automatic information capture into folders to support my information seeking activities”. Figure 8.9 present descriptive statistics of responses.

![Figure 8.9 Maintains automatic information capture into folders to seek information](image2)

**Follow a Step-By-Step Approach to Acquire Information**

With this statement, majority of respondents (63%) with a Likert score of 3.68 “strongly agreed to agree” that they “follow a step-by-step approach to acquire
information to perform tasks or provide solutions to problems”. However, 25% were neutral and only 11% disagreed with the statement. Figure 8.10 present descriptive statistics of responses.

![Figure 8.10](image1)

**Figure 8.10** I follow a step-by-step approach to seek information

**Information Capture from Formal Meetings, Official and Standardised Documents**

With this statement, three quarters of the respondents (74.68%) with a Likert score of 3.86 “agreed to strongly agree” that they “capture information from memos, letters, formal meetings, official documents, and standardised documents for use on tasks or to provide solutions to problems”. Approximately 15.19% were neutral whilst 10.12% “disagreed to strongly disagree” with the statement. Figure 8.11 present descriptive statistics of responses.

![Figure 8.11](image2)

**Figure 8.11** I capture information from memos, formal meetings and others for use
Use Internal and External Information Sources

Over three quarters of the respondents (87%) with a Likert score of 4.22 “agreed to strongly agree” that they “use internal and external information sources such as technical documents, trade magazines, trade reports, trade journals, company standards, company protocols, specifications, and government documents to seek information”. Approximately 9% were neutral whilst only 4% “disagreed” with the statement. Figure 8.12 present descriptive statistics of responses.

![Figure 8.12 I use internal and external sources such as technical documents, trade magazines, trade reports and others to seek information](image)

8.3.3 Actors’ orientations Towards Serendipity/Fortuitous ISBT

From the literature review and the qualitative inquiry, it was discovered that some construction project actors’ seek information from avenues such as casual meetings, informal encounters, accidental discoveries, search engines and others. Hence, the questionnaire items in this section capture the extent to which actors’ orientate towards Serendipity/Fortuitous ISBT. Details of descriptive statistics on the five questionnaire items in this section are presented in table 8.11. From figures 8.13 to 8.17, and table 8.10, it can be seen that 70.72% of the overall respondents with average Likert score of 3.54 “agreed to strongly agree” that they apply Serendipity/Fortuitous ISBT to meet their information needs. This strongly indicates that Serendipity/Fortuitous information-seeking is prevalence amongst construction project actors’. Details of individual questionnaire items are presented.
Table 8.11 Likert score related to orientation towards Serendipity/Fortuitous ISBT

<table>
<thead>
<tr>
<th>Statement</th>
<th>Number of Respondents</th>
<th>Likert Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I attend coffee or tea breaks, breakfast clubs, network sessions, and other casual forms of meetings with the view to seek information for use on a task or provide solutions to problems.</td>
<td>158</td>
<td>3.03</td>
</tr>
<tr>
<td>I attend conferences, seminars, lectures, and other similar events with the view to seek information for use on tasks or provide solutions to problems.</td>
<td>158</td>
<td>3.62</td>
</tr>
<tr>
<td>I rely on informal meetings or encounters with the view to seek information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>3.66</td>
</tr>
<tr>
<td>I capture important information through casual activities (such as discussions with colleagues or friends, browsing, reading, meetings) without any prior intention of seeking that information.</td>
<td>158</td>
<td>4.05</td>
</tr>
<tr>
<td>I rely on random and spontaneous opportunities to seek information for use.</td>
<td>158</td>
<td>3.32</td>
</tr>
</tbody>
</table>

Overall average Serendipity/ Fortuitous ISB Likert Score 158 3.54

Descriptive Statistics for Serendipity/Fortuitous ISB Questionnaire Items

Attends Casual Breaks Network Sessions with the View to Seek Information

The statement “I attend coffee or tea breaks, breakfast clubs, network sessions, and other casual forms of meetings with the view to seek information for use on a task or provide solutions to problems” had 43% “agree to strongly agree” responses with a Likert score of 3.03. Only 16% were neutral and 39% disagreed to strongly disagree. The responses and the Likert score indicate that noteworthy number of construction professionals seeks information through casual breaks and casual encounters. Figure 8.13 present descriptive statistics of responses.
Figure 8.13 I attend casual breaks and other casual form of meetings with the view to seek information for use on a task or provide solution to a problem

_Capture Information through Conferences, Seminars, Lectures, and Others_

This statement relate to the extent to which actors’ attend conferences, seminars, lectures, and other similar events with the view to seek information. Overall, 69% of the respondents with a Likert score of 3.62 agreed to strongly agree with the statement. Figure 8.14 present descriptive statistics of responses.

Figure 8.14 I attend conferences, seminars, lectures and other similar events with the view to seek information ...

Reliance on Informal Meetings or Encounters

The statement “I rely on informal meetings or encounters with the view to seek information to perform a task or provide solutions to problems” had agreement response of 64% with a Likert score of 3.66. Only 11% were neutral and 20% “disagreed to strongly disagree”. Figure 8.15 present descriptive statistics of responses.
I rely on informal meetings or encounters with the view to seek information to perform tasks or provide solutions to problems

Information Capture through Casual Activities

With this statement, well over three quarters of the respondents (89%) with a Likert score of 4.05 “agreed to strongly agree”, that they “capture important information through casual activities (such as discussions with colleagues or friends, browsing, reading, meetings) without any prior intention of seeking that information”. Figure 8.16 present descriptive statistics of responses.

Reliance on Random and Spontaneous Opportunities

With this statement, majority of the respondents (51%) with a Likert score of 3.32 “strongly agreed to agree” to the statement “I rely on random and spontaneous opportunities to seek information for use”. Figure 8.17 present descriptive statistics of responses.
8.3.4 Actors’ Orientations towards Associate ISBT

Another important discovery of actors’ ISB orientation is the Associate ISBT. It was discovered that construction project actors’ predominantly rely on their colleagues and friends to seek information for use. Therefore, five questionnaire items were designed to measure the extent to which project actors’ seek information from colleagues and friends for use. Responses to the questionnaire items in this section shows that construction actors rely significantly on their colleagues and/or friends both in and outside of the project environment and/or the organisation to seek information for use.

Table 8.12 presents outputs from the descriptive statistics of the five questionnaire items. From table 8.12 and figures 8.18 to 8.22, it can be seen that 82.56% of respondents with average Likert score of 4.13 “agreed to strongly agree” that they orientate towards Associate ISBT. It is encouraging to know that responses to the questionnaire items in this section are positive and well above the mean Likert score. General responses to these five questionnaire items suggest that construction project actors’ information-seeking orientation is similar to that of engineers as indicated in extant literature. Figures 8.18 to 8.22 present details of individual questionnaire items in this section.
### Table 8.12 Likert score related to orientation towards Associate ISBT

<table>
<thead>
<tr>
<th>Statement</th>
<th>Number of Respondents</th>
<th>Likert Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to contact my colleagues and/or friends (either by video conference, phone call or email) to seek key/specific information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>4.15</td>
</tr>
<tr>
<td>I believe that information from colleagues and/or friends with specialist knowledge and skills can be vital to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>4.52</td>
</tr>
<tr>
<td>I keep a network of colleagues and/or friends with the view to seek specific information to support delivery of tasks or provide solutions to problems.</td>
<td>158</td>
<td>3.87</td>
</tr>
<tr>
<td>I attend formal meetings including team briefings, stage reviews and/or other forms of meetings with the view to seek information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>4.04</td>
</tr>
<tr>
<td>I like to meet with colleagues and/or friends face-to-face to ask them specific questions in order to capture relevant information for use on tasks or provide solutions to problems.</td>
<td>158</td>
<td>4.06</td>
</tr>
<tr>
<td><strong>Overall average Associate ISB Likert Score</strong></td>
<td>158</td>
<td><strong>4.13</strong></td>
</tr>
</tbody>
</table>

**Descriptive Statistics for Associate ISBT Questionnaire Items**

*Contact Colleagues and/or Friends to Seek Key/Specific Information*

With this statement, well over three quarters of the respondents (88%) with a Likert score of 4.15 “agreed to strongly agree”, that they like to “contact colleagues and/or friends to seek key/specific information to perform a task or provide solutions to problems”. Only 7% were neutral whilst 6% “disagreed to strongly disagree” with the statement. Figure 8.18 present descriptive statistics of responses.
I contact my colleagues and/or friends to seek information to perform a task or provide solution to a problem.

Vital Information from Friends and Colleagues

Respondents were asked to rate the extent to which they “agree or disagree” to the question, “I believe that information from colleagues and/or friends with specialist knowledge and skills can be vital to perform a task or provide solutions to problems”. Surprisingly, 95% of the respondent “strongly agreed to agree” to this question. Figure 8.19 present descriptive statistics of responses.

Keep Network of Colleagues and/or Friends for Specific Information

With this statement, majority of the respondents (73%) with a Likert score of 3.87 “strongly agreed to agree” to the statement “I keep a network of colleagues and/or friends with the view to seek specific information to support delivery of tasks or
provide solutions to problems”. Figure 8.20 present descriptive statistics of responses from respondents.

Figure 8.20 I keep a network of colleagues and/or friends with the view to seek specific information

Attend Formal Meetings with the View to Seek Information

With this statement, respondents were asked to rate the extent to which they “strongly agree” to “strongly disagree” to the question “I attend formal meetings including team briefings, stage reviews and/or other forms of meetings with the view to seek information to perform a task or provide solutions to problems”. Approximately 82% of the respondents with a Likert score of 4.04 “agreed to strongly agree” to this questionnaire item. Figure 8.21 present descriptive statistics of responses.

Figure 8.21 I attend formal meetings including team briefings, stage reviews and/or other forms of meetings with the view to seek information
Meet with Colleagues and/or Friends Face-To-Face to seek Specific information

With this statement “I like to meet with colleagues and/or friends face-to-face to ask them specific questions in order to capture relevant information for use on tasks or provide solutions to problems”, majority of the respondents (80%) with a Likert score of 4.06 “strongly agreed to agree”. Figure 8.22 present descriptive statistics of responses.

Figure 8.22 I like to meet with colleagues and/or friends face-to-face to ask specific questions in order to capture relevant information

8.3.5 Actors’ Orientations towards Social Media ISBT

Social Media is an emerging information seeking and dissemination avenue for wider reach to people (colleagues or friends) with similar information needs and requirements. It was discovered that both actors’ and organisations continue to consistently use Social Media avenues to meet certain kind of information needs. It is perceived that this avenue is used when actors’ require quick responses, and sometimes from wide network of friends/colleagues to seek certain information (including information leads, validation, and others). Hence, this section of the questionnaire sought to measure the extent to which construction actors’ rely on Social Media platforms (including YouTube, LinkedIn, blogs, Twitter, and Facebook) to seek relevant information for use. Five questionnaire items were designed to measure the extent to which actors’ orientate towards Social Media ISBT.

Table 8.13 presents output of descriptive statistics of the questionnaire items. From table 8.13 it can be seen that 52.80% of the overall respondents with average Likert score of 2.46 “strongly agree to agree” that they orientate towards Social Media
ISBT. The output shows above average response to questionnaire items in this section. This implies, a definite use of Social Media avenues to seek information. Figures 8.23 to 8.27 presents details of the questionnaire items in this section.

Table 8.13 Likert score related to orientation towards Social Media ISBT

<table>
<thead>
<tr>
<th>Statement</th>
<th>Number of Respondents</th>
<th>Likert Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I occasionally seek information from social media sites to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>2.48</td>
</tr>
<tr>
<td>I keep blogs, or follow bloggers, organisations, or groups on social networking sites with the view to capture information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>2.19</td>
</tr>
<tr>
<td>I tend to join networks of friends and/or colleagues with similar interests on social media with the view to capture information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>2.49</td>
</tr>
<tr>
<td>I tend to follow discussions or activities on social networking sites including LinkedIn, Twitter, blogs, online forums, and/or other social networking communities with the view to capture relevant information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>2.53</td>
</tr>
<tr>
<td>My organisation allows employees to follow social media networking sites such as Twitter/bloggers /LinkedIn, or other social media communities to stay abreast with information.</td>
<td>158</td>
<td>3.15</td>
</tr>
<tr>
<td>Overall average Social Media ISB Likert Score</td>
<td>158</td>
<td>2.64</td>
</tr>
</tbody>
</table>

Descriptive Statistics for Social Media ISB Questionnaire Items
Occasionally Seek Information from Social Media Sites

With this question, a noteworthy number of the respondents (26%) with a Likert score of 2.48 “agreed to strongly agree” to the statement “I occasionally seek information from social media sites to perform a task or provide solutions to
problems”. This indicates the suboptimal use of Social Media avenues amongst construction professionals. Figure 8.23 present descriptive statistics of responses.

![Figure 8.23](image)

**Figure 8.23** I occasionally seek information from social media websites

*Keep Blogs/Follow Bloggers or Groups on Social Networking Sites*

With this statement, minority of respondents (14%) with a Likert score of 2.19 “strongly agree to agree” that they keep blogs, or follow bloggers and organisations on social networking sites to capture information to perform tasks or provide solutions. Figure 8.24 present descriptive statistics of responses.

![Figure 8.24](image)

**Figure 8.24** I keep or follow bloggers, organisations or groups on social networking sites with the view to capture information

*Join Networks of Friends and/or Colleagues with Similar Interests on Social Media*

The statement “I tend to join networks of friends and/or colleagues with similar interests on social media with the view to capture information to perform a task or
provide solutions to problems” had agreement response of 26% with a Likert score of 2.49. Figure 8.25 present descriptive statistics of responses.

**Figure 8.25** I tend to join network of friends and/or colleagues with similar interests on social media with the view to capture information

**Follow Discussions or Activities on Social Networking Sites**

Respondents were asked to indicate the extent to which they “follow discussions or activities on social networking sites including LinkedIn, Twitter, blogs, online forums, and/or other social networking communities with the view to capture relevant information to perform a task or provide solutions to problems”. Out of 158 respondents, 25% with a Likert score of 2.53 indicated that they “agree to strongly agree” to the statement. Figure 8.26 present descriptive statistics of responses.

**Figure 8.26** I tend to follow discussions or activities on social networking sites with the view to capture information
Organisation Allows Employees to Follow Social Media Networking Sites

The statement “My organisation allows employees to follow social media networking sites such as Twitter/bloggers/LinkedIn, or other social media communities to stay abreast with information” had agreement response of 44% with a Likert score of 3.13. Figure 8.27 present descriptive statistics of responses.

Figure 8.27 My organisation allows employees to follow social media networking sites to stay abreast with information

8.3.6 FACTOR ANALYSIS OF INFORMATION-SEEKING BEHAVIOUR TYPES

After establishing the five ISBTs through literature and the exploratory study, it was important to develop questionnaires to test its actualisation amongst construction professionals. Hence, the output of survey responses from 158 participants was manually grouped into Microsoft Excel and then imported into IBM SPSS 21.0 where it was analysed using the confirmatory Factor Analysis tool.

Exploratory factor analysis helps to explore any underlying structure in the patterns or correlations between variables. According to Field (2013), this technique has three main uses; (1) to understand the structure of a set of variables, (2) to construct a questionnaire to measure an underlying variable; and (3) to reduce a data set to a major manageable size while retaining as much of the original information as possible. For these reasons, exploratory factor analysis was undertaken using the Principal Component Analysis (PCA) technique to identify cluster of factors that directly or indirectly confirms the five ISBT variables. The data was initially tested for its reliability where the Cronbach’s alpha value ($\alpha = .826$) for
the overall scale, and eigenvalues for each factor in the data were obtained (see appendix E-1).

The factor analysis was conducted on the 25 ISB questionnaire items by means of the PCA technique, with Varimax rotation. Various indicator of factorability of the data were good, and the residuals indicated that the solution was a good one. The measure of sampling adequacy such as Kaiser-Meyer-Olkin (KMO) was calculated for the variables. A KMO is a test that represents the squared correlation between variables to the squared partial correlation between variables. KMO statistics varies between 0 and 1. A value of 0 indicates that the sum of partial correlations is large relative to the sum of correlations, indicating a diffusion in the pattern of correlations (Field, 2013). A KMO value close to 1 indicates that patterns of correlations are relatively compact and so factor analysis should yield distinct and reliable factors. According to Field, (2013, p. 684), Kaiser (1974) recommends KMO values greater than .5 (>.5) as acceptable. Therefore, the KMO measure was used to verify the sampling adequacy for the analysis. Highest loading statements with particular factors were grouped under that factor and those that correlated less than .5 with the factor were not loaded. The overall KMO = .78 and ρ = .000 which is good, and all values for individual items were greater than .70, which is well above the acceptable limit of .5 (Field, 2013).

Principal Component Analysis was used to extract the factors. Seven factors (Appendix E-1) whose eigenvalues were over the Kaiser’s criterion (i.e. eigenvalue > 1) were identified initially. These factors accounted for 62.08% of the total variance. These components are presented in appendix E-1. The factors were rotated using the Varimax rotation procedure (Field, 2013). After careful analyses and synthesis of component loadings in relation to the initial ISBTs identified, five key factor solutions, which accounted for 53.89% of the total variance (see table 8.14) were retained.

Figure 8.28 present the obtained scree plot with the point of inflexion highlighted by the thunderbolt to indicate the five factors obtained. Table 8.14 present a summary of the exploratory factor analysis result with factor loadings for the ISBT questionnaire items. The decision to retain the five factors was based on the
sample size and the convergence of the scree plot and Kaiser’s correlation on the values in components 6 and 7 (see appendix E-1).

Table 8.14 Total variance explained

<table>
<thead>
<tr>
<th>Factor</th>
<th>Cumulative Variance (%)</th>
<th>Total Variance</th>
<th>Eigen Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.739</td>
<td>20.739</td>
<td>5.185</td>
</tr>
<tr>
<td>2</td>
<td>32.902</td>
<td>12.163</td>
<td>3.041</td>
</tr>
<tr>
<td>3</td>
<td>40.471</td>
<td>7.569</td>
<td>1.892</td>
</tr>
<tr>
<td>4</td>
<td>47.409</td>
<td>6.939</td>
<td>1.735</td>
</tr>
<tr>
<td>5</td>
<td>53.389</td>
<td>5.980</td>
<td>1.495</td>
</tr>
</tbody>
</table>

![Scree Plot]

Figure 8.28 Scree plot of five extracted factors

Table 8.15 shows the factor loadings after the rotation. The items that cluster on the same factor suggest that factor 1 represents “Social Media ISBT” with 20.239% of the total variance. Factor 2 represents “Cognitive ISBT” with 12.163% of the total variance. Factor 3 represents “Associate ISBT” with 7.569% of the total variance, factor 4 represents “Systematic ISBT” with 6.939% of the total variance. In addition, factor 5 represents “Serendipity/Fortuitous ISBT” with 5.980% of the total variance. These extracted factors affirm the already identified ISBTs in literature and the exploratory study. The succeeding section compares the five ISBTs to establish respondents’ preferred ISBT within the project organisation.
### Table 8.15 Summary of the exploratory factor analysis for the ISBTs questionnaire items

<table>
<thead>
<tr>
<th>ISBT Questionnaire Items</th>
<th>Rotated Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I occasionally seek information from social media sites to perform a task or provide solutions to problems.</td>
<td>.857</td>
</tr>
<tr>
<td>I keep blogs, or follow bloggers, organisations, or groups on social networking sites with the view to capture information to perform a task or provide solutions to problems.</td>
<td>.825</td>
</tr>
<tr>
<td>I tend to join networks of friends and/or colleagues with similar interests on social media with the view to capture information to perform a task or provide solutions to problems.</td>
<td>.888</td>
</tr>
<tr>
<td>I tend to follow discussions or activities on social networking sites including LinkedIn, Twitter, blogs, online forums, and/or other social networking communities with the view to capture relevant information to perform a task or provide solutions to problems.</td>
<td>.859</td>
</tr>
<tr>
<td>My organisation allows employees to follow social media networking sites such as Twitter/bloggers /LinkedIn, or other social media communities to stay abreast with information.</td>
<td>.548</td>
</tr>
<tr>
<td>I rely on my knowledge, experience and skills to create information to perform a task or provide solutions to problems.</td>
<td>.667</td>
</tr>
<tr>
<td>I rely on my intuition, memory and mental ability to create information to perform a task or provide solutions to problems.</td>
<td>.785</td>
</tr>
<tr>
<td>I rely on my intelligence to create information to perform a task or provide solutions to problems.</td>
<td>.797</td>
</tr>
<tr>
<td>I rely on my perception to create information to perform a task or provide solutions to problems.</td>
<td>.728</td>
</tr>
<tr>
<td>I like to contact my colleagues and/or friends (either by video conference, phone call or email) to</td>
<td>.580</td>
</tr>
</tbody>
</table>
seek key/specific information to perform a task or provide solutions to problems.

I believe that information from colleagues and/or friends with specialist knowledge and skills can be vital to perform a task or provide solutions to problems.

I keep a network of colleagues and/or friends with the view to seek specific information to support delivery of tasks or provide solutions to problems.

I attend formal meetings including team briefings, stage reviews and/or other forms of meetings with the view to seek information to perform a task or provide solutions to problems.

I like to meet with colleagues and/or friends face-to-face to ask them specific questions in order to capture relevant information for use on tasks or provide solutions to problems.

I use internal and external information sources such as technical documents, trade magazines, trade reports, trade journals, company standards, company protocols, specifications, and government documents to seek information for use on a task or provide solutions to problems.

I maintain personal information management systems including information archiving and recycling in order to reuse information to perform a task or provide solutions to problems.

I create and maintain automatic information capture into folders to support my information seeking activities.

I follow a step-by-step approach to acquire information to perform a task or provide solutions to problems.

I rely on informal meetings or encounters with the view to seek information to perform a task or provide solutions to problems.

I capture important information through casual activities (such as discussions with colleagues or...
friends, browsing, reading, meetings) without any prior intention of seeking that information.

I rely on random and spontaneous opportunities to seek information for use.  

I attend coffee or tea breaks, breakfast clubs, network sessions, and other casual forms of meetings with the view to seek information for use on a task or provide solutions to problems.

I attend conferences, seminars, lectures, and other similar events with the view to seek information for use on tasks or provide solutions to problems.
8.4 ACTORS INFORMATION-SEEKING BEHAVIOUR ORIENTATIONS

After establishing that construction actors orientate towards five different ISBTs, it is important to compare actors’ orientation towards these ISBT’s in order to establish their ISBT preferences. This responds to research hypothesis 1, which states that there is a unique preference of ISBT amongst construction project actors (see chapter 5). Hence, to test this hypothesis for the ordinal data, the Friedman’s ANOVA was applied to test for significant differences in the ranking related variables. This is a nonparametric test for multiple related samples where no assumptions about the data are made. The Friedman’s test was employed to test the null hypothesis that actors confidence levels declined towards certain ISBTs regardless of any dependant factors.

