KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI, GHANA
COLLEGE OF ART AND BUILT ENVIRONMENT
DEPARTMENT OF BUILDING TECHNOLOGY

Development of a Framework for Technology Transfer Partnerships in the Ghanaian Construction Industry

By

ANTWI-AFARI MAXWELL FORDJOUR BSc. (Hons.) Construction Technology and Management

A Thesis Submitted to the Department of Building Technology of the Kwame Nkrumah University of Science and Technology in Partial Fulfillment of the Requirement for the Award of a **MASTER OF PHILOSOPHY (MPhil)** degree in **BUILDING TECHNOLOGY**

SUPERVISOR

Dr. De-Graft Owusu-Manu

MAY, 2015

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DECLARATION

This is to certify that this thesis has not been previously submitted in any form to any University or to any other body whether for the purpose of assessment, publication or for any other purpose. To the best of my knowledge and belief, I confirm that except for any express acknowledgement, reference cited in this thesis, the original work is the result of my efforts. I declare that I wholly undertook this research under supervision and where other scholarly works have been used were duly acknowledged as such.

Signature……..... Date……....

ANTWI-AFARI MAXWELL FORDJOUR
(Student, PG 9130713)

I declare that I have supervised the student in undertaking the research reported herein and I confirm that the student has effected all corrections suggested.

Signature…….. Date……..

DR. DE-GRAFT OWUSU-MANU
(Supervisor)

I confirm that the student has duly effected all corrections suggested by the examiners in conformity of the Department requirements.

Signature……..... Date…….

DR. BERNARD KOFI BAIDEN
(HOD, Department of Building Technology)

ABSTRACT

Technology Transfer (TT) is in the interest of many developing countries for creating the necessary infrastructure which underpin the fundamentals of the construction industry and sustainable economic activity for improving living standards. Globally, technology transfer partnerships

(TTPs) from transferor to transferee firms continue to stimulate rapid industrialization and economic growth particularly in the fast growing developing countries. Numerous researchers and practitioners have reported that developing countries lack the technology and the "know-how" for managing complex and multi-disciplinary construction projects and also there is an absence of appropriate TTPs framework. However, these deficiencies can be overcome by implementing TT initiatives on construction projects in DCs, to enhance the local industry's technical capabilities and knowledge. The aim of this research was to explore TTPs in Ghana, and to develop a conceptual framework for facilitating the flow of technology from transferor to transferee construction firms in Ghana. An extensive literature review was conducted on this subject towards the understanding of TT; and critical review of extant models on TT process. The review was supported with an in-depth exploratory interview to verify the issues identified in the literature and explore new areas which might not have been given expanded view in literature. The results obtained from the literature review and the indepth interview provided the basis of the development of a conceptual framework and questionnaires for the field. Similarly, the conceptual framework on TTPs process was adopted culminating into postulation of nine (9) key TT enablers hypotheses. Philosophically, this study leaned towards the positivism paradigm culminating into the adoption of qualitative and quantitative methods in which a case study interviews and survey questionnaires were administered to respondents involving TT initiatives yielding a response rate of 78 percent. Subsequently, the statistical tools utilized in data analysis include mean score; chi square test of independence; factor analysis; and descriptive analysis. Adopting a wide range of independent variables, the study found out that the independent variables to be significantly reliant on the dependent variables. The key findings of this study led to the development of a conceptual TTPs framework for the Ghanaian construction industry. Theoretically, numerous researchers have attempted to conduct TT models which predominately focused on business and manufacturing sectors. Unfortunately, none of these existing models endeavors to explore TTPs in Ghana and in attempt to fill this knowledge gap, this study developed a conceptual framework for TTPs in Ghanaian construction industry, which captured the relevant factors that influence the effectiveness of the TT process as well as the value added creation. This study contributes to more practical references to reveal the critical factors on successful transfer of technology and knowledge in order to fit in the TT process. The developed framework will aid researchers to better understand the TT process and the pertinent relationships to achieveing value from TT operations. Again, this study provides evidence of use to both engineering and construction professional as well as the economy to solve corporate problems and to guarantee value for inflows from advanced countries by managing projects efficiently. Further studies are recommended to refine and validate the framework using structural equations and methods of benchmarking to strengthened the evaluation of performance of TT process in Ghana.