Tables 8.16 and 8.17 present the output of the Friedman test. The Friedman test carried out on the data revealed significant variations in actors’ confidence levels in ISB orientations and/or preferences across the five types. The assessment clearly indicates, a significant difference between actors ISBT orientation, where $x^2(4, N = 158) = 307.876, p < 0.000$.

Where $x^2_f$ is the degree of freedom (i.e. one less than the number of ISBTs). The significant difference in actors ISBT confidence levels suggests that the composition of construction teams and project organisations influences the way these actors seek information for use.

**Table 8.16 Friedman test on confidence level in ISBT preferences**

<table>
<thead>
<tr>
<th>Information Seeking Behaviour Types</th>
<th>Number of Respondents</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Mean Ranks</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive</td>
<td>158</td>
<td>4.043</td>
<td>.5792</td>
<td>3.77</td>
<td>2.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Systematic</td>
<td>158</td>
<td>3.801</td>
<td>.5650</td>
<td>3.19</td>
<td>2.4</td>
<td>5.0</td>
</tr>
<tr>
<td>Serendipity/Fortuitous</td>
<td>158</td>
<td>3.537</td>
<td>.6488</td>
<td>2.58</td>
<td>1.4</td>
<td>5.0</td>
</tr>
<tr>
<td>Associate</td>
<td>158</td>
<td>4.127</td>
<td>.5591</td>
<td>4.09</td>
<td>1.8</td>
<td>5.0</td>
</tr>
<tr>
<td>Social Media</td>
<td>158</td>
<td>2.568</td>
<td>.9634</td>
<td>1.37</td>
<td>1.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Table 8.16 shows the output of the Friedman test of the null hypothesis. The Friedman’s test was employed to test the null hypothesis that there are differences in actors’ confidence levels towards their preference for the ISBTs regardless of any of the influencing factors. The output of table 8.17 shows a chi-square value
This suggests that there is a strong evidence to reject the null hypothesis that actors' confidence in ISB decline. The mean rank clearly suggest that actors' place more emphasis on their associates than their own cognitive ability, and other opportunities available to them internally and externally to seek information for use.

Table 8.17 Friedman test statistics on difference in actors ISBT preferences

<table>
<thead>
<tr>
<th>Number of respondents</th>
<th>158</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>307.876</td>
</tr>
<tr>
<td>df</td>
<td>4</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

8.4.1 Hierarchical Structure of Actors ISB Preference

Certainly, the mean ranking from the Friedman’s test shows actors order of preference to the five ISBTs. Hence, a hierarchical structure of actors’ ISBT preference was formulated, as presented in figure 8.29.

Figure 8.29 Hierarchical structure of actors ISBT preference

Figure 8.29 shows actors ISBT preference presented in ascending order from Social Media, Serendipity/Fortuitous, Systematic, Cognitive, to Associate ISBT. Thus, Associate ISBT is the highest ranking or the most preferred by the respondents. Unsurprisingly, Social Media ISBT is the least preferred or fifth ranked
by the respondents. The hierarchical structure is very important in relation to strategic development of information management systems and process to improve actors’ ISBs in project organisations. The structure highlights areas to focus in relation to systems development and improvement to meet actors ISB preferences. The output clearly shows actors’ reliance on colleagues; which suggests that development of teams and individuals should be at the forefront of new strategies to support ISBs and information management in project organisations. However, a surprised discovery is the fact that actors’ prefer Serendipity/Fortuitous ISBT to Social Media ISBT. This clearly suggests a suboptimal use of social media and the lack of awareness of its benefits within project environment and construction organisations. It also suggest that opportunities and avenues should be created for actors’ to explore Serendipity/Fortuitous information-seeking.

The overall assessment in table 8.16 indicates that all the ISBTs have above average Likert scores. This confirms evidence in extant literature and findings of the qualitative inquiry that certainly; construction project actors’ explore every avenue to meet their information needs.

Regarding the hierarchical ISBT structure, it is not surprising that Associate ISBT is the highest ranked. This is because extant literature suggest that engineering project actors generally prefer to seek information from their colleagues and/or friends than any other information sources (Ahmed and Wallace, 2004; Aurisicchio et al., 2012; King, 1994; Kwasitsu, 2003; Robinson, 2010; Snow, 1975). This also reflects responses from interviews during the qualitative inquiry where for example, an interviewee stated that: “I always walk up to a colleague or pick the phone to call a colleague for majority of the information that I cannot get myself. This is because I trust that colleague because of his enormous experience and knowledge. However; due to his busy schedule, I do not get him at all times and this can be very frustrating” [M&E].

Furthermore, results from the Kruskal-Wallis test showed statistically, a significance difference between the respondents’ orientation towards Associate ISBT and professional role factor ($X^2 = 18.286, df = 8, \rho = .019$). This suggests that the level
of relationship “associate” information seekers place on their colleagues in similar professional roles for information is imperative.

Similarly, the hierarchical structure demonstrates that the level of qualification underpins the hierarchy of the ranked ISBTs. This can be attributed to the number of respondents who have some form of university degree(s) level qualifications. For example, the Friedman’s tests on the five ISBTs produced a mean rank of 3.77 (table 8.16) with a standard deviation of .5792. This put Cognitive ISBT as the second preferred or ranked ISBT followed by Systematic, Serendipity/Fortuitous and Social Media ISBT for construction project actors.

The Friedman’s test indicates that the second preferred ISBT is the Cognitive type. This is consistent with literature (Ingwersen, 1996; Powell, 1982; Snow, 1975; Wilson, 1983). Interviewees in the qualitative inquiry also acknowledged this. For example, an interviewee expressed that: “I always try to get other members of the team to share my knowledge and vision of the task at hand and how I intend to approach it before proceeding with a decision in order to ensure that I have made the right decision since my professional integrity is always on the line” [Architect].

Similarly, table 8.16 shows that Systematic ISBT has the third highest mean, which indicates that although actors follow systematic approach to seeking information, they prefer other modes better. This further suggest that actors’ reliance on traditional information-seeking from sources such as library catalogues, databases, electronic resources and others is suboptimal. This is affirmed in extant literature (Rhodes, 1998) and the qualitative inquiry.

Similarly, the hierarchical structure shows that Serendipity/Fortuitous ISBT is the fourth preferred ISBT by actors; this revelation confirms findings from the exploratory analysis and extant literature (Bennett, 2006; Erdelez, 2005, 1997; Liestman, 1992). For example, it was found that design engineers favour serendipity information discovery to library, electronic or print databases. For example, an interviewee stated that; “Often when I am faced with creating new designs or new documents, I tend to rely on the internet, social media (YouTube), and other websites with an open mind in view of any accidental
discoveries/encounters. This kind of information discovery is mind blowing, it happens anywhere and everywhere and it’s less stressful since you have zero expectations and the outcome is always serendipitous....” [Design Engineer]

Unsurprisingly, project actors’ ranked Social Media ISBT the least preferred ISB. This suggests different reasons relating to factors such as awareness, age, experience levels, accessibility, availability, and others in realising the benefits of Social Media ISBT. Surprisingly, the Kruskall-Wallis test found a significance difference between respondents’ orientation towards Social Media ISBT and Professional role ($X^2 = 15.637, df = 8, \rho = .048$), and Social Media ISBT and Level of Qualification($X^2 = 16.295, df = 5, \rho = .006$).

8.5 ASSESSMENT OF FACTORS THAT INFLUENCE ACTORS’ ISBTS
As indicated in chapters four and five, several key factors influence actors’ ISBs. However, further investigations revealed that some factors directly influence actors’ information-seeking whereas others influence information use/task performance behaviours. Hence, this section responds to research objectives four, five and six to establish the key factors that influence actors’ information-seeking and information use/task performance.

A critical incident technique was employed to measure the extent to which the identified factors influence actors’ information-seeking and information use/task performance behaviours. Respondents were asked to recall recent task(s) or project(s) where they had to seek information to execute and indicate the extent to which they agree or disagree with the questionnaire items. They were asked to choose from a five-point Likert scale, ranging from “strongly agree” to “strongly disagree”. Table 8.18 present the summary of each of the influencing information-seeking and information use/task performance factors in descending order with their average Likert scores. The results shows an above average Likert score (3.81) form respondents. This indicates a strong agreement to the factors that influence their information-seeking and information use/task performance.

Notable among the responses is the “trust” factor, with a Likert score of 4.16. This suggests the extent to which “trust” influences actors’ information-seeking and
information use/task performance activities. Another factor which suggests a high potential to influence actors’ information-seeking and information use/task performance behaviours is “effectiveness”, with a Likert score of 3.96. Other factors such as currency, collaboration, usefulness, success, satisfaction, accessibility and accuracy (with high Likert scores 3.80 to 3.89) suggest having strong potential to influence actors’ information-seeking and information use/task performance.

Table 8.18 Likert Score Related to Influencing Factors

<table>
<thead>
<tr>
<th>Statement: Influencing Information Seeking Factors</th>
<th>No.</th>
<th>Likert Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall, I trust the sources used to capture information to perform the task or solve the problem.</td>
<td>158</td>
<td>4.16</td>
</tr>
<tr>
<td>My team composition or network of colleagues and/or friends enabled collaborative information seeking for task delivery.</td>
<td>158</td>
<td>3.88</td>
</tr>
<tr>
<td>Overall, I found it easy to access information to perform the task or solve the problem.</td>
<td>158</td>
<td>3.82</td>
</tr>
<tr>
<td>The way my organisation is set-up has direct impact on the way I seek information for use on a task or solve problems.</td>
<td>158</td>
<td>3.76</td>
</tr>
<tr>
<td>My organisation creates avenues/opportunities (sources and channels) to support the way I seek information to perform a task or provide solutions to problems.</td>
<td>158</td>
<td>3.73</td>
</tr>
</tbody>
</table>

Influencing information use/task performance factors

The way I seek information to perform tasks or solve problems is very effective. 158 3.96

Overall, the captured information was current (i.e. up-to-date). 158 3.89

Overall, the captured information was very useful in delivering the task or solving the problem. 158 3.84

Overall, the captured information was very influential in the successful delivery of the project or task. 158 3.83

Overall, I was satisfied with the level at which the captured information met the specifications of the task. 158 3.82

The captured information was correct (i.e. accurate) for 158 3.80
performing the task or solving the problem.

| The way I seek information for use on tasks or projects is very efficient. | 158 3.77 |
| Overall, the captured information was specific to the context of information required for the task or solving the problem. | 158 3.74 |
| The captured information was very reliable and consistent. | 158 3.65 |
| The captured information was user friendly and fit for purpose. | 158 3.64 |

Other factors such as efficiency, organisational set-up, context specific, and sources/channels (with Likert scores of 3.77 to 3.73) suggest being quite influential. However, factors such as reliability and relevance (with low Likert scores of 3.65 to 3.64) suggest a low influence on actors' information-seeking and information use/task performance behaviours.

**Descriptive Statistics for Influencing Factors Questionnaire Items**

This section presents descriptive statistics of the questionnaire items used to measure the extent to which these factors influence actors' ISBTs. In all, twelve (12) key information-seeking, and ten (10) key information use/task performance factors were identified to influence actors' ISBTs. It must be noted that the “time” factor is considered a “dynamic”, factor in that it influences both information-seeking and information use/task performance behaviours. Demographic factors such as professional role, experience, qualification, age, and employment sector and work condition are considered key information-seeking factors.

**Trust as an Influencing Information Seeking Factor**

With this factor, respondents were asked to rate the extent to which they “agree” or “disagree” with the question “overall, I trust the sources used to capture information to perform the task or solve the problem”. Figure 8.30 indicates that majority of the respondents (89.87%), “agreed”.to “strongly agree” that they trust the sources they use to seek information. This high figure supports the high Likert score for this questionnaire item. Only 7.79 % indicated their neutrality, and 2.53 % disagreed with the questionnaire item.
Trust as an influencing factor

**Collaboration as an Influencing Information-Seeking Factor**

With this factor, respondents were asked to rate the extent to which they “strongly agree” to “strongly disagree” to the questionnaire statement, “my team composition or network of colleagues and/or friends enables collaborative information-seeking for task delivery”. Figure 8.31 presents the descriptive statistics of response to the questionnaire item. Majority of the respondents (77.72%), “agreed” to “strongly agree” with the questionnaire item.

**Accessibility as an Influencing Information-Seeking Factor**

Respondents were asked to rate the extent to which they “agree” or “disagree” to the questionnaire statement “overall, I find it easy to access information to perform the task or solve the problem”. Figure 8.32 presents the descriptive statistics of
response to the questionnaire item. Majority of the respondents (70.88%), “agreed” to “strongly agree” that they find it easy to access information sources to seek information for use.

![Accessibility](image1)

**Figure 8.32 Accessibility as an influencing factor**

**Organisational Set-up as an Influencing Information-Seeking Factor**

With this statement, respondents were asked to rate the extent to which they “agree” or “disagree” to the questionnaire statement “the way my organisation or functional area is set-up has direct impact on the way I seek information for use on a task or solve problems”. Figure 8.33 presents the descriptive statistics of response to the questionnaire item. The questionnaire statement had an agreement response of 68.36%.

![Org Set-up](image2)

**Figure 8.33 Organisational setup as an influencing factor**
Sources/Channels as an Influencing Information-Seeking Factor
With this statement, respondents were asked to rate the extent to which they “agree” or “disagree” to the questionnaire statement “my organisation creates avenues/opportunities (sources and channels) to support the way I seek information to perform a task or provide solutions to problems”. Figure 8.34 presents the descriptive statistics of response to the questionnaire item. Majority of the respondents (65.82%), “agreed” to “strongly agree” to the questionnaire statement, 24.05% were neutral, and 10.13% disagreed to the statement.

Time as an Influencing Information-Seeking Factor
This factor is considered to influence both information-seeking and information use/task performance behaviours of actors. Hence, it was tested against all the five ISBTs in order to measure the extent of relationship between time and any of the five ISBTs. A critical incident technique (CIT) was applied where actors were asked to think about a recent task or project that they had to seek information within a period to perform. Respondents were asked to record the amount of time in minute they spend to seek information for use. Table 8.19 and 8.20 present the descriptive analysis of the “time” factor.
Table 8.19 Statistical analysis of average time (minutes) factor

<table>
<thead>
<tr>
<th>Statement</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Respondents</td>
<td>158</td>
</tr>
<tr>
<td>Mean</td>
<td>142.444</td>
</tr>
<tr>
<td>Median</td>
<td>60.00</td>
</tr>
<tr>
<td>Mode</td>
<td>281</td>
</tr>
<tr>
<td>St. Deviation</td>
<td>284.257</td>
</tr>
<tr>
<td>Minimum</td>
<td>5</td>
</tr>
<tr>
<td>Maximum</td>
<td>22505</td>
</tr>
<tr>
<td>Sum</td>
<td>22505</td>
</tr>
</tbody>
</table>

Table 8.20 Average time (in minutes) spent seeking information by actors

<table>
<thead>
<tr>
<th>Average time (minutes)</th>
<th>Number of Respondents</th>
<th>Percentage (%)</th>
<th>Cumulative Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>16</td>
<td>19</td>
<td>12.0</td>
<td>15.8</td>
</tr>
<tr>
<td>27</td>
<td>14</td>
<td>8.9</td>
<td>24.7</td>
</tr>
<tr>
<td>38</td>
<td>18</td>
<td>11.4</td>
<td>36.1</td>
</tr>
<tr>
<td>49</td>
<td>12</td>
<td>7.6</td>
<td>43.7</td>
</tr>
<tr>
<td>60</td>
<td>23</td>
<td>14.6</td>
<td>58.2</td>
</tr>
<tr>
<td>90</td>
<td>23</td>
<td>14.6</td>
<td>72.8</td>
</tr>
<tr>
<td>105</td>
<td>3</td>
<td>1.9</td>
<td>74.7</td>
</tr>
<tr>
<td>225</td>
<td>8</td>
<td>5.1</td>
<td>79.7</td>
</tr>
<tr>
<td>281</td>
<td>26</td>
<td>16.5</td>
<td>96.2</td>
</tr>
<tr>
<td>450</td>
<td>2</td>
<td>1.3</td>
<td>97.5</td>
</tr>
<tr>
<td>1125</td>
<td>2</td>
<td>1.3</td>
<td>98.7</td>
</tr>
<tr>
<td>2250</td>
<td>2</td>
<td>1.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

It can be seen that the average time spent by actors’ to seek information is 142.44 minute (with Std. Dev. =284.257). The mode and median values indicates that actors’ spend high amount of time seeking information. In terms of percentage average, construction project actors spend approximately 39% of their time (in hours) seeking information. This is a very high value and it can be linked to delays in task performance. This confirms literature findings that actors spend a significant amount of their time (about 40 to 60%) (King, 1994; Robinson, 2010) seeking information. Surprisingly, 16.5% of the respondents indicated that they spend on average, about 281 minutes to seek information, whereas 14.6% indicated that they spend about 90 minutes to seek information for use. Similarly, 5.9% of the
respondents spend about 225 minutes to seek information, whereas 3.8% spend only 5 minutes to seek information.

**Descriptive Statistics of Information Use/Task Performance Influencing Factors**

This section presents the descriptive statistics of questionnaire items used to measure the extent to which specific factors influence actors' information use/task performance behaviours. Ten important factors were identified as vital to influence actors' ISBTs.

**Effectiveness as an Influencing Information Use/Task Performance Factor**

This factor measures the effectiveness of the captured and used information. Hence, respondents were asked to respond to the statement “the way I seek information to perform tasks or solve problems is very effective”. Over three quarters (79.75%) of the respondents agreed with the statement. Only 19.62% responded neutral, and 0.63% disagreed. Figure 8.35 presents the descriptive statistics of response to the questionnaire item.

![Figure 8.35 Effective as information use/task performance factor](image)

**Efficiency as an Influencing Information Use/Task Performance Factor**

This factor measures the efficiency level of the captured and used information. Hence, respondents were asked to respond to the statement “the way I seek information for use on tasks or projects is very efficient”. Over three quarters
(79.75%) of the respondents agreed with the statement. Figure 8.36 presents the descriptive statistics of response to the questionnaire item.

![Efficiency Chart](image)

**Figure 8.36 Efficiency as information use/task performance factor**

*Currency as an Influencing Information Use/Task Performance Factor*

Project actors’ consistently require up-to-date information that meets their task requirements. As a result, “currency” was measured with the statement “overall, the captured information was current (i.e. up-to-date)”. In total, 67.72% of the respondent agreed to the statement. Figure 8.37 presents the descriptive statistics of response to the questionnaire item.
Useable as an Influencing Information Use/Task Performance Factor

This factor measures the extent to which the captured information is useable in task performance. As a result, respondents were asked to respond to the statement “overall, the captured information was very useful in delivering the task or solving the problem”. Overall, 76.72% of the respondents “agreed to strongly agree” with the statement. Figure 8.38 presents the descriptive statistics of response to the questionnaire item.
Relevance as an Influencing Information Use/Task Performance Factor

With this question, respondents were asked to respond to the statement, “the captured information was user friendly and fit for purpose”. Overall, 63.29% of the respondents agreed with the statement. Figure 8.39 presents the descriptive statistics of response to the questionnaire item.

![Figure 8.39 Relevance as information use/task performance factor](image1)

Reliability as an Influencing Information Use/Task Performance Factor

Similarly, respondents were asked to respond to the statement; “the captured information was very reliable and consistent”. Majority of the respondent (72.15%) agreed to the statement. Figure 8.40 presents descriptive statistics of responses.

![Figure 8.40 Reliability as information use/task performance factor](image2)
**Accuracy as an Influencing Information Use/Task Performance Factor**

Actors’ exposure to different channels and sources is such that information in transit generally changes in meaning, and this impact on its use. Hence, respondents were asked to respond to the statement; “the captured information was correct (accurate) for performing the task or solving the problem”. Majority of the respondents (63.91%) agreed to the statement. Figure 8.41 presents the descriptive statistics of response to the questionnaire item.

![Figure 8.41 Accuracy as information use/task performance factor](image)

**Satisfaction as an Influencing Information Use/Task Performance Factor**

Another factor that is vital to actors’ in terms of use of captured information to perform task is “satisfaction”. Thus, actors’ ought to demonstrate some form of satisfaction with the used information and the outcome of the used information. However, evidence suggests that actors’ generally rely on third party information that lacks detail and context. Hence, the satisfaction factor was measured with the statement “overall, I was satisfied with the level at which the captured information met the specifications of the task”. Responses from participants indicate that 77.82% agreed with the statement. Only 15.19% responded neutral, and 6.96% disagreed. Figure 8.42 presents the descriptive statistics of response to the questionnaire item.
Context Specific as an Influencing Information Use/Task Performance Factor

The statement “Overall, the captured information was specific to the context of information required for the task or solving the problem” was used to measure the context specific factor. Three quarters (74.08%) of the respondents agreed with the statement. Figure 8.43 presents descriptive statistics of responses.

Quality as an Influencing Information Use/Task Performance Factor

Actors’ require quality information for use. Hence, the statement “the captured information was user friendly and fit for purpose” was used to measure the quality
factor. Just about three-quarters (73.41%) of the respondents were in agreement with the statement. On the other hand, 20.89% responded neutral. Only 5.70% disagreed with the statement Figure 8.44 presents the descriptive statistics of response to the questionnaire item.

Figure 8.44 Quality as information use/task performance factor

8.6 RELATIONSHIPS BETWEEN ISBTS AND INFLUENCING FACTORS

Hypotheses Testing

In order to establish the relationships between the key influencing factors and the ISBTS, IBM's SPSS correlation analysis tool was used to analyse the Spearman’s ($r_s$) Nonparametric Test of Correlation. As per the requirement of bivariate correlation, the data was first checked for sources of bias. This was achieved by fitting a linear model to the data to test for normality and linearity. This ensures the validity of the model. Thus, if the relationship between the variables is non-linear, the model is invalid. In such a case, data transformation would be required for further investigation. Appendix F1 presents evidence of matrix scatter plots demonstrating the test of linearity and normality between the ISBTS and the influencing factors.

The scatter plots shows that outliers are evident in some cases, however, no logical reasons could be deduced to warrant exclusion; hence, all cases were included in the analysis. The test for linearity and normality of the relationships between the key influencing factors and the ISBTs resulted in a valid conclusion that linearity and normality between variables are appropriate and that the data is valid.
In chapter 5, 16 hypotheses statements were proposed. Therefore in testing these hypotheses, the outcome/dependent variables (ISBTs), and the independent variables (influencing factors) were organised and entered into IBM SPSS V21.0 for correlation analysis. The succeeding section present significant outcome of bivariate correlation analyses between the ISBTs and the influencing factors. Bias corrected and accelerated bootstrap 95% CI (Confidence Interval) are reported in the square brackets.

**Correlation of Associate ISBT and the Influencing Factors**
The correlation analysis shows evidence of both positive and negative significant relationships between Associate ISBT and the influencing factors. Factors such as organisational set-up, time, effectiveness, efficiency, relevance, reliability and accuracy have no significant relationship with Associate ISBT.