Keywords: Conceptual, Construction Industry, Enabler, Ghana, Technology Transfer.

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DEDICATION

This Thesis is dedicated to the ALMIGHTY GOD and most especially to my parents Mr. ANTWI-AFARI ATTA AUGUSTINE and MRS. ANTWI-AFARI COMFORT POKUAAH for their unconditional Love, Divine Favor, Support, Guidance and Encouragement for making this programme (MPhil. Building Technology) a success.

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LIST OF ABBREVIATIONS

AEC: Architectural, Engineering Construction

BCF: Building Construction Firms

CM: Comparative Marketing

CSF: Critical Success Factors

DCs: Developing Countries

EPZs: Export Processing Zones

ETT-PLC: Extended Technology Transfer Project Life Cycle

FDI: Foreign Direct Investment

GDP: Gross Domestic Product

GIA: Ghana Institute of Architect

GhIE: Ghana Institute of Engineer

GhIS: Ghana Institute of Surveyors

ICT: Information Communication and Technology

IJVs: International Joint Ventures

JV: Joint venture

KM: Knowledge Management

KMO: Kaiser-Meyer-Olkin

KT: Knowledge Transfer

MNCs: Multination Corporations

MrT: Ministry of Road and Transport

MWH: Ministry of Works and Housing

MWrWH: Ministry of Water Resource, Works and Housing

NGO: Non-Government Organisation

OECD: Organization for Economic Co-operation and Development

PCA: Principal Component Analysis

PLC: Project Life Cycle

PLF: Private Limited Liability Firms

PMI: Project Management Institute

RII: Relative Importance Index

R&D: Research and Development

SMEs: Small and Medium-Sized Enterprises

TA: Technology Acquisition

TT: Technology Transfer

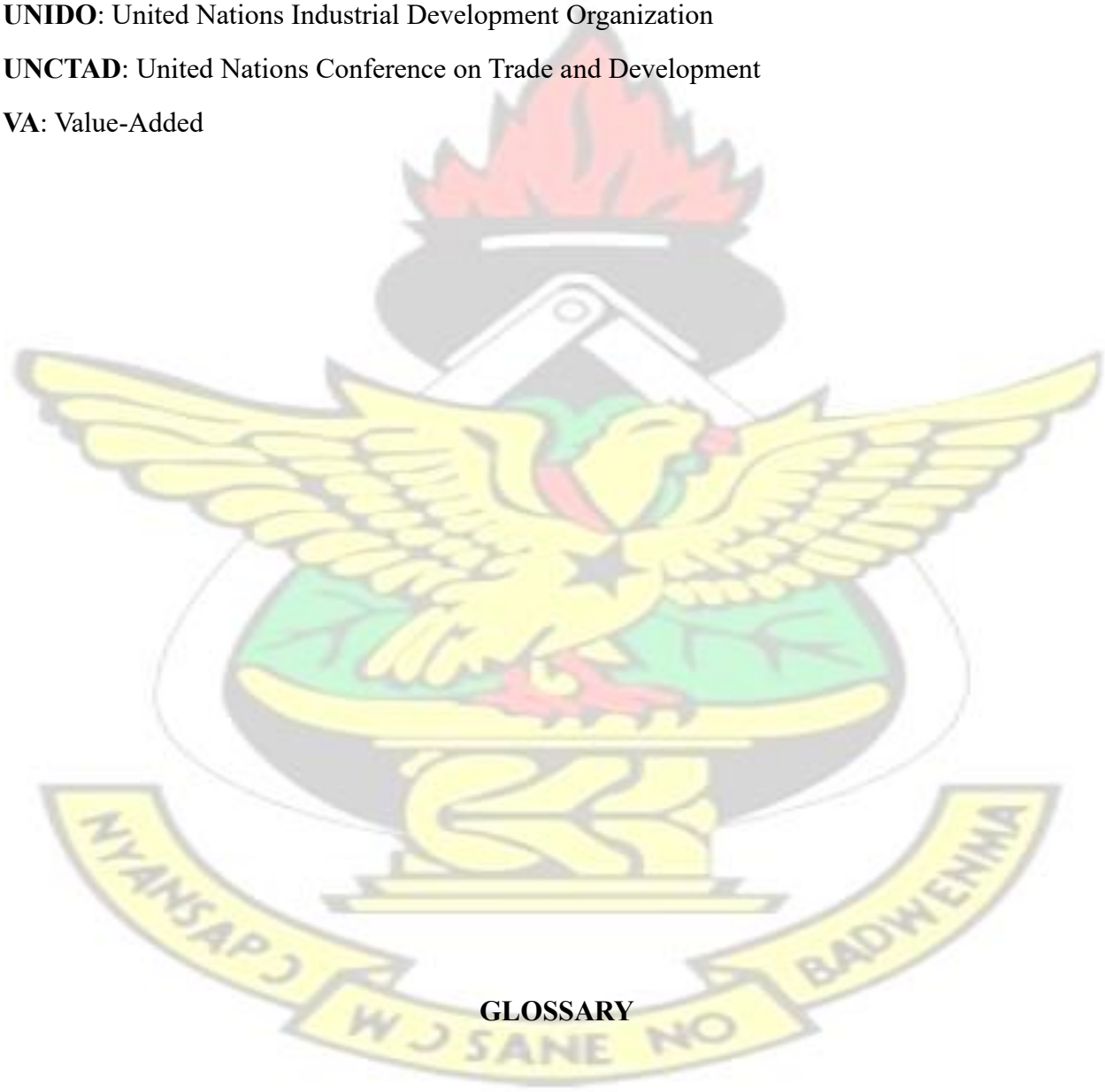
TTP: Technology Transfer Partnership

UK: United Kingdom

UNIDO: United Nations Industrial Development Organization

UNCTAD: United Nations Conference on Trade and Development

VA: Value-Added



GLOSSARY

Absorptive Capacity
Absorptive capacity involves a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends. They assume that a firm's absorptive capacity tend to develop cumulatively and is depend on the absorptive capacity of its individual members.

Construction Technology Transfer
The process of sharing the knowledge of construction industry by all means from one region/country to another, such as project management skills, building procedures, construction materials, and general construction skills for understaff.

Diaspora