- there is a significant positive relationship between Associate ISBT and Trust, $r_s = .189 \ [.025, .351], \rho = .017$.
- there is a significant positive relationship between Associate ISBT and Collaboration, $r_s = .322 \ [.184, .465], \rho = .000$.
- there is a significant positive relationship between Associate ISBT and Accessibility, $r_s = .216 \ [.060, .373], \rho = .006$.
- there is a significant positive relationship between Associate ISBT and Sources/Channels, $r_s = .196 \ [.047, .351], \rho = .013$.
- there is a significant positive relationship between Associate ISBT and Currency, $r_s = .184 \ [.027, .323], \rho = .021$.
- there is a significant positive relationship between Associate ISBT and Useable $r_s = .205 \ [.055, .343], \rho = .010$.
- there is a significant positive relationship between Associate ISBT and Satisfaction, $r_s = .184 \ [.026, .343], \rho = .020$.
- there is a significant positive relationship between Associate ISBT and Context specific, $r_s = .251 \ [.107, .397], \rho = .001$.
- there is a significant negative relationship between Associate ISBT and Quality, $r_s = .157 \ [-.006, .307], \rho = .049$.
- The correlation analysis between Associate ISBT and the demographic factors revealed a negative significant relationship ($r_s = -.212[-.356, -.057], \rho = .008$) with Condition of work factor.
Implication of the significance levels of the positive (+) and negative (-) relationship of the influencing factors with Associate ISBT is that the positive relationships demonstrates that a rise in level of the influencing factor yields a rise in the ISBT. On the other hand, the negative level indicates that a decrease in an influencing factor decreases its impact on the ISBT. Figure 8.45 illustrates the direction of relationship between the dependent and independent variables. Other factors such as efficiency, effectiveness, reliability, accuracy and time do not have significant relationship with Associate ISBT. This can imply that the non-significant factors do not influence actors’ who orientate toward Associate ISBT.

![Diagram of Information Seeking Factors and Information Use/Task Performance Factors]

**Figure 8.45 Factors that have significant association with Associate ISBT**

**Correlation of Cognitive ISBT and the Influencing Factors**
The correlation analysis shows evidence of positive relationship between Cognitive ISBT and the influencing factors. It shows that factors such as trust, time, efficiency, useable and accuracy has no significant relationship with Cognitive ISBT.

- there is a significant positive relationship between Cognitive ISBT and Collaboration, $r_s = .198 [.034, .352], \rho = .013$.
- there is a significant positive relationship between Cognitive ISBT and Accessibility, $r_s = .246 [.071, .397], \rho = .002$.
- there is a significant positive relationship between Cognitive ISBT and Organisational Set-up, $r_s = .244 [.095, .392], \rho = .002$.
- there is a significant positive relationship between Cognitive ISBT and Sources/Channels, $r_s = .212 [.045, .368], \rho = .008$. 
➢ there is a significant positive relationship between Cognitive ISBT and Effectiveness, \( r_s = .271 \ [.099, .430], \rho = .001. \)

➢ there is a significant positive relationship between Cognitive ISBT and Currency, \( r_s = .243 \ [.073, .403], \rho = .002. \)

➢ there is a significant relationship between Cognitive ISBT and Relevance, \( r_s = .242 \ [.093, .384], \rho = .002. \)

➢ there is a significant positive relationship between Cognitive ISBT and Satisfaction, \( r_s = .251 \ [.062, .426], \rho = .001. \)

➢ there is a significant positive relationship between Cognitive ISBT and Context specific, \( r_s = .226 \ [0.056, .391], \rho = .004. \)

➢ there is a significant positive relationship between Cognitive ISBT and Quality, \( r_s = .191 \ [0.019, .350], \rho = .016. \)

Similarly, the positive (+) relationship of the influencing factors on Cognitive ISBT demonstrates that a rise in level of the influencing factor yields a rise in the ISBT. Figure 8.46 illustrates the direction of relationship between the dependent and independent variables.

Figure 8.46 Factors that have significant association with Cognitive ISBT

Correlation of Systematic ISBT and the Influencing Factors
The correlation analysis of Systematic ISBT and the influencing factors present interesting revelations. The analysis shows a strong evidence of positive relationship between Systematic ISBT and the influencing factors. It shows that factors such as time, collaboration, and sources/channels have no significant relationship with Systematic ISBT.
there is a significant positive relationship between Systematic ISBT and Trust, $r_s = .173 [0.012, 0.319], \rho = .029$.

there is a significant positive relationship between Systematic ISBT and Accessibility, $r_s = .192 [0.021, 0.340], \rho = .016$.

there is a significant positive relationship between Systematic ISBT and Organisational Set-up, $r_s = .193 [0.046, 0.360], \rho = .015$.

there is a significant positive relationship between Systematic ISBT and Effectiveness, $r_s = .271 [0.109, 0.417], \rho = .001$.

there is a significant positive relationship between Systematic ISBT and Efficiency, $r_s = .328 [0.165, 0.460], \rho = .000$.

there is a significant positive relationship between Systematic ISBT and Currency, $r_s = .218 [0.050, 0.377], \rho = .006$.

there is a significant positive relationship between Systematic ISBT and Useable, $r_s = .331 [0.170, 0.472], \rho = .000$.

there is a significant positive relationship between Systematic ISBT and Relevance, $r_s = .244 [0.098, 0.382], \rho = .002$.

there is a significant positive relationship between Systematic ISBT and Reliability, $r_s = .211 [0.042, 0.358], \rho = .008$.

there is a significant positive relationship between Systematic ISBT and Accuracy, $r_s = .245 [0.075, 0.404], \rho = .002$.

there is a significant positive relationship between Systematic ISBT and Satisfaction, $r_s = .177 [0.001, 0.351], \rho = .026$.

there is a significant positive relationship between Systematic ISBT and Context specific, $r_s = .206 [0.040, 0.364], \rho = .009$.

there is a significant positive relationship between Systematic ISBT and Quality, $r_s = .205 [0.040, 0.364], \rho = .000$.

The positive (+) relationships demonstrate that a rise in the level of the influencing factors yields a rise in the ISBT. The only factor, which is not significant to Systematic ISBT, is “time”. This indicates that Systematic ISBT is not time dependent. Figure 8.47 illustrates the direction of relationship between the dependent and independent variables.
Figure 8.47 Factors that have significant association with Systematic ISBT

**Correlation of Serendipity/Fortuitous ISBT and the Influencing Factors**

The correlation analysis of *Serendipity/Fortuitous ISBT* and the influencing factors present an interesting revelation. The results show evidence of positive significant relationship between some influencing factors and *Serendipity/Fortuitous ISBT*. It shows that collaboration, currency, and accuracy have significant relationship with Serendipity/ Fortuitous ISBT.

- there is a significant positive relationship between Serendipity/Fortuitous ISBT and Collaboration, $r_s = .211 [.048, .366], p = .008$.
- there was a significant positive relationship between Serendipity/Fortuitous ISBT and Currency, $r_s = .264 [.125, .408], p = .001$.
- there is a significant positive relationship between Serendipity/Fortuitous ISBT and Accuracy, $r_s = .202 [.056, .332], p = .011$.

The implication of the levels of significance of the influencing factors with *Serendipity/Fortuitous ISBT* is that the positive relationships demonstrate that a rise in level of the influencing factor yields a rise in the ISBT. Hence, serendipity/fortuitous information seekers tend to collaborate during their information-seeking process to capture current and accurate information for use. Figure 8.48 present an illustration of the direction of relationship between the dependent and independent variables.
Correlation of Social Media ISBT and the Influencing Factors
The correlation analysis shows that there is evidence of negative relationships between the useable influencing factor and Social Media ISBT. It shows that only usability influencing factor has significant relationship with Social Media ISBT.

- there is a significant negative relationship between Social Media ISBT and useable, $r_s = .160[-.007, .331], \rho = .045$.

The implication of the level of significance of the influencing factors with the Social Media ISBT is that the negative relationship demonstrates that a decrease in the level of the influencing factors yields a decrease in the usability of information captured. Figure 8.49 illustrates the direction of relationship between the dependent and independent variables.

Figure 8.49 Factors that have significant association with Social Media ISBT

The overall correlation analyses shows that majority of the information-seeking and information use/task performance influencing factors have significant positive and negative relationship with the five ISBTs. This confirms evidence in the extant literature and the findings of the qualitative inquiry that certainly actors' ISBs are
potentially influenced by information-seeking and information use/task performance factors. It must be noted that not all the factors have the potential to influence actors’ ISBTs.

It is crucial to emphasise that correlation does not establish a causal link between the ISBTs and the influencing factors. Some part of the outcome results does appear to contradict logical thinking; however, the same logical reasons support the reason why the outcome is evident in the participants’ ISB process. There is definite existence of strong relationship, which is statistically significant and consistently present in the data. These findings can be attributed to the wider differences between the demographic factors of respondents and the notion that, construction project is predominantly executed by professionals working together (in teams) throughout the PLC. The findings also suggest that certain factors have direct impact on actors’ ISB orientations; hence, greater emphasis on those factors can improve actors’ ISB processes in the project environment. Regarding the factors that have significant relationships with the ISBTs, the “trust” factor has a significant positive relationship between Associate and Systematic ISBTs. This confirms literature and exploratory review findings that project actors trust their colleagues and formal sources for majority of their information (Denize and Young 2007; Hertzum et al. 2002; Hertzum 2002).

Similarly, the “collaboration” factor significantly and positively relates to Associate ISBT, Cognitive ISBT, and Serendipity/Fortuitous ISBT. This affirms literature findings and findings from the qualitative inquiry that actors’ generally prefer to collaborate with colleagues and/or friends irrespective of qualification and other factors (Court, 1997; Wallace and Ahmed, 2003; Yitzhaki and Hammershlag, 2004). In addition, the “accessibility” factor confirms literature findings and qualitative inquiry findings that actors’ perceive accessibility as the most important determinant of their information sources selection (Holland and Powell, 1995; Pinelli, 1991; Yitzhaki and Hammershlag, 2004). This factor significantly and positively relates to Associate, Cognitive, and Systematic ISBTs.

Similarly, the “organisational setup” factor significantly and positively relates to Cognitive ISBT, and Systematic ISBT. This indicates that the organisational
structure and setup and team composition has potential influence on actors’ ISBTs. Another important factor that has significant and positive relationship with the ISBTs is the “source/channel” factor. The correlation analysis shows that sources/channel factor has significant positive relationship with Associate and Cognitive ISBTs. This is expected since actors’ sources/channels selection is rely on trust. Another important factor identified in literature and the qualitative inquiry to influence actors’ ISB is “time” (Allard et al., 2009; King, 1994; Leckie et al., 1996; Lowe et al., 2004; Robinson, 2010). However, the correlation analysis revealed a no significant relationship between the time factor and all the five ISBTs. This is not surprising since literature and the qualitative inquiry affirms this situation.

The correlation analysis for the “effectiveness” factor in relation to the five ISBTs found positive significant relationships with Cognitive and Systematic ISBTs. This indicates literature findings and qualitative inquiry findings that actors’ prefer to capture information that is effective in delivering the task. Similarly, the efficiency factor positively and significantly correlates to Systematic ISBT. This suggests that Systematic ISBT aids accurate information capture to facilitate timely task delivery. Similarly, this confirms literature findings and qualitative inquiry findings (Hertzum et al., 2002).

The currency factor significantly and positively correlates to Associate, Cognitive, Systematic and Serendipity/Fortuitous ISBTs. This outcome is evident in literature and qualitative inquiry findings, in that actors’ generally prefer up-to-date information that is consistent with task requirement and context (Nicholas, 2000). The correlation analysis for the “useable” factor indicates a significant negative relationship with Social Media ISBT and a significant positive relationship with Associate and Systematic ISBTs. This suggests that the outcome of these ISBT results in useable information. Confirming the extant literature and qualitative inquiry findings was the “relevance” factor (Borlund, 2003; Saracevic, 1996, 1975; Schamber et al., 1990). The correlation analysis revealed a significant positive relationship with Cognitive and Systematic ISBTs. This suggests that information captured through these two ISBTs is comprehensive, accurate and clear. Similarly, the correlation analysis of the “reliability” factor results in a positive significant relationship with Systematic ISBT. According to Pinelli et al. (1991), reliability is the
most compelling reason to use information sources. This suggests that systematic approach to information-seeking is reliable.

Another factor that had significant positive relationship with Systematic and Serendipitous/Fortuitous ISBTs is the “accuracy”. This affirms extant literature and qualitative inquiry findings that information captured through these two ISBTs are sensitive to change in meaning and context (Eppler, 2006). Similarly, the “satisfaction” factor significantly and positively correlates to Associate, Cognitive and Systematic ISBTs. This suggests that information captured through these ISBTs presents actors' with comfortable attitude towards its use.

On the hand, the correlation analysis for the “context specific” factor indicates a significant positive relationship with Associate, Cognitive, Systematic and Serendipity/Fortuitous ISBTs. This suggests that the outcome of these four ISBTs results in context specific information. Similarly, the “quality” factor has a significant positive correlation with Associate and Systematic ISBTs and a significant negative correlation with Associate ISBT. This confirms literature and qualitative inquiry findings that information from Associate ISBT is unstructured and unguaranteed. On the other hand, information from Systematic ISBT is structured and guaranteed.

Finally, the correlation analysis between Associate ISBT and the demographic factors revealed a negative significant relationship with the “condition of work” factor. This support literature and qualitative inquiry findings including the “least effort principle” (Zipf, 1949) that through team work, working condition influence Associate ISB process. In general, all the significant factors identified through the correlation analyses present sufficient evidence of linear relationships and a foundation to how these factors influence actors’ ISBTs. These findings respond to the proposed hypotheses however, the outcome of the regression analyses is used to confirm the hypotheses results.

8.7 SUMMARY
This chapter sought to respond to research objective four, five and six. The chapter began by establishing the demographic background of respondents to the questionnaire items. Different statistical tools and techniques were applied to the
data. This resulted in outcomes relevant to construction project actors’ ISBs in the project environment. The analysis helped to structure responses to questionnaire items regarding actors ISB orientations, and the influencing factors. The ISB questionnaire scale revealed that construction project actors’ prefer Associate ISBT than the remaining four ISBTs. Thus, the hierarchical structure showed the rankings of the ISBTs where Associate ISBT is the most preferred followed by Cognitive, Systematic, Serendipity/Fortuitous and Social Media ISBT.

Bivariate Correlation analysis was carried out to establish the relationships between the influencing factors and the five ISBTs in order to respond to the formulated hypotheses. The outcome revealed both significant and insignificant relationships. Analyses of the findings revealed key factors that have positive and/or negative relationship with the ISBTs. These findings confirm the findings from extant literature and the qualitative inquiry. In general, the findings indicate that respondents’ ISBT orientations are influenced by the information-seeking and information use/task performance factors. The succeeding chapter present the second part of the quantitative findings, which focuses on multiple regression analyses to identify the factors that predict actors’ ISBTs and to test the proposed hypotheses.
CHAPTER 9 : QUANTITATIVE FINDINGS II: FACTORS THAT PREDICT ISBTs

9.1 OVERVIEW

In the previous chapter, correlation analysis was used to establish the relationships between ISBTs and the influencing factors to determine the correlation coefficients. This helped to establish the relationships (either positive or negative), the significance levels and the confidence level of these factors and the ISBTs. Hence, regression modelling is used in this chapter to measure the naturally occurring scores on the predictor variables to establish the set of data that give rise to the best prediction of actors' ISBT preference. This chapter specifically responds to research objective four.

Regression modelling is a statistical technique that underlines the ability to predict someone's score of one variable on the basis of their scores on one or more other variables (Brace et. al., 2012). In this context, the emphasis is on the ability to predict the output of key factor(s) on the ISBTs and to justify the relationships these predictor variables have on the ISBTs. Hence, the regression modelling will provide the means to predict the influence of key factors (independents or predictors) on the outcome variable (dependent or ISBTs).

Therefore, series of multiple regression analyses are performed on the five ISBTs and the influencing factors to assess the extent to which the independent variables predict the dependent variables. It intends to establish how useful the predictor variables estimate the likely scores of actors’ preferences for the ISBTs. This also intends to test the proposed hypotheses for this study.

The Standard or Forced Entry method was used for the regression modelling. This is because the independent variables (the information-seeking and/or information use/task performance factors) have already been established to influence actors’ ISBs. This implies all the identified influencing factors including the demographic factors were entered into the regression model to establish the factors that significantly predicts actors' ISBTs.

In order to minimise the volume of this chapter, only significantly predicted factors are reported. The detailed analyses can be found in appendix E-2. The following
sections present multiple regression analysis of ISBTs (as dependent variables) and the influencing factors (as independent variables).

9.2 COGNITIVE ISBT AND SIGNIFICANT INFLUENTIAL FACTORS

Multiple regression analysis was performed on all the influencing factors identified as the predictor variables and Cognitive ISBT as the outcome variable. Table 9.1 presents the output of the regression model. A significant model emerged: $F(22, 135) = 1.769, \rho < .026$. The model explains 22.6% of the variance in Cognitive ISBT ($R^2 = .226$). This indicates that 22.6% of the prediction is accurate. This means the model significantly improves the prediction of actors’ orientation to Cognitive ISBT. Table 9.1 gives information about the predictor variables entered into the model.

Table 9.1 Linear model of predictors of information-seeking and information use/task performance factors of Cognitive ISBT

<table>
<thead>
<tr>
<th>Variables in equation</th>
<th>B</th>
<th>S.E.</th>
<th>β</th>
<th>ρ</th>
<th>95.0% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Upper</td>
</tr>
<tr>
<td>(Constant)</td>
<td>1.554</td>
<td>.570</td>
<td>.007</td>
<td>.426</td>
<td>2.682</td>
</tr>
<tr>
<td>Source/Channels</td>
<td>.015</td>
<td>.058</td>
<td>.025</td>
<td>.792</td>
<td>-.100 .131</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>.315</td>
<td>.103</td>
<td>.355</td>
<td>.003</td>
<td>.112 .518</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.774</td>
</tr>
</tbody>
</table>

The table shows a linear model of predictors of Cognitive ISBT with bias correlated and accelerated confidence intervals reported. The model shows that the “effectiveness” factor is the only significant predictor, with positive relationship to Cognitive ISBT. This implies information captured through Cognitive ISBT is likely to be more effective. Thus, for any information captured through Cognitive ISBT, the effectiveness of the information will increase by 0.315 times other factors. The multiple regression equation generated for actors’ Cognitive ISBT is as follows:

$$ Cognitive\ ISBT = \beta_0 + \beta_1 \times Effectiveness $$

Therefore the regression model of the significant factor is:

$$ Cognitive\ ISBT = 1.554 + 0.315(Effectiveness) $$
Bias in the Model: Testing the Assumptions of Regression

The positive $\beta$ – value indicates a positive relationship with the output variable. Hence, should the model be used for prediction, the $\beta$ – value suggests the extent to which information captured through Cognitive ISBT effectively influence task performance. It must be noted that the focus of the hypothesis test is to verify and explain relationship. Hence, to test evidence of bias of the regression model, analysis of the residuals was undertaken. Figure 9.1 presents a histogram plot of the model. For the Cognitive ISBT data, the distribution is very normal: the histogram is symmetrical and approximately bell-shaped, indicating that the assumption of normality has not been violated.

![Histogram of standardised residual of actors Cognitive ISBT model](image)

**Figure 9.1 Histogram of standardised residual of actors Cognitive ISBT model**

Figure 9.2 present the P-P plot, which shows slight deviations from the normality as deviations from the diagonal line. As shown in the model (figure 9.2), the dots lie along the diagonal line, which indicates a normal distribution. This suggests the residuals are normally distributed, and it confirms the conclusions drawn from the histogram.
Figures 9.3 and 9.4 present scatterplots of standardised residual and the residual of outcome variable against the predictor when both variables are regressed. The essence for the partial plots is to detect and identify obvious outliers that might have undue influence on a predictor's regression coefficient, non-linear relationships and heteroscedasticity.

Figure 9.3 Partial regression plot of standardised residual - (H1)
Figure 9.4 Partial regression plot of the effective factor - (H18i)

Figure 9.3 shows the graph for the model. The points are randomly and evenly dispersed throughout the plot. This pattern indicates linearity and homoscedasticity; hence, the assumption has been met. For Effectiveness (see figure 9.4), the partial plot shows a positive relationship to Cognitive ISBT. The clouds of dots are evenly dispersed around the line, and there are no obvious outliers. This indicates homoscedasticity. To test for independence of the residuals in the model, the Durbin-Watson statistic was obtained (table 9.1) to be 1.774. This value which is very close to 2 indicates that the assumptions have not been violated.

The findings indicate that the regression model is a valid representation of the captured data and it can be applied to the population. In addition, it indicates that construction project actors' orientation to Cognitive ISBT is significant and has positive relationship to the “effectiveness” factor. Hence, the result supports the alternate hypothesis (H1.8i); that there is a significant relationship between Cognitive ISBT and “effectiveness”.

9.3 ASSOCIATE ISBT AND SIGNIFICANT INFLUENTIAL FACTORS
Multiple regression analysis was run for all the influencing factors identified as the predictor variables and Associate ISBT as the outcome variable. Table 9.2 presents the output of the regression model. A significant model emerged: $F(22,135) = 2.126, \rho < .005$. The model explains 25.7% of the variance in Associate ISBT ($R^2 = .257$). This indicates that 25.7% of the prediction is accurate. Thus, the
model significantly improves the prediction of actors’ orientation to Associate ISBT. Table 9.2 gives information about the predictor variables entered into the model.

Table 9.2 Linear model of predictors of information seeking and information use/task performance factors of Associate ISBT

<table>
<thead>
<tr>
<th>Variables in equation</th>
<th>B</th>
<th>S.E.</th>
<th>β</th>
<th>ρ</th>
<th>95.0% CI</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>2.603</td>
<td>.539</td>
<td>.000</td>
<td></td>
<td>1.538</td>
<td>3.669</td>
<td></td>
</tr>
<tr>
<td>Collaboration</td>
<td>.154</td>
<td>.062</td>
<td>.216</td>
<td>.014</td>
<td>.031</td>
<td>.276</td>
<td></td>
</tr>
<tr>
<td>Work Condition</td>
<td>-.377</td>
<td>.167</td>
<td>-.179</td>
<td>.025</td>
<td>-.707</td>
<td>-.047</td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.774</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table shows a linear model of predictors of Associate ISBT with bias correlated and accelerated confidence intervals reported. The model shows that “collaboration” and “work condition” factors are the only significant predictors, in which “collaboration” has positive relationship to Associate ISBT; whereas “work condition” has a negative relationship. This implies actors’ collaboration level increases their orientation towards Associate ISBT by 0.154 units. However, the lack of balance (e.g. fragmentation) in their working condition decreases by 0.377 units more than other factors. The multiple regression equation generated for Associate ISBT is:

\[ \text{Associate ISBT} = \beta_0 + \beta_1 \times \text{Collaboration} + \beta_2 \times (-\text{Work Condition}) \]

Therefore the regression model of the significant factors is:

\[ \text{Associate ISBT} = 2.603 + 0.154(\text{Collaboration}) - 0.377(\text{Work Condition}) \]

**Bias in the Model: Testing the Assumptions of Regression**

The positive \( \beta - value \) indicates a positive relationship with the output variable, whereas the negative \( \beta - value \) indicates a negative relationship with the output variable. The \( \beta - values \) suggest the extent to which information captured through Associate ISBT influences task performance. The negative relationship between “working condition” and Associate ISBT suggest the need to balance both teamwork and independent work within construction project organisations. This further affirms literature and qualitative findings. The focus of the hypothesis test is to verify and explain relationship; hence, to test evidence of bias of the regression model, analysis of the residuals was undertaken.
Figure 9.5 presents a histogram plot of the model. For the Associate ISBT data, the distribution is very normal: the histogram is symmetrical and approximately bell-shaped, which indicates that the assumption of normality has not been violated.