A diaspora is an individual who is educated and qualified with latest knowledge and technology of developed country where he/she resides, and sharing a common national and/or ethnic identity. Whereas refugees may or may not ultimately settle in a new geographic location, the term diaspora refers to a permanently displaced and relocated collective.

Explicit Knowledge
Knowledge that has been or can be articulated, codified, and stored in certain media. It can be readily transmitted to others.

Horizontal Transfer
This type of transfer usually occurs among developed countries, in which only technology such as tools, instruments, methods, etc., is transferred since the knowledge already exist in the transferee country.

Knowledge
Knowledge is understood as the qualifications and skills necessary to produce technology. It involves expertise and skills acquired by a person through experience or education (the theoretical or practical understanding of a subject). It also refers to the sum of what is currently known in a particular field (facts and information). Moreover, it also refers to the awareness or familiarity gained by experience of a fact or situation.

Knowledge Management
This comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable the adoption of insights and experiences.

Research and Development
According to the Organization for Economic Co-operation and Development (OECD), it refers to "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications".

Tacit Knowledge
As opposed to explicit knowledge which is not easily shared, and consists often of habits and culture that we do not recognize in ourselves. In the field of knowledge management, the concept of tacit knowledge refers to a knowledge which is only known by an individual and that is difficult to communicate to the rest of an organization.

Technology
Technology is the application of knowledge embedded in a product. It can also refer to the application of scientific discoveries and inventions, which can be achieved through scientific research.

Technology Transfer
The process of sharing skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments and other institutions (e.g. Companies, research centres, universities) to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services.

Technology Transfer Projects
Projects whereby advanced technology is transferred from developed to developing countries.

Transferor
Refers to international companies having skills and the latest technologies that wish to further transfer and deliver construction projects in developing countries.