![Histogram of standardised residual for Associate ISBT model](image)

**Figure 9.5 Histogram of standardised residual for Associate ISBT model**

The normal P-P plot of expected cumulative probability against observed cumulative probability in figure 9.6 shows that the points are reasonably close to the straight line. This indicates the assumption of normal distribution of the residuals. This confirms the conclusions drawn from the histogram.
Linearity of the relationship between Associate ISBT and the influencing variables was assessed by examining Figure 9.7. This figure shows the graph of the Associate ISBT model. The random distribution of the points and the spread out across the graph is indicative of a situation that suggests that the assumption of linearity and homoscedasticity has been met. This implies that the assumption of constant variance is valid. However, the slightly funnel shape of the distribution suggest an increasing variance across the residuals.
Independent test of Durbin-Watson statistics was obtained of the error terms. The Durbin-Watson's value is 1.774, which is very close to 2 indicate that the assumption has not been violated. Thus, the residuals in the model are independent. Hence, the general conclusion of the regression model is that the model is accurate and produces a valid representation of the data and can be applied to the population.

Figures 9.8 and 9.9 present the scatter plots of the standardised residual and the plot of the residual of the outcome variable against the predictor when both variables are regressed. The essence for the partial plots is to detect and identify obvious outliers that might have undue influence on a predictor’s regression coefficient, non-linear relationships and heteroscedasticity.

**Figure 9.8 Partial regression plot of collaboration factor - (H1 2v)**

Figure 9.8 present partial plot of “collaboration” against Associate ISBT. The plot shows a linear positive relationship between the variables. The points are evenly distributed and dispersed throughout the high level of collaboration. There are no obvious outliers, indicating no violation of the assumption of homoscedasticity.

Figure 9.9 shows the partial plot of “work condition” against Associate ISBT. The plot shows a marginal positive relationship of Associate ISBT to “work condition”.
The relationship looks less linear than other predictors and the points’ shows separated cases indicating the marginal size of independent working against teamwork. However, no obvious outliers are present on the plots, but the separated case suggests an uneven spread hence, a violation of the assumption of homoscedasticity.

To test for independence of the residuals in the model, the Durbin-Watson statistic was obtained (table 9.2) to be 1.774. This value is very close to 2, which indicates that the assumptions have not been violated. The findings shows that the generated regression model is a valid representation of the captured data and it can be applied to the population. This indicates that construction project actors’ orientation to Associate ISBT is significant and has positive relationship to the collaboration, and a negative relationship with work condition. It can be concluded that the result supports the alternate hypothesis \( (H_1) \) 2v; that there is a significant relationship between Associate ISBT and the “collaboration” factor. This result also supports the alternate hypothesis \( (H_1) \) 12iv; that there is a significant relationship between Associate ISBT and the “work condition” factor.

9.4 SYSTEMATIC ISBT AND SIGNIFICANT INFLUENTIAL FACTORS
Multiple regression analysis was performed on all the influencing factors identified as the predictor variables, and Systematic ISBT as the outcome variable. Table 9.3
present the output of the regression model. From the analysis, a significant model emerged: $F(22, 135) = 2.226, \rho < .002$. The model explains 27.0% of the variance in Systematic ISBT ($R^2 = .270$). This implies that overall, 27.0% of the prediction is accurate. Thus, the model significantly improves the prediction of actors’ orientation towards Systematic ISBT. Table 9.3 presents the values calculated for the independent variables entered into the model.

Table 9.3 Linear model of predictors of information-seeking and information use/task performance factors of Systematic ISBT

<table>
<thead>
<tr>
<th>Variables in equation</th>
<th>B</th>
<th>S.E.</th>
<th>$\beta$</th>
<th>$\rho$</th>
<th>95.0% CI Lower</th>
<th>95.0% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>1.454</td>
<td>.540</td>
<td>.008</td>
<td>.386</td>
<td>2.522</td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>.153</td>
<td>.072</td>
<td>.205</td>
<td>.012</td>
<td>.295</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.113</td>
<td>.053</td>
<td>.246</td>
<td>.009</td>
<td>.218</td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>2.018</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table depicts a linear model of predictors of Systematic ISBT with bias correlated and accelerated confidence intervals reported. The model shows that “quality” and “age” factors are the only significant predictors with positive relationship to Systematic ISBT. This implies Systematic ISBT is influenced by actors “age” and the capture of “quality” information. This suggests that (grown up/more experienced) actors’ are more likely to orientate towards Systematic ISBT and that the quality level of information captured increases by 0.153 units more than other factors. The multiple regression equation generated for the Systematic ISBT model is:

$$\text{Systematic ISBT} = \beta_0 + \beta_1 \times \text{Quality} + \beta_2 \times \text{Age}$$

Therefore the regression model of the significant factors is:

$$\text{Systematic ISBT} = 1.454 + 0.153(\text{Quality}) + 0.113(\text{Age})$$

**Bias in the Model: Testing the Assumptions of Regression**

The positive $\beta$ – *values* indicates a positive relationship with the output variable. Similarly, the $\beta$ – *values* suggest the extent to which the application of Systematic ISBT underpins actors’ age and the quality level of the captured information to influence task performance. This affirms literature and qualitative findings.
Nevertheless, the focus of the hypothesis test is to authenticate and explicate relationship. Hence, to test evidence of bias of the regression model, analysis of the residuals was carried out. Figure 9.10 depicts a histogram plot of the model. The distribution is very normal; the histogram is symmetrical and approximately bell-shaped curve, indicating that the assumption of normality has not been violated.

Figure 9.10 Histogram of standardised residual of Systematic ISBT model

Figure 9.11 presents the normal probability plot of expected cumulative probability against observed cumulative probability. The plot shows that the plotted points are reasonably close and lie on the straight line. This indicates an assumption of normality. This confirms the conclusions drawn from the histogram.
Figure 9.11 Normal P-P plot of regression standardised residual for actors

Figure 9.12 Scatterplot of standardised residual against predicted value

Figure 9.12 shows the graph of the Systematic ISBT model. The random distribution and evenly dispersed nature of the points throughout the plot is indicates that the assumptions of linearity and homoscedasticity have been met. This implies that the assumption of constant variance is valid. Durbin-Watson statistics was obtained from the test for independence of the error terms. The Durbin-Watson’s value is 2.018, which is very close to 2, which indicates that the assumption has been met. Thus, the residuals in the model are independent.
Figures 9.13 and 9.14; shows the partial plots of residuals of the outcome variable against each of the predictor variable when both variables are regressed separately on the remaining predictors. These partial plots are intended to detect and identify obvious outliers that might have undue influence on a predictor’s regression coefficient, non-linear relationships and heteroscedasticity. Figure 9.13 shows a positive linear relationship of even distribution and randomly dispersed points. There are no obvious outliers and the pattern of the point is an indicative homoscedasticity.
Figure 9.14 depicts the partial plots of “age” against Systematic ISBT. The plot shows a linear positive relationship between the variables. The points are evenly distributed and dispersed throughout the high level of the “age” factor. There are no obvious outliers hence, an indication of no violation of the assumption of homoscedasticity. These findings present strong arguments that the regression model is a valid representation of the captured data. Thus a conclusion of greater orientation of project actors’ to Systematic ISBT is significant, and has positive relationship to key influencing factors such as “quality” and “age”.

It can be concluded that the result supports the alternate hypothesis ($H_1$) that there is a significant relationship between Systematic ISBT and the “quality” factor. The result also supports the alternate hypothesis ($H_1$) that there is a significant relationship between Systematic ISBT and the “age” factor.

9.5 SERENDIPITY/FORTUITOUS ISBT AND SIGNIFICANT INFLUENTIAL FACTORS

A multiple regression analysis was performed for all the influencing factors identified as the predictor variables, and Serendipity/Fortuitous ISBT as the outcome variable. Table 9.4 presents the output of the regression model. From the analysis, no significant model emerged: $F(22,135) = 1.157, \rho = .297$. However, it must be noted that there are two significant influencing factors. The model explains 15.9% of the variance in Serendipity/Fortuitous ISBT ($R^2 = .159$). This implies that overall, 15.9% of the prediction was accurate. However, the model insignificantly does not improve the prediction of actors’ orientation to Serendipity/Fortuitous ISBT. Table 9.4 presents the values calculated for the independent variables entered into the model.

Table 9.4 Linear model of predictors of information-seeking and information use/task performance factors of Serendipity /Fortuitous ISBT

<table>
<thead>
<tr>
<th>Variables in equation</th>
<th>B</th>
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<th>$\rho$</th>
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<td></td>
<td></td>
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<tr>
<td>Collaboration</td>
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<td>.185</td>
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</tr>
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<td></td>
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<td>Currency</td>
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<td>.102</td>
<td>.254</td>
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<td>.017</td>
</tr>
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<td></td>
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<td></td>
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<td>.419</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td></td>
<td></td>
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<td></td>
<td>1.790</td>
</tr>
</tbody>
</table>

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The table depicts a linear model of predictors of Serendipity/Fortuitous ISBT with bias correlated and accelerated confidence intervals reported. The model shows that “currency” and “collaboration” factors are the only significant predictors with positive relationship to Serendipity/Fortuitous ISBT. This implies that the odds of actors’ collaborating after Serendipity/Fortuitous information discovery are 0.153 times higher than other factors. Similarly, the odds of Serendipity/Fortuitous information discovery being current are 0.218 times higher than other factors. This generally mean project actors’ who more orientate to Serendipity/Fortuitous ISBT are more likely to capture information that is current within the context and are likely to collaborate in the task/project delivery. The multiple regression equation generated for the Serendipity/Fortuitous ISBT model can be presented as:

\[ \text{Serendipity/Fortuitous ISBT} = \beta_0 + \beta_1 \times \text{Collaboration} + \beta_2 \times (\text{Currency}) \]

Therefore the regression model of the significant factors is:

\[ \text{Serendipity/Fortuitous ISBT} = 2.346 + 0.153(\text{Collaboration}) + 0.218(\text{Currency}) \]

**Bias in the Model: Testing the Assumptions of Regression**

The positive \( \beta \) – *values* indicates a positive relationship with the output variable. Hence, this suggests the extent to which the application of Serendipity/Fortuitous ISBT process underpins “current” information capture and increase in “collaboration” in task performance. This further affirms literature and qualitative findings. Nevertheless, the focus of the hypothesis test is to authenticate and explicate relationships. Hence, to test evidence of bias of the regression model, analysis of residuals was carried out. Figure 9.15 present a histogram plot of the model. The plot shows a bell-shaped distribution which indicate that the assumption of normality has not been violated.
Figure 9.15 Histogram of standardised residual of Serendipity/Fortuitous ISBT model

Figure 9.16 Normal P-P plot of regression standardised residual for actors
Figure 9.17 Scatterplot of standardised residual against predicted value

Linearity of the relationship between variables was assessed by examining figure 9.17. This figure shows the graph of the Serendipity/Fortuitous ISBT model. The random distribution of data points and the spread out across the graph is indicative of linear relationship and that the assumption is not violated. Independent test of error terms was obtained from the Durbin-Watson statistics value. This value is 1.790, which is close to 2 hence, this indicates that the assumption is not violated. Thus, the residuals in the model are independent. The analyses show that the regression model is accurate though not significant, and produces a valid representation of the data and can be applied to the population.
Figures 9.18 and 9.19 presents the partial plots of residuals of the outcome variable against each of the predictor variables when both variables are regressed separately on the remaining predictors. These partial plots are intended to detect and identify obvious outliers that might have undue influence on a predictor’s regression coefficient, non-linear relationships and heteroscedasticity. Figure 9.18 shows the partial plot of “collaboration” against Serendipity/Fortuitous ISBT. The partial plot shows a positive linear relationship of even distribution and randomly dispersed points. There are no obvious outliers and the pattern of the points is an indicative homoscedasticity.

Similarly, figure 9.19 shows the partial plot of “currency” against Serendipity/Fortuitous ISBT. The plot shows a positive linear relationship to Serendipity/Fortuitous ISBT. There is no indication of obvious outliers on this plot, and the cloud of dots is evenly spaced around the line, indicating homoscedasticity. These findings suggest that the regression model is a valid representation of the captured data. Thus, a conclusion of orientation of construction project actors’ to Serendipity/Fortuitous ISBT is not significant, although there are strong positive relationship to two key influencing factors such as “collaboration” and “currency”.
Figure 9.19 Partial plot of the currency factor against Serendipity/Fortuitous ISBT - (H1 10iv)

It can be concluded that the result supports the alternate hypothesis (H16v); that there is a significant relationship between Serendipity/Fortuitous ISBT and the “collaboration” factor. The result also supports the alternate hypothesis (H110iv); that there is a significant relationship between Serendipity/Fortuitous ISBT and the “currency” factor.

9.6 SOCIAL MEDIA ISBT AND SIGNIFICANT INFLUENTIAL FACTORS
Multiple regression analysis was carried out for all the influencing factors identified as the predictor variables, and Social Media ISBT as the outcome variable. Table 9.5 presents the output of the regression model. From the analysis, the model that emerged was not significant: $F(22, 135) = 1.255, p = .214$. The model explains 17.0% of the variance in Systematic ISBT ($R^2 = .170$). This implies overall, 17.0% of the prediction was accurate. This indicates that there is a chance for the model to improve the prediction of actors’ orientation to Social Media ISBT. Surprisingly, the analysis reveals a significant relationship between “trust” and Social Media ISBT. Table 9.5 presents the values calculated for the independent variables entered into the model.
Table 9.5 Linear model of predictors of information-seeking and information use/task performance factors of Social Media ISBT

<table>
<thead>
<tr>
<th>Variables in equation</th>
<th>B</th>
<th>S.E.</th>
<th>β</th>
<th>ρ</th>
<th>95.0% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>(Constant)</td>
<td>2.163</td>
<td>.981</td>
<td>.029</td>
<td>.029</td>
<td>.222</td>
</tr>
<tr>
<td>Trust</td>
<td>-0.464</td>
<td>.164</td>
<td>-0.320</td>
<td>.005</td>
<td>-0.788</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.775</td>
</tr>
</tbody>
</table>

The table shows a linear model of predictors of Social Media ISBT with bias correlated and accelerated confidence intervals reported. The model shows that the “trust” factor is the only significant predictor with negative relationship to Social Media ISBT. This implies, the odds of actors’ trusting Social Media to seek relevant information are -0.464 times lesser than other factors. This generally mean project actors who orientate to Social Media ISBT are more likely to “trust” social media to capture relevant. The multiple regression equation generated for the Social Media ISBT model is:

\[ Social\ Media\ ISBT = \beta_0 + \beta_1 \times (-Trust) \]

Therefore the regression model for the significant factor is:

\[ Social\ Media\ ISBT = 2.163 - 0.464(Trust) \]

**Bias in the Model: Testing the Assumptions of Regression**

The negative \( \beta \) value indicate a negative relationship with the output variable. Hence, the \( \beta \) value suggest the extent to which the application of Social Media ISBT process underpins “trust” in the captured information and its use for task performance. This confirms literature and qualitative findings. Nevertheless, the focus of the hypothesis test is to authenticate and explicate relationships. Hence, to test evidence of bias of the regression model, analysis of residuals was carried out to test the assumption of the regression. Figures 9.22 and 9.23 presents residual plots of Social Media ISBT. Similarly, figure 9.20 present the histogram plot of the model. This plot shows a bell-shape distribution slightly skewed to the left. The shape of the distribution indicates that assumption of normality is not violated.
Figure 9.20 Histogram of standardised residual of Social Media ISBT model

Figure 9.21 presents the normal P-P plot of expected cumulative probability against observed cumulative probability. This figure shows that the points are reasonably close to the straight line. This indicates the assumption of normal distribution of the residuals, which confirms the conclusions drawn from the histogram.

Figure 9.21 Normal P-P plot of regression standardised residual for actors
The relationship between Social Media ISBT and the influencing variables was assessed for linearity by examining figure 9.22. This figure shows the graph of the Social Media ISBT model. The points are randomly distributed and spread out across the graph indicating that the assumption of linearity and homoscedasticity has been met. This implies the assumption of constant variance is valid. However, the slightly funnel shape distribution suggests an increasing variance across the residuals. Independent test of Durbin-Watson statistics was obtained of the error terms. The Durbin-Watson’s value is 1.775, which is close to 2 indicates that the assumption has not been violated. This implies the residuals in the model are independent. The general conclusion of the regression model is that the model is accurate and produces a valid representation of the data and can be applied to the population.

Figure 9.22 Scatterplot of standardised residual against predicted value - (H1)

Figure 9.23 presents the partial plots of “trust” against Social Media ISBT. The plot shows a linear negative relationship between the variables. The points are evenly distributed and dispersed slightly to the left. There are no obvious outliers hence, an indication of no violation of the assumption of homoscedasticity. The findings suggest that the regression model is a valid representation of the captured data. This indicates a not significant relationship between the influencing factors and actors' orientation to Social Media ISBT, although there is a negative significant relationship to one key influencing factor (i.e. trust). The result supports the
alternate hypothesis \((H_{1\,6iii})\); that there is a significant relationship between Social Media ISBT and the “trust” factor.

![Partial Regression Plot](image)

**Figure 9.23** Partial plot of the trust factor against Social Media ISBT - \((H_{1\,6iii})\)

It was established in the previous chapter that majority of the information-seeking and information use/task performance factors have significant relationships (both positive and/or negative) with the five ISBTs. Certainly, the outcome of the regression analyses of the hypotheses tests indicates that the alternate hypotheses are supported. However, majority of the influencing information-seeking and information use/task performance factors are not supported. The five ISBTs were measured through the survey instrument that asked respondents about the extent to which they agree or disagree that their ISB orientations is influenced by factors such as sources/channels, organisational setup, trust, accessibility, collaboration, time, effectiveness, efficiency, quality, currency, useable, relevance, reliability, accuracy, satisfaction, context specific, professional role, experience, qualification, working condition, sector and age.

The hypotheses were supported as the multiple regression analyses revealed the following significant relationships:

- a positive significant relationship between Associate ISBT and the “collaboration” factor \((H_{1\,2v})\).
a negative significant relationship between Associate ISBT and the “work condition” factor (H_{12iv}).

a positive significant relationship between Cognitive ISBT and the “effectiveness” factor (H_{8i}).

a positive significant relationship between Systematic ISBT and the “quality” factor (H_{9iii}).

a positive significant relationship between Systematic ISBT and the “age” factor (H_{14v}).

a positive significant relationship between Serendipity/Fortuitous ISBT and the “collaboration” factor (H_{6v}).

a positive significant relationship between Serendipity/Fortuitous ISBT and the “currency” factor (H_{10iv}).

a negative significant relationship between Social Media ISBT and the “trust” factor (H_{6iii}).

The test revealed that, although twenty-two factors (22) (i.e. information seeking and/or information use/task performance factors including demographic factors) were identified to influence actors’ ISBTs, only the significant factors’ predicted actors’ orientations to the ISBTs. It revealed that different factors influence (either positively or negatively) different ISBTs. This implies a blanket generalisation or assumption that actors’ ISBTs are influenced by all the identified factors would rather be impractical. Hence, relevant significant factors needs to be considered during strategy development to support actors’ information-seeking. The findings provide empirical evidence that support the argument that the extent of factors that influence actors’ ISBTs go beyond the “intervening” and/or “situational” factors to include some degree of demographic variables.

The findings suggest that high prevalence of intervening, situational and demographic factors does not entirely result in higher factors to influence actors’ orientation toward the ISBTs. This suggests that actors’ increased orientation to ISBTs might be influenced by certain factors, which are not defined in this study. In general, the findings suggest that the design and development of IB strategies should take into account the needs of actors’ ISBs to design systems that align with actors’ ISB orientations.
9.7 SUMMARY

This chapter assessed the extent to which information-seeking and information use/task performance factors influence actors' ISBTs and the verification of the hypothesised relationships. The multiple regression technique from IBM SPSS version 21.0 statistical tool was used to model responses from the questionnaire survey. The findings revealed significant models of Associate ISBT, Cognitive ISBT and Systematic ISBT. However, the regression model that emerged for Serendipity/Fortuitous ISBT and Social Media ISBT was not significant. The results also revealed that different ISBT models are influenced by different information-seeking and/or information use/task performance factors. Although twenty-two (22) information-seeking and information use/task performance factors were identified to predict actors ISBTs, the findings surprisingly revealed that actors' orientation towards any of the ISBTs are influenced by a few significant information-seeking and information use/task performance factors. These include age, work condition, effectiveness, collaboration, quality, currency, and trust.

Overall, the test hypotheses confirms the extent to which actors ISBTs are influenced by key information-seeking and information use/task performance behaviour factors and a scope to formulate the framework for actors' ISBs in the project organisations. Thus, revelations from the hypotheses offer a defined scope for actors' ISBTs model.
CHAPTER 10: INFORMATION SEEKING BEHAVIOUR TYPE MODEL

10.1 OVERVIEW

This chapter presents the development of project actors’ ISBT model and discussion of results of the quantitative and qualitative inquiries. This discussion responds to the research questions, research objectives and the research aim. In addition, the chapter presents discussion of research contribution to knowledge, conclusion and recommendations for future study. The succeeding sections present consolidation of research findings to develop the ISBT model and a discussion summary of the factors that influence actors ISBTs.

10.2 DEVELOPMENT OF INFORMATION-SEEKING BEHAVIOUR TYPE MODEL

This research set out to investigate the ISBs of project actors in the construction sector to respond to two key research questions:

i. Is there discernible ISB preference(s) of construction project actors?

ii. To what extent are the ISBs of actors influenced by information-seeking and information use/task performance factors in the project organisation?

To respond to these questions, a mixed method research approach was adopted. The findings from the analyses of the qualitative and quantitative inquiries responded to the research questions.