Transferee
Refers to public and private local companies in developing countries that need to improve their poor construction capabilities.

Transfer Mode
The means or vehicle, whereby knowledge or technology can be transferred, e.g. A joint venture contract.

Transferred Technology
This is target technology (in this study for example, precast technology) to be transferred within the TT process.

Vertical Transfer
This type of transfer usually occurs from developed to developing countries, in which both knowledge (explicit, tacit, and know-how skills) and technology are transferred.

CHAPTER ONE

GENERAL INTRODUCTION TO THE RESEARCH

1.1 INTRODUCTION

The purpose of this chapter is to present a broad survey of this thesis which emphasizes on research in terms of the background of the study and its perspective to Ghanaian Construction industry. Issues with regard to the statement of the research problem, the aim of the research and objectives of the study were also exclusively dealt with in this chapter. This is subsequently followed by the research questions, scope, and justification of the research, methodology adopted and finally the organization of the research.

1.2 BACKGROUND OF STUDY

The construction industry is complex involving a number of discrete transactions usually undertaken on an ad hoc, one-off geographically specific basis (Winch, 1998). The contribution of the construction industry to sustainable economic growth and development of a nation is very significant (Musa, *et al.,* 2010; Moavenzadeh & Rossow, 1976). Apart from the fact that the construction industry plays a major contribution to Gross Domestic Product (GDP) and employment creation (Danso *et al.,* 2011), it also provides the basic infrastructure needed to accommodate the inputs of all other sectors of the economy (Danso *et al.,* 2011; Oforeh, 2006; Babalola, 2006). Global trends have revealed that GDP contribution of the construction industry has been very consistent recording on the average annual growth of 8.2% to the economy of Ghana (Owusu-Manu & Badu, 2011) and between 8-10% in the UK and other developed economies (Crosthwaite, 2000).

Pioneer research by Mansfield (1975) pointed out that, "One of the fundamental processes that influence the economic performance of nations and firms is technology transfer". The performance of firm capabilities to assimilate, adapt, modify, and generate technology cannot be done only by importing technologies from foreign countries but also through advanced man power and management training, domestic production of materials, tools and equipment, and individual innovation focused on construction industry (Ganesan & Kelsy, 2006).

In the initial stages of the industrialization of virtually all developing countries, capital and technology (production and managerial technology) are scarce (Dunning, 1983). A promising means of promoting economic development to overcome these bottlenecks is attracting foreign direct investment (FDI). Apart from its direct effects in terms of the expansion of domestic output, capital formation, employment, and export, FDI can bring about indirect benefits through technology transfer and diffusion, skills upgrades and the development of local ancillary industries through the creation of backward linkages (Blomström & Kokko, 1999; Markusen & Venables, 1999; Borensztein *et al.,* 1995; Dunning, 1993).

Moreover, progressive global competition, driven by trade liberalization, deregulation of trade and investment, and the revolution of information and communication technology (IT), have changed global competition by making it more dynamic (Ernst & Kim, 2002). These changes have prompted multinational firms to view their global production as a network rather than as "stand-alone overseas investment projects" (Ernst & Kim, 2002). This trend is expected to proliferate, and the host countries of FDI stand ready to adapt appropriately to benefit from such changes.

Conversely, Mayer & Blaas (2002) point out that, in recent decades, Small Medium Enterprises (SMEs) have begun to utilize technology transfer as a strategic means of meeting challenges posed by the globalization of business. However, the existing literature has focused on the issue of international technology transfer through formal and voluntary forms such, as intra-firm technology and arm's-length trade of technology (Cui *et al.,* 2006; Chung, 2001; Ofer & Potterovich, 2000; Bhagat & Kedia, 1988; Chen, 1996; Hofstede, 1994; Reddy & Zhao, 1990). Again, Szulanski's (1996) investigation into why intra-firm knowledge transfers can be so difficult points to issues such as: lack of motivation; lack of absorptive capacity; lack of retentive capacity of recipients; formalized structures and systems; lack of numerous individual exchanges; and an arduous (i.e. laborious and distant) relationship between the transfer partners.