In response to the first research question, it was found that construction project actors have unique ISB preferences. These actors have high preference for Associate ISBT than Cognitive, Systematic, Serendipity/Fortuitous and Social Media ISBT. In addition, it was found that information-seeking factors (such as collaboration, age, working condition, accessibility, organisational setup, source/channels, and trust), and information use/task performance factors (such as accuracy, context specific, currency, effectiveness, efficiency, quality, relevance, reliability, satisfaction, and useable) have significant relationships with the ISBTs. It was also found that factors such as age, work condition, effectiveness, quality, trust, collaboration, and currency predicts actors ISBT orientations. Thus, the knowledge gap regarding the ISB(s) of construction project actors’ and the factors that influences such behaviours has been bridged. However, the need to seek, share and use information underpins the reasoning behind effective knowledge management (Bhatt, 2001; Hari et al., 2005). This is vital to performance
improvement and contribution to knowledge in the construction sector. Hence, it is practical to consolidate the entire research findings into a model that depicts the ISBTs of actors in construction organisations and the project environment.

Figure 10.1 illustrates the relationships between the ISBTs and the influencing information-seeking factors and information use/task performance factors. It illustrates the association of the significant factors to the ISBTs and how these factors predict actors’ ISBTs orientation.

Figure 10.1 Relationships between influencing factors and ISBTs

In order to integrate the significant factors that influence actors information-seeking and information use/task performance behaviours to establish the sequence in which actors seek and use information, figure 10.2 was formulated. This figure presents the consolidated model of project actors’ ISBT. The model illustrates the relationship between the factors that have significant correlations and the factors that significantly predicts actors' ISBTs during information-seeking and information use/task performance.
In terms of how the information-seeking and information use/task performance factors influence actors’ ISBTs; it was empirically found that:

- Factors such as collaboration and age are positive information-seeking predictors, whereas working condition is a negative information-seeking predictor.
- Factors such as accessibility, collaboration, organisational setup, sources/channels and trust have positive information-seeking association with the ISBT(s).

In terms of the influencing information use/task performance factors, it was found that:

- Factors such as currency, effectiveness and quality are positive information use/task performance ISBT(s) predictors, whereas trust is a negative information use/task performance ISBT(s) predictor.
- Factors such as accuracy, context specific, currency, effectiveness, efficiency, quality, relevance, reliability, satisfaction, and usable have positive information use/task performance association with the ISBT(s).
- The usable and quality factors have negative information use/task performance association with the ISBT(s).
These findings provide verification of the conceptual framework presented in chapter 4 with the developed version succinctly presented in figure 10.2.

**10.2.1 Information-Seeking Behaviour Type Model**

Figure 10.3 present the main project actors’ ISBT model. The model provides insight that explains the factors that influence and predicts actors’ information-seeking and information use/task performance behaviours in the project organisation. It indicates that actors’ information-seeking is triggered by information need in relation to a task. This need is influenced (positively and/or negatively) simultaneously by the information-seeking and information use/task performance (predictors and/or association) factors. These factors influence actors’ ISBT preference/choice to seek appropriate information through appropriate sources to perform intended task. The process is then repeated hence, the feedback arrow

It is anticipated that this model will guide and enhance the information-seeking and information dissemination amongst actors in the project environment particularly at the information intensive (design development) phases of the PLC.

![ISBT Hierarchy Diagram](image)

**Figure 10.3 Proposed Actors ISBT model**

This will engage decision makers to implement strategies that will contribute towards improving project actors’ ISBs as well as establishing an IB culture in the
construction sector. Thus, the findings are intended to urge organisations and decision makers to explore the fundamental problems that underpin and inhibit ISBs of actors in project organisations. It is envisaged that as actors understand their ISBs, systems could be designed to channel appropriate information, based on actors' ISB preferences.

10.3 RESEARCH FINDINGS
This study began by investigating the IB of construction project actors where both qualitative and quantitative inquiries were used to establish actors' ISB orientations. Zipf's (1949), principle of least effort was the underpinning theory for this research. IBM SPSS version 21.0 was used for the quantitative data analyses. The PCA technique of Factor analysis was used to establish the five ISBTs. Having established actors’ ISBTs, the Friedman test was used to rank the ISBTs in order of actors’ preferences. This revealed the order of preference (in descending order) as Associate, Cognitive, Systematic, Serendipity and Social Media ISBT. Correlation analysis was used to explore the extent of associations between the influencing information-seeking and information use/task performance factors, and the five ISBTs. This revealed significant factors that influence actors information-seeking and information use/task performance behaviours. In addition, Multiple Regression was used to explore the underlying influencing factors that predict actors’ ISBTs. This resulted in the identification of key factors that predicts actors ISBTs. The following section present discussion of the findings that succinctly address the research questions. It is important to note that only significant aspects of the findings are discussed.

10.3.1 Difference between the ISBTs
The quantitative data analysis through Friedman’s ANOVA revealed significant variations in actors’ confidence levels of ISB preferences. This analysis was carried out to test the null hypothesis that there are differences in actors’ confidence levels towards their ISBT preferences irrespective of the influencing factors. The assessment clearly indicates that each of the ISBTs is significantly different from the other with unique characteristics.
The Friedman test was applied to the data to establish actors' order of preference for the five ISBTs. This is presented in ascending order as Social Media, Serendipity/Fortuitous, Systematic, Cognitive, to Associate ISBT. This implies Associate ISBT is the highest ranked or the most preferred by the respondents, whereas Social Media ISBT is the least ranked or least preferred. This findings affirms the knowledge that engineers predominantly prefer to seek information from their colleagues both internal and external to their organisation (Byström and Järvelin, 1995; Hertzum and Pejtersen, 2000; Hertzum, 2002; Leckie et al., 1996; Robinson, 2010). Similarly, Ellis and Haugan (1997), found that engineers and scientists heavily rely on internal communications, and contacts within their personal networks to seek information for use.

The findings demonstrate a suboptimal use of social media in the construction industry. This indicates the need to maximise its benefits in relation to information seeking, sharing and use. This is not surprising since extant literature suggest that majority of organisations either block or prevent their employees from accessing social media sites during working times (Hsu and Lin, 2008; Kwai Fun IP and Wagner, 2008). Hence, the need to educate employers and actors about the potential benefits of Social Media information-seeking to actors’ and business.

**10.3.2 Association between the influencing information-seeking and information use/task performance factors and the five ISBTs**

This section discusses results of the significant information-seeking and information use/task performance factors that influences actors' ISBTs.

**Significant Association between Condition of Work and the ISBTs**

The Kruskal-Wallis and Correlation tests revealed that the “work condition” factor influences Associate ISBT. In fact, the Correlation analysis showed that work condition negatively correlate with Associate ISBT. In addition, the Multiple Regression analysis revealed that work condition predict a negative influence on Associate ISBT. This result confirms hypothesis H_{12iv} that work condition influences Associate ISBT. This implies, working in a team directly influences colleagues to seek information from each other. This factor strengthens teamwork in project organisations. However, the negative relationship suggests that actors
who work in isolation do not benefit from Associate ISBT approach. This also suggest that the fragmented nature of Construction organisations tends to support the negative relationship between work condition and Associate ISBT.

**Significant Association between Organisational Setup and the ISBTs**
The Correlation analysis revealed that the “organisational setup” factor influences both Cognitive ISBT and Systematic ISBT. The analysis revealed a positive significant relationship between organisational setup and the two ISBTs. This implies a good organisation setup with appropriate systems and resources certainly enhance actors’ application of Cognitive and Systematic ISBTs. This support the findings that organisational settings drives actors ISBs (Hert, 1997).

**Significant Association between Professional Roles and the ISBTs**
Similarly, the Kruskal-Wallis and Correlation tests revealed that the “professional role” factor influences Associate and Social Media ISBTs. The results revealed that professional role has a positive significant relationship with both ISBTs. This suggests that actors’ role tend to influence the kind of colleagues they consult to seek information and the kind of associations they form. These findings supports the findings of Nicholas (2000), and Leckie et al. (1996), that actors' job role/occupation are primary drivers of their ISBs. In addition, key roles (including architects, designers, and engineers) tend to rely on Social Medial ISBT to seek information for use; hence, the positive significant relationship.

**Significant Association between Level of Qualifications and the ISBTs**
The Kruskal-Wallis test revealed that the “qualification level” factor influences actors' Social Media ISBT. The result revealed a positive significant influence on Social Media ISBT. This implies actors’ with good qualification levels (especially degree level) are likely to use Social Media ISBT. Since majority (126/158) of the responded had some form of a university degree. This indicates that level of qualification influences actors ISBs. This finding is supported by Johnson et al., (1995) and Vakkari and Kuokkanen, (1997).
**Significant Association between Age and the ISBTs**
The Multiple Regression analysis revealed that the “age” factor influences Systematic ISBT. It revealed that *age* is a positive significant predictor of Systematic ISBT. This result support hypothesis H14v. The descriptive statistics revealed that majority (102/158) of the respondents fall between the age range of 21 to 40 years. This is a strong indication that middle-aged actors’ are more likely to apply Systematic ISB approach. This findings is consistent with the findings of Nicholas, (2000) and Gruppen, (1990).

**Significant Association between Trust and the ISBTs**
The Correlation test revealed a positive significant relationship between the “trust” factor and Associate and Systematic ISBTs. This implies that project actors’ *trust* both Systematic and Associate ISBTs approach to seek information. In addition, the Regression Modelling revealed that *trust* is a negative predictor of Social Media ISBT. This support hypothesis H6iii. This result suggests that although actors trust social media sources to seek information, the negative impact on the information tends to suggest a lack of trust in the information. This is consistent with extant literature (Zhao et al., 2007; Tseng and Fogg, 1999; Marchand et al., 2002).

**Significant Association between Collaboration and the ISBTs**
The Correlation test revealed that “collaboration” influences Associate ISBT, Cognitive ISBT and Serendipity/Fortuitous ISBT. The results revealed that *collaboration* has a positive significant relationship with the three ISBTs. In addition, the Multiple Regression modelling revealed that *collaboration* positively predicts Associate and Serendipity/Fortuitous ISBTs. This supports hypotheses H2v and H6v. It also affirms the findings of Sonnenwald and Pierce (2000), that collaboration between participants influences success in performance outcomes.

**Significant Association between Accessibility and the ISBTs**
The Correlation test revealed a positive significant relationship between “accessibility” and Associate ISBT, Cognitive ISBT and Systematic ISBT. Thus, *accessibility* influences the three ISBTs. This implies construction project actors predominantly apply Associates, Cognitive and Systematic ISBT approaches to
seek information. Zhao et al. (2008), assert that accessibility is the highest-ranking information characteristic in information transactions.

**Significant Association between Sources/Channels and the ISBTs**

The Correlation test revealed that the “sources/channel” factor influences both Associate ISBT and Cognitive ISBT. The test revealed a positive significant relationship between sources/channels and Associate and Cognitive ISBTs. This implies that associate and cognitive information seekers find it easy to approach appropriate sources/channels. This underpins findings in extant literature that actors choice of channels and sources is based on factors including context of information, level of accessibility, reliability, and delivery time of information (Pinelli, 1991; Kwasitsu, 2004; Fidel and Green, 2004; Savolainen, 2007; Robinson, 2010).

**Significant Association between Effectiveness and the ISBTs**

Results from the Correlation analysis revealed that “effectiveness” influences both Cognitive and Systematic ISBTs. The findings revealed a positive significant relationship between effectiveness and Cognitive and Systematic ISBTs. This implies that construction project actors find information captured through Cognitive ISBT and Systematic ISBT as effective for use. In addition, the Multiple Regression analysis revealed that effectiveness is a positive predictor of Cognitive ISBT. This implies that information captured through Cognitive ISBT is more effective. This supports hypothesis H₁₈i that effectiveness influences actors ISB preferences.

**Significant Association between Currency and the ISBTs**

The Correlation analysis revealed that “currency” influences four ISBTs namely, Associate, Cognitive, Systematic and Serendipity/Fortuitous ISBT. The result revealed a positive significant relationship between currency and the four ISBTs. In addition, the Multiple Regression analysis revealed that currency is a positive significant predictor of Serendipity/Fortuitous ISBT. This supports the hypothesis that actors ISBT is influenced by the currency factor. These findings imply that information captured through Associate ISBT, Cognitive ISBT, Systematic ISBT, and Serendipity/Fortuitous ISBT is current for use.
**Significant Association between Useable and the ISBTs**
The Correlation test revealed that the “useable” factor influences Associate, Systematic and Social Media ISBTs. The analysis revealed that useable has a positive significant relationship with Associate ISBT and Systematic ISBT. This implies that captured information through both Associate ISBT and Systematic ISBT is user friendly and serves its intended purpose. The positive relationship indicates a positive impact in the use of information captured through these ISBTs. On the other hand, useable had a negative relationship with Social Media ISBT. This suggests that although information captured by actors through social media is useable, it might have a negative effect on the entire process. This impact could be anything from time delay, through context specifics to use of the information.

**Significant Association between Satisfaction and the ISBTs**
The Correlation test revealed that the “satisfaction” factor has a positive significant relationship with Associate, Cognitive and Systematic ISBTs. This implies actors who seek information through Associate, Cognitive and Systematic ISBTs gain positive satisfaction through the process. Thus, satisfaction positively influences information-seeking and task performance.

**Significant Association between Relevance and the ISBTs**
The Correlation test revealed that the “relevance” factor influences Cognitive ISBT and Systematic ISBT. The test revealed a positive significant relationship between relevance and the two ISBTs. This implies information captured by actors through both Cognitive and Systematic ISBTs is relevant for use. Hence, a positive impact in the use of captured information.

**Significant Association between Reliability and the ISBTs**
The quantitative data analysis through Correlation test revealed that the “reliability” factor has a positive significant influence on Systematic ISBT. This implies that Systematic ISBT approach is reliable and results in reliable information capture.

**Significant Association between Accuracy and ISBTs**
The Correlation test revealed that the “accuracy” factor influences Systematic ISBT and Serendipity/Fortuitous ISBT. The findings revealed that accuracy has a positive
relationship with the two ISBTs. This implies, information captured by systematic and serendipity/fortuitous information seekers is accurate and easily applicable.

**Significant Association between Quality and the ISBTs**
The Correlation test revealed that the "quality" factor influences Cognitive, Systematic and Associate ISBTs. It revealed that quality has a significant positive relationship with both Cognitive and Systematic ISBTs. This implies the quality of information captured through Systematic and Cognitive ISBTs is good for use. On the other hand, quality had a negative significant relationship with Associate ISBT. This implies the quality of captured information might not be good enough. In addition, the Regression Modelling revealed that quality is a positive significant predictor of Systematic ISBT. This support hypothesis H1.9iii that the quality factor influences actors' ISBs.

**Significant Association between Context Specific and the ISBTs**
The Correlation analysis revealed that the “context specific” factor influences Associate, Cognitive and Systematic ISBTs. The findings revealed a positive significant relationship between the context specific factor and the three ISBTs. This implies information captured through Associate, Systematic and Cognitive ISBTs is context specific for use.

**Significant Association between Time and the ISBTs**
The quantitative result of the study revealed that the average time spent by actors to seek information is 142.44 minute (with Std. Dev. =284.257). This implies actors spend approximately 39% of their time (in hours) seeking information. This translates to high impact on actors’ information-seeking and task performance behaviours. This confirms literature findings that actors spend a significant amount of their time (about 40 to 60%) (King, 1994; Robinson, 2010) seeking information. Interestingly, there was no significant relationship between time and the five ISBTs.

10.4 RESEARCH VALIDATION PROCESS
Research findings provide assertions that generate insight into the core and intended aim of a research. This is judged through validity of the findings. Validity refers to the power of a measure of a procedure to produce the same results each
time it is applied to the same situation (Belson, 1986). Brinberg and McGrath (1985) defines research validity as the “informativeness of a specific study to develop and support a hypotheses”. In quantitative terms, this implies believing a statement to be true when it is not (rejecting the null hypothesis) or rejecting a statement, which in fact is true (incorrectly supporting the null hypothesis) (Silverman, 2006). However, trustworthiness of qualitative findings is assessed through credibility, dependability, authenticity and transferability of the findings (Lincoln et al., 2011). Creswell (2009), posit that validity does not carry the same connotations in qualitative research as it does in quantitative research, nor a companion for reliability. Qualitative validity and reliability has been presented in section 6.6.2. Hence, the validation process discussed here focuses on quantitative inquiry.

Traditionally, validity has been defined as internal and external (Campbell and Stanley, 1963). Brinberg and McGrath (1985), posit different meanings to validity in three stages of the research process. In stage one, validity means value or worth. This identifies, develops and clarifies elements and relations that define the value of the research. Stage two validity refers to correspondence, or fit or internal validity, whereas stage three validity refers to robustness, generalisability or external validity. This stage embodies increasing the confidence concerning the interpretation of the findings.

**Internal Validity**

Internal validity focuses on the extent to which the observed treatment effect in a study is causal (Brinberg and McGrath, 1985; Bryman, 2012). In essence, internal validity establishes the variation an effect (dependent variables) generates through changes in level or intensity of the independent variable and not by some other causal force(s). Xiao (2002), demonstrates internal validity through the search of convergence between published research, research findings and academic validation. Essentially, this demonstrates convergence to make valid arguments about cause-effect relationships. According to Maxwell (1992), this kind of convergence theorises the presence or absence of agreement within the community of inquirers about the description of interpretive used.
In this study, the process of internal validity was achieved through dissemination of the research findings to the wider academic community and industry practitioners through publications and conference proceedings in international outlets. Similarly, references made to extant literature in the discussions of both qualitative and quantitative results confirm rigour and consistency in the findings. Conference proceedings and doctoral workshops involve peer review and assessment of rigour and robustness of the research findings by independent reviewers. Xiao and Lucking (2008), assert that the peer review process provides opportunities for research methodologies, meanings and interpretation to be challenged. This process involves critical scrutiny which provides informed, fair, reasonable and professional judgement about merits of the research work (Runeson and Loosemore, 1999). Hence, the internal validity of this research is in the form of rigorous peer reviewed conference proceedings, academic workshops, and a book chapter (see in appendix A).

The initial findings of this research were presented at academic workshops and conferences for scrutiny. In total, two peer-reviewed papers were presented at reputable academic and industry focused conferences and doctoral workshops. In addition, a special issue journal paper was peer reviewed and published as a book chapter. Importantly, feedback from reviewers tends to enhance the richness of the research work and potentially improves the research findings. In addition, acceptance of papers after rigorous reviews enhances the premise that the paper makes arguments, interpretations and evaluative findings against extant research. Hence, once a paper is accepted for publication, both the content and citations in them are validated. Table 10.1 presents published output of the research findings that has undergone academic scrutiny and rigorous peer reviews.

<table>
<thead>
<tr>
<th>Number</th>
<th>Authorship</th>
<th>Year</th>
<th>Number of references cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dzokoto et al.</td>
<td>2013</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>Dzokoto et al.</td>
<td>2014</td>
<td>42</td>
</tr>
<tr>
<td>3</td>
<td>Dzokoto et al.</td>
<td>2014</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>116</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Average Total</strong></td>
<td></td>
<td><strong>38.67</strong></td>
</tr>
</tbody>
</table>
Therefore, publications of these papers in prestige forums and outlets after going through rigorous peer review process confirms that this research has met the scholarly and academic standards required and that it is internally valid. Thus, the peer review process validates the robustness, rigour, relevance and trustworthiness of the content of this research together with the citations found in the papers.

**External Validity through Industry Participants**
External validity responds to whether the research findings of one research can be obtained in another settings with different research participants and procedures (Brewer, 2000). Consequently, external validity responds to the issue of generalisability (Bryman, 2012). According to Brewer (2000), external validity is not a single construct but represent a whole set of questions about generalisability, each with different implications for interpretation and extension of research findings. Brinberg and McGrath (1985), posit that the process of external validity transforms the research information into knowledge. For this research, external validity was achieved through interview of industry professionals to validate the research findings. It is argued that with this approach, one can be more confident of the validity of the findings (Silverman, 2006).

**Industry Participants for Respondent Validation**
According to Lincoln and Guba (1985), research trustworthiness can be reinforced by substantial engagement with industry professionals by checking the meaning of data interpretations with actor groups who provide the initial data. In this research, semi-structured face-to-face interviews were adopted to validate the research findings. Observations and questionnaires were not used due to logistical constraints, time, cost restrictions and nature of the research. Moreover, the face-to-face interviews helped to capture detailed responses from participants from their natural environment.

In all, fifteen (15) participants were purposefully sampled for the validation process. These were sampled based on several reasons including; neutrality to the research findings, experience levels in construction project delivery and organisation management, professional roles and resource constraints. The participants were
invited via personalised email correspondence together with interview questions and the research findings. The interview questions were designed to respond to:

i. validity of the extent to which the hierarchy of the five ISBTs represent the order of ISB preferences of interviewees,

ii. validity of the extent to which identified influencing factors represent the factors that influence the ISBs of professional actors in the project environment, and

iii. validity of the extent to which the developed ISBT model represent the ISB of industry professionals.

The research findings were extracted in the form of a report together with the interview questions (see appendix B-4) and were presented to the participants.

From the sampled participants, six (6) agreed to take part in the validation process (representing 40%) by confirming their availability for face-to-face interviews. Two more participants initially agreed in principle to take part; however, communication broke down. Hence, they were eliminated from the sampled group. Table 10.2 present demographic information of selected participants.

<table>
<thead>
<tr>
<th>No.</th>
<th>Professional role</th>
<th>Years of exp.</th>
<th>Employment sector</th>
<th>Condition of work</th>
<th>Highest qual.</th>
<th>Age range</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Senior QS</td>
<td>15</td>
<td>Private</td>
<td>Team</td>
<td>PhD</td>
<td>31-40</td>
</tr>
<tr>
<td>P2</td>
<td>Project Manager (design)</td>
<td>6</td>
<td>Private</td>
<td>Team</td>
<td>MSc/ CEng</td>
<td>31-40</td>
</tr>
<tr>
<td>P3</td>
<td>Senior Structural Engineer</td>
<td>14</td>
<td>Private</td>
<td>Team</td>
<td>MSc</td>
<td>31-40</td>
</tr>
<tr>
<td>P4</td>
<td>Facilities Manager</td>
<td>23</td>
<td>Public</td>
<td>Team</td>
<td>PhD</td>
<td>41-50</td>
</tr>
<tr>
<td>P5</td>
<td>Facilities/ Services Manager</td>
<td>15</td>
<td>public</td>
<td>Team</td>
<td>BSc</td>
<td>51-60</td>
</tr>
<tr>
<td>P6</td>
<td>Project Design Engineer</td>
<td>4</td>
<td>Private</td>
<td>Team</td>
<td>MSc</td>
<td>31-40</td>
</tr>
<tr>
<td>Total</td>
<td>77</td>
<td>Mean 12.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10.2 Demographic factors of participants
The participants are labelled with the letter ‘P’ (participant 1 is labelled P1, participant 2 is labelled P2, in that order). The background information of the industry practitioners demonstrates that their viewpoints are highly valuable to validating the research findings. Scheduled interview appointments were made with all six participants at their work premises. The participants were informed about the ethical procedures of Loughborough University (see appendix B-1). In addition, they were informed of their confidentiality and that they could withdraw from the process whenever they want. In all, the mean number of years of experience of the participants in the AEC sectors was 12.83 (see table 10.2).

In essence, the external validation approach with industry professionals assess the feasibility of the research findings. Objectively, this is intended to establish the extent to which the research findings represent the responses of practitioners and experts of which the research is designed to support. In all, each participant responded to ten (10) questions.

**Results of Industrial Respondent Validation**

One-to-one interviews were conducted with the industry professionals. Prior to the interview, brief introduction, definition of key terms and overview of the research methodology was presented. The participants were also informed of literature, exploratory and the main findings of the research. In all, six face-to-face interviews were conducted, in which the data was audio-recorded and transcribed verbatim. Analysis of data showed comparable but minor differences in responses to the research findings. Each interview lasted an average of 30 minute (the point where all questions were answered). The limited number of participants interviewed was sufficient to confirm or disconfirm validity of the research findings. During the interviews, participants were asked about the extent to which their ISBTs and the factors that influence their ISBs reflect the research findings. The collected data was analysed thematically to confirm or disconfirm validity of the research findings.

**Discussion of Validation Results and Research Findings**

The interview results were discussed into seven main parts. The first part focuses on ISBT preferences of the participants. The second part focuses on the relationship between the positive significant influencing factors and the Associate ISBT orientation of the participants. The third part focuses on respondents’
Cognitive ISBT orientation and its relationship with the positive significant influencing factors. The fourth part assesses respondents’ Systematic ISBT preference and the significant influencing factors. Similarly, the fifth part focuses on respondents’ orientation towards Social Media ISBT and the negative relationship it has with the influencing factors. The sixth part examines respondents’ orientation towards Serendipity/Fortuitous ISBT and the influencing factor. Finally, the seventh part examines the extent to which the developed ISBT model represents the ISBs of participants in construction project organisations. Respondents’ assessment of the relevance of research findings are discussed below.

1. **Information-Seeking Behaviour Type(s) Preferences**

Response to this question was captured in the form of a ranked data. This was intended to establish the extent to which the ISBT preferences of participants represent the research findings. It was also intended to assess the degree of ISBT categories amongst the respondents. Hence, interviewees were asked to respond to the statement “to what extent does the hierarchy of actors’ ISBT preferences in the research findings reflect your ISBT?” Interviewees were asked to rank their responses in order of 1 to 5 (where “5” represents high preference whereas “1” represents least preference). Table 10.3 present responses to this question (see appendix B-5, table 10.3b).

**Table 10.3 Hierarchical order of interviewees' ISBT preference**

<table>
<thead>
<tr>
<th>Hierarchy</th>
<th>ISBTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Systematic</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Cognitive</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Associate</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Social Media</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Serendipity/Fortuitous</td>
</tr>
</tbody>
</table>

All the interviewees recognised the importance of the categorisation of the ISBTs. Regarding the degree to which interviewees prefer the five ISBTs postulated in the findings, it was evident that the respondents have same/similar preferences to the five ISBTs; hence, the assessment is valid. Thus, the least preferred ISBT amongst the interviewees is the Serendipity/Fortuitous ISBT with a mean score of 1.5; whereas the most (the first) preferred ISBT amongst the interviewee is the
Systematic ISBT with a mean score of 4.17. Cognitive ISBT was the second preferred ISBT (with a mean score of 4.00) followed by Associate ISBT (with a mean score of 3.67), then social media ISBT (with a mean score of 1.67). Essentially, the responses validate the research findings. However, a comparative analysis of responses to the research findings indicates that the first and third preferred ISBTs of interviewees do correspond to the first and third ISBTs in the research findings. However, the second, fourth and fifth ISBT preferences of the interviewees corresponds to the revelations in the findings. Hence, a partial validity verdict is pronounced.

Majority of the respondents indicated that their ISBT preferences depend on factors including organisational setup, resource availability, context specificity of the task, working condition and other demographic factors including qualification and experience. The differences in responses compared to the research findings revealed some fundamental factors, which were not captured in this study. For example, some respondents indicated that personal integrity and the ability to demonstrate their capability and knowledge influences their ISBT orientation. An interviewee (P3) who ranked Systematic ISBT as the most preferred and Serendipity/Fortuitous ISBT as the least preferred indicated that … my priority for seeking information comes from trust, accessibility, channel, effectiveness, efficiency, currency, usability, reliability and other things underpins my reasons to choose systematic first and serendipity last. For instance, one of the most important factors that influence my choice is the accuracy of the information [Senior Structural Engineer (P3)]. Similarly, another respondent (P2) whose most preferred ISBT is Associate indicated that … majority of the information I seek comes from colleagues who are very experienced in their area and they tend to translate the information to you in common language. Therefore, I will first talk to my associate, and then I will apply a systematic process by going through specifications or documents that have already been generated. I then apply my cognitive process to problem solve the situation. They will be my first three preferences. I rarely use social media and I very rarely apply serendipity/fortuitous… [Project design Manager (P2)]
Overall, majority of interviewees considered Systematic ISBT (see table 10.3) as their most preferred, and Serendipity/Fortuitous ISBT as their least preferred ISBT. In general, average responses from interviewees to this question indicate a partial validity verdict to the hierarchical order of ISBT preferences identified in the research findings. Certainly, a valid pronunciation is made in relation to the categorisation of respondents ISBTs in the project environment.

2. Relationship between influencing factors and Associate ISBT

The essence of this question was to assess the extent to which interviewees’ orientation towards Associate ISBT is influenced by positive correlated significant information-seeking and information use/task performance factors. Consequently, respondents were informed that the research findings revealed that factors such as accessibility, collaboration, trust, currency, context specific, useable, satisfaction, professional role and sources/channels has positive significant relationship with associate ISBT. Therefore, respondents were asked to respond to the statement “How does this reflect your information seeking activities when you rely on your associates to seek information for use?”

All respondents overwhelmingly affirmed that their orientation towards Associate ISBT is influenced by all the factors listed. However, some respondents indicated that factors such as accessibility, trust and collaboration were highly important in their consideration for Associate ISBT. Other respondents also suggested that factors such as relevance and reliability should be positively correlated to Associate ISBT. Similarly, some respondent also indicated that although it would be difficult to establish the order of importance of these factors, they think some factors are more important than others.

For example an interviewee (P4) stated that ...you are dealing with people rather than systems..., people have different behaviour, different way of communicating, different learning process so they cannot really communicate back to you easily especially if they have an agenda, why would they give you that information. Unless you give them something else... Sometimes, even colleagues go further than the request you make. They devote their time to help you resolve your information need and they open new doors, new ideas for you… so all these factors reflect my preference for Associate ISBT [Facilities/ Services Manager – P4].
Similarly, P4 was asked to respond to the statement “to what extent do factors such as quality and role which has negative relationship with Associate ISBT reflect in your ISB”. P4 indicated that …*it is possible to have a negative quality relationship with Associate ISBT because if you don’t get the proper information and the proper result, it will mean a negative or bad information supplied. For example, if someone has a hidden agenda and decide not to give you all the information you need.* Similarly, P4 indicated that …*sometime you approach people who are inexperience and do not have a clue in their role. All these can have a negative influence on the use of Associate ISBT…* [Facilities/Services Manager – P4].

Overall, since the respondents confirmed that there is a positive significant relationship between the identified influencing factors and their (interviewees) orientation towards Associate ISBT, the responses validate the research findings. Similarly, all the respondents indicated that factors such as quality and role have negative relationship with Associate ISBT. This indicates that responses from interviewees validate the research findings.

3. **Relationship between the influencing factors and Systematic ISBT**

Regarding this section, the object was to assess the extent to which interviewees’ orientation towards Systematic ISBT, and the positive correlated significant influencing information-seeking and information use/task performance factors reflects the research findings. Respondents were informed that the research findings revealed that factors such as *accessibility, organisational setup, trust, currency, accuracy, context specific, effectiveness, efficiency, quality, relevance, reliability, useable, satisfaction,* and *age* has positive significant relationship with Systematic ISBT. Hence, respondents were asked to respond to the statement “to what extent does this reflect your information-seeking activities when you apply Systematic ISBT approach to seek information for use?”

The respondents viewed the findings as true representation of their orientation towards Systematic ISBT. They indicated that all the factors listed positively influence their orientation towards Systematic ISBT. Some respondents indicated that some factors such as *accuracy, organisational setup, currency, context specific, efficiency, effectiveness,* and *trust* are highly influential in their preference to use
Systematic ISBT approach. The consensus was that Systemacti ISBT approach is a true reflection of their routine information-seeking activities (see table 10.3).

Respondent P5, who rated Systematic ISBT second most preferred, indicated that his work context and professional role limits his application of Systematic ISBT. However, all the factors indicated are influential in his orientation towards Systematic ISBT. P5 indicated that this type of information-seeking is the “traditional type” hence, it occurs naturally.

Another respondent (P3) indicated that factors such as organisational setup, accessibility, trust, currency, context specific and accuracy are highly influential in his orientation towards Systematic ISBT. P3 indicated that his organisation has information library, online catalogues, databases, journal subscription, and he is permitted to freely use social media to seek information. Hence, all these influence his preference for Systematic ISBT.

Overall, responses from interviewees indicate a true validity of the research findings that Systematic ISBT has a positive significant relationship with the listed factors above.

4. Relationship between the influencing factors and Cognitive ISBT

Similarly, the aim was to assess the degree to which interviewees’ orientation towards Cognitive ISBT is influenced by positive correlated significant influencing information-seeking and information use/task performance factors. The research findings revealed that factors such as accessibility, collaboration, organisational setup, sources/channel, currency, context specific, effectiveness, relevance and satisfaction has positive significant relationship with Cognitive ISBT. As a result, participants were asked to respond to the statement “to what extent does this reflect your information-seeking activities when you rely on Cognitive ISBT to seek information for use?”

Respondents indicated that the findings bare true resemblance to their orientation towards Cognitive ISBT. They implied that all the identified influencing factors positively influence their orientation towards Cognitive ISBT. Some respondents assert that factors such as accessibility, organisational setup, sources/channels
and satisfaction are highly influential in their preference to use Cognitive ISBT. In general, respondents agreed to the statement that the positive significant relationship of Cognitive ISBT and the identified influencing factors are indicative of their Cognitive ISB. For example, respondent P2 who rated Cognitive ISBT as his third most preferred ISBT stated that …cognitive to me is very important however, I think both associate and systematic comes before cognitive. This is because you either use associate or systematic approach to seek the information first and then apply your cognitive to use the information to resolve a task or a problem…[Project design Manager – P2]

This response from respondent P2 suggest a perspective, which depends on other types of ISBTs before cognitive information seeking approach. P2 indicate that the identified factors are representative of his orientation towards Cognitive ISBT.

Participant P6 asserts that factors such as professional role, organisational setup, and channels/sources are influential in his adoption of Systematic ISBT. He indicated that even if he orientate towards Cognitive ISBT or Associate ISBT, the culture in his organisation demand a systematic approach by going through documents, specifications and others sources before embracing Cognitive ISBT to either use the information or verify the information. He indicated that organisational culture and structure, integrity, seniority and other factors are influential in his approach to information seeking.

In summary, all respondents agreed to the statement. Therefore, the findings that factors such as accessibility, collaboration, organisational setup, sources/channel, currency, context specific, effectiveness, relevance and satisfaction has a positive significant relationship with Cognitive ISBT is valid.

5. Relationship between the influencing factors and Serendipity/Fortuitous ISBT

This question assesses the extent to which interviewees’ orientation towards Serendipity/Fortuitous ISBT reflects the research findings. Thus, the findings indicated that factors such as collaboration, accuracy, and currency have a positive (but not significant) relationship with Serendipity/Fortuitous ISBTs. Hence, interviewees were asked to respond to the statement “How does this reflect your
information-seeking activities when you rely on Serendipity/Fortuitous ISBT approach to seek information for use?”

As much as the overwhelming response to this statement indicate that Serendipity/Fortuitous is the least preferred ISBT among interviewees, they indicated that the statement truly represent their orientation towards Serendipity/Fortuitous ISBT. The respondents acknowledged their awareness and occasional use of this type of ISBT however; they indicated that it lacks recognition and attention. For example participant P5 indicted that his professional role, line of work, information context and source/channel availability indicates his preference for Serendipity/Fortuitous ISBT. Overall, majority of the respondents agreed that the identified influencing factors truly influence their orientation towards Serendipity/ Fortuitous ISBTs. However, they indicated the need to create opportunities to promote this type of ISBT within the project organisation.

6. **Relationship between the influencing factors and Social Media ISBT**

This section assesses the extent of interviewees’ orientation towards Social Media ISBT. Thus, the research findings revealed that factors such as *usability, role, and qualification levels* negatively correlate to Social Media ISBT. As a result, participants were asked to respond to the statement “to what extent does this reflect your information-seeking activities when you rely on Social Media ISBT to seek information for use?”

Respondents indicated that the findings bare true resemblance to their reliance on Social Media ISBT. They implied that the identified influencing factors had negative influencing effect on their orientation towards Social Media ISBT. Some respondents assert that factors such as *organisational setup, accessibility, and sources/channels* should have significant negative relationship with Social Media ISBT.

A respondent indicated that though he likes to use Social Media ISBT, restrictions at work prevent him from using it, hence he only uses it in his private time (especially when at home). Other respondents indicated that they rely on social media for key information because they will get instant response from large group
of people however, social media information seeking can be time consuming, ineffective, and is prone to the problem of IO.

In summary, respondents agreed with the statement indicated above. Therefore, the findings that factors such as usability, professional role, and qualification level have negative relationship with Social Media ISBT are valid.

7. Relevance of the ISBT Model

With this question, respondents were asked to examine the ISBT model below (see figure 10.4) and respond to the statements:

1. How relevant does the model represent the way you seek and use information to perform task(s)
2. What can be done to improve the model?

![Proposed Actors Information Seeking Behaviour Type(s) model](image_url)

All the respondents recognised the importance of the ISBT model to represent the true ISB of project actors in the project environment. The respondent indicated that examining the model present a true representation of their ISBs. Some respondent indicated that the feedback arrow from the use information to the actor information need should be removed since the entire process does not show an end to the information-seeking process. This point was considered critically, however; it was
concluded that the arrow should remain to indicate the cyclical nature of actors ISB process.

8. Recommendations to improve the model

Participants were asked to respond to the question “what can be done to improve the model?” Some respondents indicated that the model present a true representation of their ISBs. Others suggested that the influencing factors should be structured in a hierarchical manner to indicate an order of hierarchy to the ISBTs. However, the respondents were reminded that hierarchical structure of the influencing factors was not defined in the research scope. Other respondents indicated that the feedback arrow from use information to the actor information need factor should be removed entirely. They indicated that this would demonstrate a start and an end to the information-seeking process. Another respondent indicated that the instructive notes (such as the predictors, and influences) should be removed entirely from the model. Other respondents also indicated that the positive and negative signs should be removed, and stated in a descriptive guidance/instruction sheet. Majority of the respondent suggested that, there should be an instruction sheet to direct and guide the applicability of the model. The participants also indicated the need for IB/ISB awareness in organisations and the sector to enhance IB culture. Some participant suggested that IB culture could be achieved only if senior management embrace the concept.

Most of the recommendations made by the respondents were applied to the model. Overall, the participants indicated that the ISBT model is a valid representation of their ISB in task performance within the project environment and construction organisations. Figure 10.5 presents the improved actors ISBT that addresses some of the recommendations by the respondents. Thus, the interpretation of the ISBT model is in line with the research findings and validates the research aim and objectives.
10.5 SUMMARY
This chapter presented consolidation of research findings to develop the ISBT model of actors in the project environment and the construction organisation. The chapter also presented discussion of the research validation and research findings thereby highlighting the identified ISBTs and the influencing information-seeking and information use/task performance factors. The study identified various significant factors that predict actors’ ISBTs. Similarly, factors that have significant relationships with the ISBTs were identified. Both negative and positive predictors and association factors were identified.

In addition, assessment of the research findings amongst industry professionals to establish the validity of the research was presented. The opinions of six industry professionals were captured through one-to-one semi-structured interviews to confirm or disconfirm the validity of the research findings. Hence, the evidence presented in this study provides a unique contribution to the ISB study in both academic and non-academic sectors. The chapter explored different validity methods and approaches applicable to a study of this kind. Both internal and external validity of the research were presented. The prevailing situations as captured during the interview process indicate the unique and context specific nature of tasks or projects or the construction industry as a whole.
Finally, responses from industry professionals affirmed the research findings thereby indicating its validity and the robustness of the study. The participant confirmed that their ISBT orientations and the factors that influence their ISBTs are accurately represented in the ISBT model and that the model is valid. In all, these findings have important implications to the ISBs of actors’ in the project environment and the construction sector. In addition, construction organisations have a responsibility to make provisions to support actors’ ISBs, whereas actors have a responsibility to seek ways to improve their ISB preferences in task performance. Overall, this chapter responded to the fourth, fifth and sixth research objectives.
CHAPTER 11 : CONCLUSIONS AND RECOMMENDATIONS

11.1 OVERVIEW

This research set out to investigate the ISBs of project actors in construction organisations and the factors that influence their ISBs. This led to key research findings including five ISBTs, seven (7) information-seeking influencing factors and ten (10) information use and/or task performance influencing factors. These were consolidated to develop the Project Actors’ Information Seeking Behaviour Type model. This chapter presents the overall summary of the work carried out to achieve the research aim and objectives, key findings, response to research questions, contribution to knowledge, limitations and opportunities for future research.

11.2 RESEARCH SUMMARY

Chapter one presented the background of the research to identify the main issues underpinning the research. This revealed a dearth of IB/ISB research and literature of actors in the Construction sectors. This highlighted a consistent lack of IB culture and suboptimal performance in project delivery and organisation management. Literature reviews revealed various problems that affect the sector. However, the paradigm shift of the sector from predominantly paper based through to nD modelling informed the need to establish actors’ IB culture that underpins the information critical nature of construction activities.

The reviews revealed that studies in this area within Construction overlooked the social aspects of information use to focus on underpinning process and systems. As a result, detailed insight into the IB/ISB studies of actors in the Construction sectors informed two key research questions:

i. Is there discernible ISB preference(s) of construction project actors?

ii. To what extent do information-seeking and information use/task performance factors influence actors’ ISBs?

To answer these questions, the research aimed to investigate the IB of construction project actors. The object was to unearth actors’ ISB preference(s) and the factors that influence their information-seeking and/or information use/task performance behaviours in the construction sector. To achieve this aim, six research objectives were proposed which were achieved through literature reviews, qualitative and quantitative research methods.
The study achieved the research aim and objectives through literature reviews, exploratory interviews of construction project actors, and quantitative inquiry. The deductive research approach presented convergence between literature review and the findings of the exploratory study. The theoretical approach that links actors ISB approach to extant literature findings helped to classify the five ISBTs and to conceptualise the ISBT model.

11.2.1 Review of Research Objectives

**Objective 1**: To investigate the extent of actors’ IB/ISB culture in relation to performance in construction organisations.

Chapters two and four responds to this objective. This objective was achieved through literature review to establish the intricacies of the extent of IB/ISB research and literature in the construction sector. Review of IB/ISB literature and construction information management/communication management literature revealed the dearth of research and IB/ISB literature of professionals in the sector. The review revealed the highly diverse nature of the sector with discrete sub-sectors and subcontractors. It revealed that the industry is highly fragmented and it continues to battle the problem of IO, poor information dissemination, suboptimal information seeking, process duplication and high rate of project failures and underperformance. It was revealed that the UK government has identified Construction as an enabling sector under industrial strategy, since the industry is central to the UK’s economy and its contributions are highly significant to GDP growth. (HM Government, 2015). It was revealed that human IB factors fundamentally underpin project delays. Similarly, the reviews revealed that the paradigm shift from paper based information dissemination and information-seeking to integrated BIM enabled project delivery process and nD information modelling necessitate a culture change in actors’ IB/ISB process.

Essentially, it is envisaged that BIM will integrate the construction process and the industry. Hence, appraisal of these issues highlights the gaps in the IB culture in the sector and a need to investigate the ISBs of professionals. To address these gaps, this thesis proposes that IB/ISB culture be established in the sector to inform actors’ preparedness to embrace the paradigm shift and to enhance continuous performance improvement.
**Objective 2:** To investigate the extent of IB/ISB research of actors’ in general.

This objective was achieved through the review of IB/ISB literature to establish the general nature of IB/ISB research. This is addressed in chapter three, where different key terms were identified, the nature and extent of IB/ISB research was reviewed. The main empirical study in this chapter revealed that scholars use models and frameworks to represent the output of IB/ISB research. The study revealed the context of IB/ISB research of different professionals, occupations and laypeople. This revealed the dearth of IB/ISBs literature and research of actors in the construction sector. Hence, given the context of this research, the mixed method research strategy was used to investigate the IB/ISBs of construction professionals. The study adopted a deductive approach where the underlying epistemology is positivism, and the principle of the least effort theoretical approach to undertake a two-stage research process. A sequential mixed method strategy was adopted for the empirical data collection where an initial exploratory study was conducted to investigate and establish the IB/ISBs of industry practitioners. This revealed the ISB preferences of construction project actors and the influencing factors synonymous to professionals in other industry sectors. Consequently, to address the identified knowledge gap, the thesis concedes that ISB orientations of construction project actors be embedded in strategies to improve the IB/ISB culture within the sector to enhance project delivery and performances.

**Objective 3:** To review literature to establish the extent of IB and/or ISB research of professionals in different industry sectors.

This objective is addressed in chapters three, four, five, and seven. In bridging the identified knowledge gap, an in-depth review of IB/ISB literature of professionals in different occupations was conducted to establish the unique preferences and approach to information-seeking. The review revealed different IB/ISB preferences in context. Furthermore, the review revealed several relevant factors that influences the information-seeking and information use/task performance of professionals in these occupations. These were consolidated to formulate interview questions to investigate the ISBs of construction project actors. Hence, an exploratory study was conducted with construction professionals to understand their day-to-day IB/ISB activities, and the factors that influence such behaviours. The captured empirical data was analysed thematically to confirm the identified ISBs of professionals and
the factors that influence their information-seeking and information use/task performance in the different occupations.

Therefore, throughout the literature review, efforts were made to extracts the unique ISB preferences that professionals exhibit. The review of IB literature and research of professionals in different occupations including construction and the IB/ISB models resulted in the extraction of five ISB types (including Associate ISBT, Cognitive ISBT, Systematic ISBT, Serendipity/Fortuitous ISBT and Social Media ISBT). These were synthesised with the findings from the exploratory study to form the basis for the quantitative inquiry. Thus, the qualitative inquiry provided empirical verification of the identified ISB preferences of actors in different occupations. Statistical techniques including descriptive statistics, Factor analysis, and the Friedman’s test were used to establish the order of preference of actors ISBTs.

**Objective 4:** To investigate the factors that influence actors’ information-seeking and information use/task performance in project organisations.

This objective was addressed in chapters three through to nine inclusive. The key factors that influence actors information-seeking and information use/task performance behaviours were extracted. This was achieved through extensive literature review of IB/ISB models, IB/ISBs of professionals in different occupations and the outcome of the exploratory study. The sequential mixed method design comprised of an initial qualitative inquiry followed by a quantitative inquiry. The qualitative inquiry provided empirical verification of the identified actors’ ISB preferences and the factors that influence their ISBs. The analysis revealed distinct categorisation of 22 influencing factors into information-seeking factors and information use/task performance factors.

These factors were discussed to establish their relevance to actors’ information-seeking and information use/task performance. Synthesis of these factors and their relationship with the ISBTs resulted in the conceptual framework for actors’ ISBTs in the project organisation. The conceptual framework enabled the formulation of hypotheses for the study. The hypotheses were tested through quantitative analysis to reveal the distinct ISBTs and the significant influencing factors.
Overall, the analysis revealed seven (7) significant information-seeking factors and ten (10) significant information use/task performance factors. The research findings revealed that factors such as accuracy, currency, context specific, efficiency, effectiveness, relevance, reliability, satisfaction, quality and useable influenced actors’ ISBTs during the information-seeking and information use/task performance process. It was found that some of these factors have different level of associations (such as positive or negative) with the five ISBTs. However, the findings revealed that factors such as accessibility, collaboration, work condition, source/channels, trust, age, and organisational setup, significantly predict actors ISBT preferences.

**Objective 5:** *To conceptualise the ISB processes of actors’ in construction project organisations.*

This objective was addressed in chapters four and five where several IB/ISB models were reviewed and presented. This highlighted the extent of IB/ISB research and the output from such studies. The models present how professionals seek, share and use information to perform tasks. They highlight problems within different context of IB/ISB research in different occupations and sectors including academia, LIS, engineering. It was evident, the lack of IB/ISB literature and models that focuses on construction project actors. It was established that the study of human behaviour is best presented with a model to depict human activities.

The mixed method approach was used to collect empirical data to establish the foundation for the conceptual model. Thus, the exploratory inquiry helped to understand the sequence of project actors’ information-seeking process. Hence, by drawing on the *principles of least effort*, a conceptual model of actors’ ISB was formulated. This framework comprised of the information-seeking and information use/task performance influencing factors and the five ISB types. The structure of the framework and the interdependencies of the influencing factors resulted in the formulation of 16 hypotheses.

Drawing on the conceptual framework, measurement framework was developed to provide the overall coherent guide for systematic assessment of the extent of actors’ information-seeking and information use/task performance behaviours. The measurement framework was used to collect the main quantitative data for the
study. Analysis of the main data revealed significant findings that truly represent actors’ ISBT preferences and the significant relationships between the ISBTs and the influencing factors.

**Objective 6:** *To develop project actors’ Information-Seeking Behaviour Type model.*

This objective was addressed in chapter ten through quantitative data analysis to establish the order of preference of actors’ ISBTs. Similarly, the influencing information-seeking and information use/task performance factors that had significant positive and/or negative relationships with the ISBTs were identified. These findings influenced the development of the project actors ISBT model. The findings together with the model were validated with industry professionals through semi-structured interviews. Responses from these professionals predominantly validate the study. Table 11.1 present a summary of research approach and responses to the research objectives.
<table>
<thead>
<tr>
<th>Objectives</th>
<th>Research Approach</th>
<th>Literature findings and responses to objectives</th>
<th>Research Chapters</th>
</tr>
</thead>
</table>
| 1. Investigate the extent of project actors' IB/ISB culture in relation to performance in construction organisations. | Literature review | • Revealed the dearth of research and IB/ISB literature in the sector.  
• Revealed the diverse nature of the sector with discrete sub-sectors and subcontractors.  
• Revealed that the industry is highly fragmented and continues to battle the problem of IO, poor information dissemination, suboptimal information seeking, process duplication, high rate of project failures and underperformance  
• Revealed that human IB factors fundamentally underpin project delays.  
• Revealed that the paradigm shift from paper based information dissemination and information-seeking to integrated BIM enabled project delivery process and nD information modelling necessitate a culture change in actors’ IB/ISB process. | Two and four       |
| 2. To investigate the extent of IB/ISB research of actors' in general     | Literature review | • Revealed that scholars use models/frameworks to depict the output of IB/ISB research  
• Revealed the context of IB/ISB research of professionals different in occupations.  
• Defined key terms, and reviewed the nature and extent of IB/ISB research.  | Three and four     |
| 3. To review literature to establish the extent of IB and/or ISB research of professionals in                           | Literature review | • Revealed different IB/ISB preferences in context of professionals in different occupations.  
• Revealed the relevant factors that influences the information-seeking and information use/task performance of professionals in these occupations  
• Extraction of five ISB preferences (including Associate, Cognitive, Systematic, Serendipity/Fortuitous and Social Media). | Three and four     |
| General | 4. To investigate the factors that influence actors’ information-seeking and information use/task performance in project organisations | **Literature review** | **Qualitative exploratory study** | **Extracted the key factors that influence actors information-seeking and information use/task performance behaviours.**
- Revealed that factors such as accessibility, collaboration, organisational setup, source/channels, accuracy, context specific, currency, effectiveness, efficiency, quality, relevance, reliability, satisfaction, and useable influenced actors’ ISBTs during the information-seeking and information use/task performance process.
- Revealed that factors such as collaboration, work condition, age, currency, trust, effectiveness, and quality significantly predict actors’ ISBTs. | Three through to nine inclusive |
| 5. To conceptualise the ISB processes of actors’ in construction project organisations. | **Literature review** | **Qualitative exploratory study** | **Quantitative study** | **Drawing on the principles of least effort, a conceptual model of actors’ ISB was formulated.**
- The framework comprised of the information-seeking and information use/task performance influencing factors and the five ISB types.
- The structure of the framework and the interdependencies of the influencing factors resulted in the formulation of 16 hypotheses
- Developed research measurement framework to provide a coherent guide for systematic assessment of the extent of actors’ information-seeking and information use/task performance behaviours. | Five. |
| 6. To develop project actors’ ISBT model. | **Quantitative approach** | **Qualitative approach** | **Revealed the influencing information-seeking and information use/task performance factors that had significant positive and/or negative relationships with the ISBTs**
- Validated the findings together with the model with industry professional through semi-structured interviews | Five, eight, nine and ten |
11.3 CONCLUSION OF THE RESEARCH
The overall aim of this research was to investigate the IB of project actors in the construction sector. This is achieved through the identification of the five ISBTs that represents the ISB preferences of construction project actors. Similarly, the research has identified key factors that influence actors’ ISB preferences during task performance. On the other hand, the research identified key factors that predict actors’ ISBTs during information-seeking and information use/task performance process. Overall, construction project actors have unique IB culture and ISB preferences, hence a need to create awareness amongst actors in the sector.

The research also revealed the distinct differences and preferences in actors’ ISBTs, where the application of each of the ISBTs depends on key influencing factors. Overall, it was found that project actors have high preference for Associate ISBT than the remaining ISBTs. This confirms the Zipf’s principle of least effort. This also suggests that an effective team and a well-composed construction organisation have the potential to enhance effective information-seeking.

Similarly, it was found that the extent of factors that influence actors’ ISBT preferences vary significantly. Some factors have positive and/or negative relationship with the ISBTs. Similarly, other factors have no significant relationship with the ISBTs. It has been established that actors generally spend significant amount of time seeking information however, the time factor was found to be task dependent. This implies that although time is vital to information-seeking and task performance, its relationship to the ISBTs is not significant. Thus, time has no significant influence on actors ISBT preferences. Overall, the conclusion responds to the research questions, and the findings indicate actors’ ISBT preferences in the project organisation.

11.4 CONTRIBUTION TO KNOWLEDGE
This study provides new insight into the IB research and IB culture of actors in the construction sector. It provides insights into the ISBs of project actors and the factors that influence their information-seeking and information use/task performance. This has been achieved by investigating the ISB activities undertaken
by decision makers involved at the design development phases of the PLC. In so doing, this research categorised actors’ ISBs into Associate ISBT, Cognitive ISBT, Systematic ISBT, Serendipity/Fortuitous ISBT and Social Media ISBT as the five key ISB preferences amongst actors’ in the project environment. The five types of ISBTs are novel contribution of this research to knowledge.

The research revealed the hierarchical ISBT preferences of project actors and the underlying key influencing information-seeking and information use/task performance factors. This research has shown that key information-seeking and information use/task performance factors influences actors’ ISB at different stages during the process. Thus, these factors have different association levels to the ISBTs and different influence level. Whereas some may have positive or negative association and influence on the five ISBTs, others have both. The research explains the collective association of the ISBTs with the influencing factors and how they influencing actors’ information activities during the project delivery process.

As a contribution to previous studies that examines actors ISBs, this study has put the spotlight on the ISBTs and the influencing factors underlying IO issues, information process duplications, poor information sharing and lack of focus of IB/ISB research in the Construction.

As a consolidation of the entire research findings, an ISBT model, which focuses on project actors’ information-seeking activities and the underpinning factors that influence their ISBT preferences has been developed.

Beyond the specific outcomes discussed, this research contributes to construction IB/ISB research through the social aspect of actors’ ISBs and the factors that influence such behaviours. Given the challenges in investigating actors’ IBs/ISBs in sectors such as Construction, other researchers who study dimensions of actors’ IB/ISB and the underlying influencing factors could replicate the approach adopted for this research.

Considering that the initial phases of the PLC is appropriate phase to influence the IBs/ISBs of actors’ during the project delivery, this research provides insights which
could potentially advance a coherent IB/ISB culture in the construction industry and the project environment.

The output of this research has since resulted in the publication of two technical papers and one book chapter in refereed international construction and engineering journals. Part of the findings of this research has also been presented in doctoral workshops and conferences. Complete bibliographic details of these papers are provided in appendix A.

11.5 LIMITATION TO THE RESEARCH
This research set out to investigate the IB of construction project actors; however, the study focused on actors' ISB. This is due to the broad nature of topic and the lack of empirical IB research and IB literature in the construction sector. The study narrowed its focus on actors involved in the design development phases of the PLC. Thus, it was impractical to investigate the entire construction process and the entire construction sector, hence it was practical to focus on the information critical phases of the PLC.

In addition, the research was limited by time and resource constraints. Time was influential in funding this research (to complete the research in three years), since the duration of an average construction project is much longer and the complications associated with the adopted research methodology. Hence, the research scope defined in terms of the studentship and available resources. This limited the researcher to delve deep into the ISB of actors in construction project organisations.

Although the mixed method approach was adopted for this study, this approach restricts an in-depth view of the intricacies of project actors. Hence, it is recommended that a future study could combine a quantitative inquiry with a case study approach to delve deep into the intricacies of actors’ IB in the construction process. However, convergence between aspects of qualitative and quantitative inquiries together with the validation process reinforced the credibility of the research findings.
Another limitation of this research is the geographical and industrial boundaries of the empirical data. Given that the focus of the empirical aspect of this research is the UK construction sector, it is plausible that there may be differences in the findings if this study is replicated in different industrial and geographical locations. Hence, this aspect is also recommended for future research.

The findings of this study are based on the professional judgement of construction actors who responded to the questionnaire survey and the exploratory interview. Hence, one cannot be certain that the findings present a true reflection of the ISBs of construction professionals in general. However, since the judgements of these professionals are shaped by experiences and expertise, it presents respectable responses, which implies the findings are indicative of actors’ ISBTs in construction organisations.

Another possible limitation is the adoption of the 5-point Likert scale to measure actors’ ISBTs and the influencing factors. It is probable that the scale was not wide enough to capture key differences in the measured variables. Meaning this may have partly influence the surprising outcomes of the analysed results and the findings as a whole. Perhaps, a wider scale (such as the 7-point Likert scale) may be more sensitive to subtle differences.

11.6 INDUSTRIAL IMPLICATIONS OF RESEARCH FINDINGS

This research has contributed to the understanding of the IB/ISBs of professionals in the construction sector. Practical implications of this research include:

i. This research presents insights of IB culture of actors in construction organisations. This research has overcome the rare existence of IB literature to present the intricacies of ISBTs of actors. These are categorised into Associate, Cognitive, Systematic, Serendipity/Fortuitous and Social Media ISBTs in descending order of preference. This presents a better understanding of actors’ ISB orientations and expectations. This implies the need to develop strategies to support actors’ ISBTs to enhance information culture within the sector.

ii. The categorised information-seeking and information use/task performance influencing factors establishes appropriate directions, and
focuses expectation of actors on the impact of IB/ISB culture in relation to performance of project organisations and the construction sector.

iii. The project actors ISBT model present a conceptual overview of the IB/ISB culture within project organisations. This present an opportunity for policy makers and key stakeholders to understand the dimensions of actors' ISB culture, the associated influencing factors and where to focus attention to enhance information-seeking and information dissemination.

iv. The entire research findings informs industry and key stakeholders including academic institutions to make educated decisions to meet the expectations of the paradigm shift of the construction process from traditional (paper based) ISBs to preferential ISBs of actors in an integrated project organisations. The practical perspective of this research is that stakeholders can take advantage of the findings to create avenues that explores and enhances the application of the five ISBTs. Similarly, they can take advantage of the factors that influences these ISBTs to design strategies to enhance performance and information culture in the sector.

11.7 RECOMMENDATIONS FOR FUTURE RESEARCH
As per the research findings and limitations acknowledged above, the following are recommendations for future research:

i. The study presents an overview of actors' ISBTs in construction organisations. Hence, there is a scope to explore the ISBTs teams to investigate their relationships with the influencing factors.

ii. Studies can be conducted to explore actors ISBTs at different levels (such as functional/departmental, and organisation wide) in relation to performance.

iii. To complement the broadness of IB/ISB research, and the impact of actors' ISB/IB on industry and the world economy, replication of this research in different industry sectors and geographical locations is recommended to explore different outcomes.

iv. A key issue this study sort to address was to explore the IB of actors in the construction sector hence, both qualitative and quantitative methods of inquiries were employed. This helped to establish the research findings. However, the study implores future researchers to apply quantitative and
case study approach to delve into the subtle differences of actors’ ISBTs and performance in construction organisations.

v. This research presents an opportunity for institutions (including academics, researchers and others) to create fundamental avenues (including training provisions, study programmes and curriculums) to engage students and professionals into developing good insights into actors ISBTs, automated information capture and dissemination and IB/ISB culture in construction project organisation and project delivery process.
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APPENDICES

Appendix A: Publications

Publications

Refereed conference paper


Refereed book chapter
Appendix B-1 Loughborough University Ethical Checklist

Participant Information Sheet

Project Title: Information Behaviour of Construction Project Actors

Main Investigator Details
Name: Frank K. Dzokoto
University postal: Robert Bakewell Halls, Flat A Sub Warden, Loughborough University, LE11 3TU
Email address: f.k.dzokoto@lboro.ac.uk.

Supervisor Details
Name: Dr Francis Edum-Fotwe
University postal: Senior Lecturer, Construction Management, Civil and Building Engineering Department, Loughborough University, LE11 3TU
Email address: fancis.edum-fotwe@lboro.ac.uk. Contact number:

What is the purpose of the study?
The purpose of the study is to capture the information behaviour (IB) of KEY ACTORS in the construction project organisation to establish their information needs, how they create, seek, share, store, use and retrieve information and the channels and sources the rely on for this process. The study will also solicit information on how building information modelling (BIM) process and/or enterprise resource planning (ERP) systems impact on the information behaviour of these actors. The main object of this study is to formulate an effective information behaviour framework to guide project actors in their Information Behaviour to enhance performance, meet project delivery demands, and organisation management. Below are some definitions of key terms for your reference:

- Information Behaviour (IB) is defined as the process of human behaviour through sources and channels of information to actively and/or passively seek information and use information.
- BIM is defined as a process for interacting with set of intelligent information systems, policies, tools and technologies to generate a methodology (a process), project design, manage the design and the construction process throughout the project/product life cycle and to facilitate infrastructure/facility management.
- ERP is defined as a strategic management system for organisation wide information processing abilities and capturing data into a single database for use.

Who is doing this research and why?
This research is being conducted by Frank K. Dzokoto, a PhD Construction Management student at the School of Civil and Building Engineering Department, Loughborough University. The supervisors for this research are Dr. Francis Edum-Fotwe and Dr. Peter Demian. “This study is part of a Student research project supported by Loughborough University.”

Are there any exclusion criteria?
No!
Once I take part, can I change my mind?
Yes! After you have read this information and asked any questions you may have we will ask you to complete an Informed Consent Form, however if at any time, before, during or after the sessions you wish to withdraw from the study please just contact the main investigator. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing.

Will I be required to attend any sessions and where will these be?
No!

How long will it take?
The estimated amount of time for each session of participation during the interview process is about 45 minutes, and the amount of time required to complete questionnaires is 15 minutes. However the estimated duration for observation (if required) will be based on participants discretion.

Is there anything I need to do before the sessions?
No!

Is there anything I need to bring with me?
No!

What type of clothing should I wear?
Any descent clothing will be appropriate to wear for taking part in this study.

Who should I send the questionnaire back to?
Any additional information relevant to this study should be sent to the main investigator as detailed above.

What will I be asked to do?
You will be asked to take part in a case study, interview, questionnaire and/or process at the preliminary and the main study stages.

What personal information will be required from me?
The personal information that will be required from you include your age, occupation, academic qualification, and professional work experience.

Are there any risks in participating?
No!

Will my taking part in this study be kept confidential?
Yes! Your taking part in this study will be kept confidential and any information and data acquired will be used for research purposes only. At no circumstance will your true identity or that of your organisation or any respondent be disclosed.

What will happen to the results of the study?
The result of the study will be published and used for academic purposes.

What do I get for participating?
In return for your participation, you will be provided with a summary of the research findings and the framework developed upon completion of this study.
I have some more questions who should I contact?

Should you have any questions or require further clarification about this research study, please feel free to contact the main investigator on Email: f.k.dzokoto@lboro.ac.uk.

What if I am not happy with how the research was conducted?

If you are not happy with how the research was conducted, please contact Mrs Zoe Stockdale, the Secretary for the University’s Ethics Approvals (Human Participants) Sub-Committee:
Mrs Z Stockdale, Research Office, Rutland Building, Loughborough University, Epinal Way, Loughborough, LE11 3TU. Tel: 01509 222423. Email: Z.C.Stockdale@lboro.ac.uk

The University also has a policy relating to Research Misconduct and Whistle Blowing which is available online at http://www.lboro.ac.uk/admin/committees/ethical/Whistleblowing(2).htm.
Appendix B-2 Typical Invitation Letter to participate in Interview

Loughborough University

School of Civil & Building Engineering
Loughborough University, Leicestershire, LE11 3TU, UK

Dear [Name],

REQUEST FOR ASSISTANCE WITH RESEARCH ON IMPROVING INFORMATION SEEKING ACTIVITIES PROJECT PROFESSIONALS

As part of research on improving the information sharing and seeking activities of professionals in the Architecture, Engineering and Construction (AEC) sectors, this study is being undertaken to understand these activities. The study aims to explore how construction professionals’ information seeking and sharing activities influence project performance and how it can be improved during project /task execution process. Findings from this research would be used to develop a framework which could guide professionals on the most suitable strategies to employ in seeking and sharing information to improve project/task delivery.

Research of this nature largely relies on contributions from industry experts. Thus, as a key player in the UK construction industry, access to one of your projects is fundamental to the success of this research. I would be grateful if I could gain access to one of your teams on on-going projects for a case-study spanning a maximum period of one month at no cost to your organisation. This would involve interviews with both head office and field personnel who make key decisions on the project design development process and the construction process. Interviews and any other data obtained from the project would be kept CONFIDENTIAL and used for research purposes only.

Identities of all individual and organisations will be kept confidential and the entire research process is being conducted in accordance with Loughborough University’s ethical and safety guidelines. In return for your participation, the research findings and any tools developed from the study would be made available to you. The findings could have the potential to guide effective information sharing and seeking behaviours, and performance improvement of professionals within project environments.

Other members of the research team are Dr Francis Edum-Fotwe and Dr Peter Demian, both of whom are accomplished researchers in the field of construction management. Any further correspondence can be sent to f.k.dzokoto@lboro.ac.uk. Thank you.

Yours faithfully,
Frank K. Dzokoto
PhD Student - Construction Management Research Group
Appendix B-3: Interview Schedule

Exploratory Interview

Semi-structured Interview Questions Guide

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Position/Work role</th>
<th>Gender</th>
<th>Age Range</th>
<th>Years of Experience</th>
<th>Qualification</th>
</tr>
</thead>
</table>

Consider a task or project that you have worked on up until the last two years, try to recall how you sought information to execute the task or project. By responding to the following questions:

1. Personal Information
   a. How does your qualification, and experience influence the way you sought information to execute the task/project?

   
   

   b. How does your working conditions (i.e. working in a team or working on your own) influence the way (i.e. sources and/or channels) you seek information for use?

   
   

2. Information creation/Information seeking behaviour
   a. To what extent do you rely on your knowledge, (i.e. memory, intuition, intelligence), experience and skills to meet your information needs for the task at hand?

   
   

   b. To what extent do you rely on formal meetings, briefings, memos, official documents, company extranet, common data environment/ (i.e. shared areas) to meet your information needs for the task at hand?

   
   

   c. To what extent do you rely on your colleagues and/or friends either internal or external to your organisation for vital information that will help in the task delivery?

   
   

   d. To what extent do capture relevant information from informal or casual meeting during breaks, conferences, seminars, network sessions, team bonding exercises, and others?
e. To what extent do you freely visit social network sites such as LinkedIn, Twitter, YouTube, Facebook, blog/bloggers, and other social community centres to capture relevant information for use on the task delivery?

3. **Information seeking sources/channels**
   a. Which channels and/or sources (e.g. colleagues, face-to-face, telephone, video conference, mails, cloud systems, extranet, internet, magazines, social media, library, journals, peer reviewed articles, conferences, meetings, trade magazines, technical documents, technical manuals, etc.) do you rely on for majority of your information and why?

4. **Factors that influence information seeking and information use/task performance**
   a. What essential factors influence your information seeking activities to ensure that the appropriate information is captured for use?
   b. What essential factors influence your information use/task performance activities to ensure that the appropriate information is captured for use?

5. **Time as an influencing factor**
   a. To what extent does time affect your information seeking and information use/task performance behaviour?
Appendix B-4 Validation Interview Guide
Validation Interview
Validation of findings: Information behaviour of construction project actors

Definitions of key terms
It has been found that professionals in the Architecture, Engineering and Construction (AEC) sectors have preference for any of the five Information-Seeking Behaviour Types (ISBTs) shown below, when seeking information to perform task(s) or provide solution(s) to problem(s):

1. **Associate ISBT**: the act of seeking information from colleagues and/or friends either internal and/or external to the organisation.

2. **Cognitive ISBT**: the process of relying on your thinking or mental ability to seek information for use.

3. **Systematic ISBT**: the process of following a structured approach to seek information for use.

4. **Social Media ISBT**: the dynamic process of actively or passively seeking (and sharing) information through social network sites for use.

5. **Serendipity/Fortuitous ISBT**: is the act of discovering or encountering information by chance either planned or unplanned without any connotation.

Similarly, it was found that actors’ information seeking behaviours have significant relationships with certain key information seeking and information use/task performance influencing factors as listed and defined below:

1. **Trust**: The level of confidence or faith of the information
2. **Accessibility**: The degree of ease with which to obtain or reach
3. **Sources**: The medium through which knowledge or information is stored, captured and presented
4. **Channels**: The medium through which information is carried or transferred from one station to another
5. **Effectiveness**: The accuracy and completeness with which to achieve defined goal
6. **Efficiency**: The degree of accuracy and completeness with which to achieve set goals and the relevant resources expended to achieving them
7. **Currency**: The state of being up-to-date with the present (not outdated)
8. **Usability**: The totality of being fit to use or fit for purpose.
9. **Relevance**: The degree of closeness to the context of the information required
10. **Reliability**: The degree of being consistently good in performance, quality and use
11. **Accuracy**: The degree of conformity to specification or standard or true value.
12. **Satisfaction**: The level of comfort and attitude towards captured information and use of information for its intended purpose
13. **Context specific information**: Is a detailed piece of information that influences easy interpretation and application.

14. **Quality**: The totality of excellence of the context that satisfies or meets the expected needs or user specification.

15. **Collaboration**: The act of working with someone with the view to achieve an outcome.

16. **Time**: The degree to achieve or occur at a specified period.

17. **Organisational Setup**: The structure and arrangements that exist to facilitate effective information behaviour and information management.

18. **Condition of work**: Work in a team or work independently (i.e. solo).

**Section A: Information-Seeking Behaviour Types (ISBTs) Preference**

The Friedman test was used to rank the five ISBTs to establish the other of preference amongst construction project actors as shown below:

- 1<sup>st</sup>. Associate
- 2<sup>nd</sup>. Cognitive
- 3<sup>rd</sup>. Systematic
- 4<sup>th</sup>. Serendipity/Fortuitous
- 5<sup>th</sup>. Social Media

**Question**

1. To what extent does this reflect your information seeking behaviour?

<table>
<thead>
<tr>
<th>Associate ISBT</th>
<th>Cognitive ISBT</th>
<th>Systematic ISBT</th>
<th>Social Media ISBT</th>
<th>Serendipity/Fortuitous ISBT</th>
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<tbody>
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</table>

2. What is the reason behind your ratings?

**Section B: Relationship between influencing factors and Associate ISBT**

It was found that key factors such as *accessibility, collaboration, trust, currency, context specific, useable, satisfaction, professional role* and *sources/channels* have significant positive relationship with Associate ISBT.

**Question**: How does this reflect your information seeking activities when you rely on your Associates (colleagues and/or friends both internal and external to your organisation) to seek information for use?
**Predictor Question for Associate:**

It was found that the *quality* and *Condition of work* factors predict a negative significant influence on Associate ISBT.

**Question:** To what extent does this reflect your application of Associate information seeking approach to capture information for use?

**Section C: Relationship between influencing factors and Systematic ISBT**

It was found that factors such as *accessibility, organisational setup, trust, accuracy, currency, context specific, effectiveness, efficiency, quality, relevance, reliability, satisfaction, usability and age* had a positive significant relationship with Systematic ISBT.

**Question:** To what extent does this reflect your information seeking activities when you apply a systematic approach to seek information for use?

**Section D: Relationship between influencing factors and Cognitive ISBT**

It was found that factors such as *accessibility, collaboration, organisational setup, sources/channel, currency, context specific, effectiveness, relevance and satisfaction* had a positive relationship with Cognitive ISBT.

**Question:** To what extent does this reflect in your information seeking activities when you rely on your cognitive ability to seek information for use?

**Section E: Relationship between influencing factors and Serendipity/Fortuitous ISBT**

It was found that factors such as *collaboration, accuracy, and currency* had a positive relationship with Serendipity/Fortuitous ISBT.

**Question:** To what extent does this reflect in your information seeking activities when you apply a Serendipity/Fortuitous approach to seek information for use?

**Section F: Relationship between influencing factors and Social Media ISBT**
It was found that the *usability, professional role,* and *qualification level* factors had a negative relationship with Social Media ISBT.

**Question:** To what extent does this reflect your application of social media approach to seek information?

**Section D: Time Factor**

The study showed that the mean time spent by actors’ to seek information is 142.44 minute (with Std. Dev. =284.257). The study also found high mode (281 min) and median (60.00 min) time values that actors’ spend to seek information. In terms of percentage, it implies construction project actors spend approximately 39% of their time (in hours) seeking information. (Min =5; Max =22505)

**Question:** To what extent does this reflect the average time you spend seeking information to perform a task (i.e. resolve a problem, execute a project, make a decision, etc.)

**Project Actors Information seeking behaviour type**

![Figure 1: Project Actors Information seeking behaviour type model](image)

**Questions:**

3. How relevant does the framework, represent the way you seek information and use information to perform task(s)

4. What can be done to improve this framework?
SECTION C: Socio-Demographic Questions

1. Name of respondent (optional):
   __________________________________________________________

2. Name of organisation (optional):
   __________________________________________________________

3. Employment sector: Public [ ] Private [ ] Other, please specify: _______________________

4. Which of the following best describes your professional role?

   Architect [ ] Building Surveyor [ ] Civil Engineer [ ] Facilities/ Service Manager [ ] Project Manager [ ] Quantity Surveyor [ ] Construction Manager [ ] Services Engineer [ ] Health & Safety Manager [ ] Design Engineer [ ] Planning Engineer [ ] Site Manager [ ] Design Manager [ ] Engineering Manager [ ] Technologist [ ] Other, please specify: __________

5. Which of the following best describes the conditions in which you work?

   In a team [ ] On your own [ ] Freelancer [ ] Other, please specify: _________________

6. What is the highest level of qualification you have attained?

   A Levels [ ] University degree [ ] BTEC [ ] NVQ [ ] HNC [ ] HND [ ]

   Other, please specify: ___________________________________________

7. Which age bracket do you fall into?

   Under 20 years [ ] 21-30 years [ ] 31-40 years [ ] 41-50 years [ ] 51-60 years [ ]

   Over 60 years [ ]

8. How many years of experience do you have in your current position?

   1-3 years [ ] 4-6 years [ ] 7-10 years [ ] 11-15 years [ ] 20 years [ ]

   21-25 years [ ] Other, Please specify: __________________________________________

Appendix B – 103b: The extent of interviewees ISBT preference

<table>
<thead>
<tr>
<th>Cases</th>
<th>Associate ISBT</th>
<th>Cognitive ISBT</th>
<th>Systematic ISBT</th>
<th>Social Media ISBT</th>
<th>Serendipity/Fortuitous ISBT</th>
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</thead>
<tbody>
<tr>
<td>C1</td>
<td>5</td>
<td>4</td>
<td>2</td>
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<td>1</td>
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<td>Eb2</td>
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<td>4</td>
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<td>P3</td>
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<td>S4</td>
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<td>Es5</td>
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<td>N6</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Mean Score</td>
<td>3.67</td>
<td>4</td>
<td>4.17</td>
<td>1.67</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Appendix C-1: Typical Cover Letter for Main Survey

Dear [Name],

REQUEST FOR ASSISTANCE WITH RESEARCH ON IMPROVING INFORMATION SEEKING ACTIVITIES PROJECT PROFESSIONALS

As part of research on improving the information sharing and seeking activities of professionals in the Architecture, Engineering and Construction (AEC) sectors, this study is being undertaken to understand these activities. The study aims to explore how construction professionals’ information seeking and sharing activities influence their performance in tasks delivery, and how it can be improved. Findings from this research would be used to develop a framework which could guide professionals on the most suitable strategies to employ in seeking and sharing information to improve project/task delivery.

Research of this nature largely relies on contributions from industry experts. RICS being a key player in the UK construction industry, access to professionals/industry experts who are members and attend RICS’s organised events (such as the RICS Matrics Ball 2014) is fundamental to harnessing effectively, information that would help improve the information seeking and sharing activities and performance of professionals in the project environment. A link to the questionnaire survey is shown for your reference https://www.survey.lboro.ac.uk/isapp. It should take about 15 minute to complete. Hence I would be grateful if you could grant me access to your organised events within the region and the country as whole so that I can attend to discuss my research work and to solicit responses to my research questionnaire.

Responses obtained from participants would be used for research purposes only. Identities of all individual and organisations will be kept confidential and the entire research process is being conducted in accordance with Loughborough University’s ethical and safety guidelines. In return for your participation, the research findings and any tools developed from the study would be made available to you. The findings could have the potential to guide effective information sharing and seeking behaviours of professionals within project environments.

Other members of the research team are Dr Francis Edum-Fotwe and Dr Peter Demian, both of whom are accomplished researchers in the field of construction management. Any further correspondence can be sent to f.k.dzokoto@lboro.ac.uk. Thank you.

Yours sincerely,
Frank K. Dzokoto
PhD Student - Construction Management Research Group
Appendix C-2: Questionnaire

Questionnaire Survey: Information Seeking Activities of Project Actors

In your current role within the Architecture, Engineering and Construction (AEC) sectors, when you are faced with performing a task or providing a solution to a problem, you use your prior knowledge, contact colleagues for some information, search through books or trade magazines, visit social media sites, or rely on other avenues to seek information needed to perform the task. This survey seeks to understand the sources you check and the activities you undertake to acquire the information.

The questionnaire comprises of seven sections.

Instructions
The survey consists of statements that describe some activities you undertake to seek information from different sources to provide solutions to problems or to perform tasks.

Please answer the questions by reflecting on the current tasks or projects you are executing and indicate how closely each statement corresponds to the way you seek information to perform the task. No answer is “correct” or “incorrect”, we are only interested in your perceptions. The questionnaire should take approximately 10 minutes to complete.

All information provided will be completely confidential according to the ethical research guidelines of Loughborough University. By submitting this form, you consent to participate in this research and you may withdraw this consent at any time with no explanation.

Should you have any questions or require further clarification about this research study, please feel free to contact the main investigator:

Name: Frank Dzokoto - PhD Student, Mobile: ............... Email: f.k.dzokoto@lboro.ac.uk
Supervisors: Dr. Francis Edum-Fotwe and Dr. Peter Demian - Senior Lectures - Civil and Building Engineering.

Note: If you are not happy with how the research was conducted, please contact Mrs Zoe Stockdale, The University’s Ethics Approvals Sub-Committee: Research Office, Rutland Building, Loughborough University, LE11 3TU. Email: Z.C.Stockdale@lboro.ac.uk

Thank you for your support.
**SECTION A: Information seeking by personal memory/intuition**

The following sections seek to analyse the sources you rely on to seek information to perform a task or solve a problem. Please put a tick (✓) in the box that most closely corresponds to the extent to which you agree or disagree (5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree) with each of the statements:

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
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</thead>
<tbody>
<tr>
<td>1. I rely on my knowledge, experience and skills to create information to</td>
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<tr>
<td>perform a task or provide solutions to problems.</td>
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<tr>
<td>2. I rely on my intuition, memory and mental ability to create information</td>
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<tr>
<td>to perform a task or provide solutions to problems.</td>
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<td>3. In addition to my memory, I occasionally rely on library catalogues,</td>
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<tr>
<td>electronic and print databases to seek information to perform a task or</td>
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<td>provide solutions to problems.</td>
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<td>4. I rely on my intelligence to create information to perform a task or</td>
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<td>provide solutions to problems.</td>
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<td>5. I rely on my perception to create new information to perform a task or</td>
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<td>provide solutions to problems.</td>
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</table>

**SECTION B: A step-by-step information seeking approach**

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</thead>
<tbody>
<tr>
<td>1. I maintain personal information management systems including information</td>
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<td>archiving and recycling in order to reuse information to perform a task or</td>
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<tr>
<td>provide solutions to problems.</td>
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<tr>
<td>2. I create and maintain automatic information capture into folders to support</td>
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<tr>
<td>my information seeking activities.</td>
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<tr>
<td>3. I follow a step-by-step approach to acquire information to perform a task</td>
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<tr>
<td>or provide solutions to problems.</td>
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<tr>
<td>4. I like to capture information from memos, letters, formal meetings, official</td>
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<td>documents, and standardised documents for use on tasks or to provide solutions to problems.</td>
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<tr>
<td>5. I use internal and external information sources such as technical documents,</td>
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<tr>
<td>trade magazines, trade reports, trade journals, company standards, company protocols, specifications, and government documents to seek information for use on a task or provide solutions to problems.</td>
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</table>

**SECTION C: Unplanned or unintentional information seeking approach**

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<tr>
<th>Statement</th>
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</thead>
<tbody>
<tr>
<td>1. I sometimes attend coffee or tea breaks, breakfast clubs, network sessions,</td>
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<tr>
<td>and other casual forms of meetings with the view to seek information for use</td>
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<tr>
<td>on a task or provide solutions to problems.</td>
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<tr>
<td>2. I sometimes attend conferences, seminars, lectures, and other similar events with the view to seek information for use on tasks or provide solutions to problems.</td>
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<tr>
<td>3. I sometimes rely on informal meetings or encounters with the view to seek information to perform a task or provide solutions to problems.</td>
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<td>4. I sometimes capture important information through casual activities (such as discussions with colleagues or friends, browsing, reading, meetings) without any prior intention of seeking that information.</td>
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<tr>
<td>5. I sometimes rely on random and spontaneous opportunities to seek</td>
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</table>
### SECTION D: Information seeking from colleagues and friends

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</thead>
<tbody>
<tr>
<td>1. I like to contact my colleagues and/or friends (either by video conference, phone call, or email) to seek key/specific information to perform a task or provide solutions to problems.</td>
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<tr>
<td>2. I believe that information from colleagues and/or friends with specialist knowledge and skills can be vital to perform a task or provide solutions to problems.</td>
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<tr>
<td>3. I keep a network of colleagues and/or friends with the view to seek specific information to support delivery of tasks or provide solutions to problems.</td>
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<tr>
<td>4. I attend formal meetings including team briefings, stage reviews and/or other forms of meetings with the view to seek information to perform a task or provide solution to problems.</td>
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<tr>
<td>5. I like to meet with colleagues and/or friends face-to-face to ask them specific questions in order to capture relevant information for use on tasks or provide solutions to problems.</td>
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### SECTION E: Information seeking from social media networks/sites

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<tbody>
<tr>
<td>1. I sometimes seek information from social media sites to perform a task or provide solutions to problems.</td>
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<tr>
<td>2. I keep blogs, or follow bloggers, organisations, or groups on social networking sites with the view to capture information to perform a task or provide solutions to problems.</td>
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<tr>
<td>3. I tend to join networks of friends and/or colleagues with similar interests on social media with the view to capture information to perform a task or provide solutions to problems.</td>
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<tr>
<td>4. I tend to follow discussions or activities on social networking sites including LinkedIn, Twitter, blogs, online forums, and/or other social networking sites with the view to capture relevant information to perform a task or provide solutions to problems.</td>
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<tr>
<td>5. My organisation allows employees to follow social media networking sites such as Twitter/bloggers/LinkedIn, or other social media sites to stay abreast with information.</td>
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### SECTION F: Influencing factors on information seeking activities

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<tbody>
<tr>
<td>1. My organisation creates avenues/opportunities to support the way I seek information to perform a task or provide solutions to problems.</td>
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<tr>
<td>2. The way I seek information to perform a task or solve problems is very effective.</td>
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<td>3. The way I seek information for use on tasks or projects is very efficient.</td>
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<td>4. The way my organisation is set-up has direct impact on the way I seek information for use on a task or problem solving.</td>
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<td>5. My team composition or network of colleagues and/or friends has influence on the way I seek information for use on a task or a project.</td>
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</table>
**SECTION G: Significant performance factors**

Please think of a specific, recent task or a problem that you had to acquire information to execute or solve, and indicate by ticking (✓) the box that closely corresponds to the extent to which you agree or disagree (5= Strongly Agree, 4= Agree, 3= Neutral, 2= Disagree, 1= Strongly Disagree) with each of the statements:

<table>
<thead>
<tr>
<th>Significant performance factors</th>
<th>1</th>
<th>2</th>
<th>3</th>
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</thead>
<tbody>
<tr>
<td>1. Overall, I trusted the sources used to capture information to perform the task or solve the problem.</td>
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<td>2. Overall, I found it easy to access information to perform the task or solve the problem.</td>
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<td>3. Overall, the captured information was current and up-to-date.</td>
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<td>4. The captured information was user friendly and fit for purpose.</td>
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<td>5. Overall, the captured information was close to the context of information required for the task or solving the problem.</td>
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<td>6. The captured information was very reliable and consistent.</td>
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<td>7. The context of the captured information was correct for performing the task or solving the problem.</td>
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<td>8. Overall, I was satisfied with the level at which the captured information met the specifications of the tasks.</td>
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<td>9. Overall, the context of the captured information was very influential in the successful delivery of the project or task.</td>
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<td>10. Overall, the context of the captured information was very influential on my performance in delivering the tasks or solving the problem.</td>
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</table>

11. On average, how long did you spend to capture information for use on the project or to perform the task?

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<tr>
<th>Time Range</th>
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</thead>
<tbody>
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<td>22-32 minute</td>
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<td>44-54 minute</td>
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<tr>
<td>55-65 minute</td>
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<td></td>
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<tr>
<td>One day</td>
<td></td>
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<td></td>
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<tr>
<td>one and half days</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Other, please specify:</td>
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</tbody>
</table>

410
SECTION H: Socio-demographic Questions

1. Name of respondent: ____________________________

2. Name of organisation: _____________________________________________

3. Employment sector: Public □ Private □ Other, please specify: _______________

4. Which of the following best describes your professional role?
   Architect □ Building Surveyor □ Civil Engineer □ Facilities Manager □ Project Manager □
   Quantity Surveyor □ Construction Manager □ Services Engineer □ Health & Safety
   Manager □ Design Engineering Manager □ Planning Engineer □ Site Manager □
   Design Manager □ Engineering Manager □ Technologist □
   Other, please specify: ______________________________________

5. Which of the following best describes the conditions in which you work?
   In a team □ On your own □ Freelancer □ Other, please specify: _______________

6. What is the highest level of qualification you have attained?
   A Levels □ University degree □ BTEC □
   NVQ □ HNC □ HND □
   Other, please specify: ______________________________________

7. Which age bracket do you fall into?
   Under 20 years □ 21-30 years □ 31-40 years □ 41-50 years □
   51-60 years □ Over 60 years □

8. How many years of experience do you have in your current position?
   1-3 years □ 4-6 years □ 7-10 years □ 11-15 years □ 16-20 years □
   More than 20 years □ Other, Please specify: _________________________
### Appendix D: Data Analyses

#### Appendix D-1: Kruskal Wallis Test

i. **Kruskal-Wallis test between Associate ISBT and employment sectors**

   **Test Statistics\(^\text{a,b}\)**

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<thead>
<tr>
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<th>Associate</th>
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<td>df</td>
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<td>Asymp. Sig.</td>
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   a. Kruskal Wallis Test  
   b. Grouping Variable: Q11Sector

ii. **Kruskal-Wallis test between Associate ISBT and employment sectors**

   **Test Statistics\(^\text{a,b}\)**

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   a. Kruskal Wallis Test  
   b. Grouping Variable: Q13WorkCondition

iii. **Kruskal-Wallis test between Associate ISBT and professional role**

   **Test Statistics\(^\text{a,b}\)**

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   a. Kruskal Wallis Test  
   b. Grouping Variable: Q12Role

iv. **Kruskal-Wallis test between Social Media ISBT and professional role**

   **Test Statistics\(^\text{a,b}\)**

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   a. Kruskal Wallis Test  
   b. Grouping Variable: Q12Role

v. **Kruskal-Wallis test between Associate ISBT and years of experience**
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a. Kruskal Wallis Test  
b. Grouping Variable: Q16ExpLevel

vi. Kruskal-Wallis test between Cognitive ISBT and years of experience

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a. Kruskal Wallis Test  
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vii. Kruskal-Wallis test between Systematic ISBT and years of experience

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a. Kruskal Wallis Test  
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viii. Kruskal-Wallis test between Social Media ISBT and years of experience

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a. Kruskal Wallis Test  
b. Grouping Variable: Q16ExpLevel
ix. Kruskal-Wallis test between Serendipity/Fortuitous ISBT and years of experience

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a. Kruskal Wallis Test  
b. Grouping Variable: Q16ExpLevel

xi. Kruskal-Wallis test between Social Media ISBT and level of qualification

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a. Kruskal Wallis Test  
b. Grouping Variable: Q14HighQual

x. Kruskal-Wallis test between Associate ISBT and age

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a. Kruskal Wallis Test  
b. Grouping Variable: Q15Age

xi. Kruskal-Wallis test between Cognitive ISBT and age

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a. Kruskal Wallis Test  
b. Grouping Variable: Q15Age
xii. Kruskal-Wallis test between Systematic ISBT and age

**Test Statistics**

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a. Kruskal Wallis Test  
b. Grouping Variable: Q15Age

xiii. Kruskal-Wallis test between Serendipity/Fortuitous ISBT and age

**Test Statistics**

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a. Kruskal Wallis Test  
b. Grouping Variable: Q15Age

xiv. Kruskal-Wallis test between Social Media ISBT and age

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**Appendix E-1 Factor Analysis - Total variance explained**

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<th>Total Variance</th>
<th>Eigen Values</th>
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<td>20.739</td>
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<td>2</td>
<td>32.902</td>
<td>12.163</td>
<td>3.041</td>
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<td>3</td>
<td>40.471</td>
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<td>1.892</td>
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<td>4</td>
<td>47.409</td>
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<td>5</td>
<td>53.389</td>
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<tr>
<td>6</td>
<td>57.937</td>
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<td>1.137</td>
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<tr>
<td>7</td>
<td>62.037</td>
<td>4.146</td>
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Appendix E-2: Quantitative Findings II

Linear model of predictors of information-seeking and information use/task performance behaviour factors of Cognitive ISBT

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<th>S.E.</th>
<th>$\beta$</th>
<th>$\rho$</th>
<th>95.0% CI Lower</th>
<th>95.0% CI Upper</th>
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<tr>
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<td>.355</td>
<td>.003</td>
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<td>.253</td>
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Durbin-Watson 1.774
Linear model of predictors of information seeking and information use/task performance factors of Associate ISBT

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**Durbin-Watson** 1.774
Linear model of predictors of information seeking and information use/task performance behaviour factors of Systematic ISBT

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Linear model of predictors of information seeking and information use/task performance behaviour factors of Serendipity/Fortuitous ISBT

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**Durbin-Watson**: 1.775
Appendix F-1: Matrix Scatter Plot of the Influencing Factors
Systematic ISBT and the Influencing factors
## Associate ISBT and the Influencing Factors

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### Notes

- *Data representation is visualized using a [graph or chart]*
- *Detailed analysis is provided in the document.*

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*422*
Cognitive ISBT and the Influencing factors

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Serendipity/Fortuitous ISBT and the Influencing factors

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Social Media ISBT and the Influencing factors