However, very few studies have investigated the dynamic process of technology transfer and technological capability-formation in developing countries (Cyhn, 2002; Kim, 1997), and even they have not focused directly on technology transfer through informal mechanisms, such as the incidence of 'inter-firm' technology transfers. Moreover, inter-firm technology transfer is evolving; thus, it is necessary to investigate to what extent these strategies affect the content of inter-firm technology transfer, how local firms adapt to these changing environments and how they utilize inter-firm relationship with assemblers as a means to develop their own technological capabilities (Ernst & Kim, 2002). Research on inter-firm technology transfer is scarce and there are few studies that set out to explain the process of technological capability formation (Ernst & Kim, 2002). This need has created a new niche-market for technology transfer (Morrissey & Almonacid, 2005). It is against this background that this study will attempt to exploit some of the issues pointed out by previous research and focus on newer areas that remained unexplored.

1.3 PROBLEM STATEMENT

Kim (1997) report affirmed that firms in developing economies can develop their technological capability by many means. They can develop the technology through their own efforts, through a systematic research and development program; they can learn technology from other firms; they can accumulate it through experience (learning by doing). However, from the early stages of economic development, technology transfer from foreign countries seems to have been the most important channel for technology acquisition (Cyhn, 2002).

Again, the growing body of literature suggests that enormous study on technology transfer has been offered, but many of them focused only at intra-firm level, (Lin, 2003; Yamashita, 1998; Ramachandran, 1993). It is evident that the involvement of foreign construction firms within a construction market of a certain country, improves capacity of construction industry of that host country (Ofori & Lean, 2001). When foreign contractors are invited, host country expects technology transfer to the local construction industry through their involvement which encourages the flow of new technology to the local industry to upgrade the capabilities of local contractors (Ofori & Lean, 2001).

Technology transfer may be classified into three main types, according to the characteristics of the firm relationship between the source and the recipient. They are: 'arms'-length trade of technology; intra-firm technology transfer; and inter-firm technology transfer (Capannelli, 1997). However, the literature has thus far paid greater attention to the first two channels in term of upgrading the technological capabilities of developing countries (Reddy & Zhao, 1990).

However, inter-firm technology transfer is evolving; thus, it is necessary to investigate to what extent these strategies affect the content of inter-firm technology transfer, how local firms adapt to these changing environments and how they utilize inter-firm relationship with assemblers as a means to develop their own technological capabilities (Ernst & Kim, 2002). Research on interfirm technology transfer is scarce and there are few studies that set out to explain the process of technological capability formation (Ernst & Kim, 2002). Godkin (1988) provided a comprehensive list of problem areas associated with inter-firm technology transfer and these problems still persist with rapidly changing technological and business trends new problems have emerged.

Accordingly, to explore this issue thoroughly, there is a huge research gap in the development of a framework of technology transfer partnerships in respect to inter-firm perspective. This research intended to investigate how local construction firms can benefit from the operations of their foreign counterparts, in developing their human resource capabilities and their physical facilities. Also, work on construction partnership has not considered in details the effective operation of such firms in such a way as to be channels for transferring technology to local contractors in developing countries. This has created an empirical research gap in Ghana and such knowledge is important because it could offer deeper insight about the construction industry in Ghana in terms of economic, knowledge advancement and project performance. As a result of the problems identified in technology transfer partnerships, it has become apparent to perform an empirical study into the criteria of developing a framework for technology transfer partnerships in Ghana.

1.4 AIM AND RESEARCH OBJECTIVES

This section addresses the research aim and research objectives of the study.

1.4.1 Research Aim

The aim of this research is to explore technology transfer partnerships in Ghana, and to develop a conceptual framework for facilitating the flow of technology from transferor to transferee in construction firms in Ghana.

1.4.2 Research Objectives

To endeavor to accomplish the above stated aim, the following specific objectives were established:

1. To conduct literature survey to establish critical technology transfer typologies pertinent to the construction industry;

2. To establish the channels of transfer of technology from transferor to transferee construction firms in Ghana;

3. To explore the underlying risk factor confronting technology transfer partnerships applicable to the construction industry;

4. To establish the underpinning success factors inherent in technology partnerships; and

5. To develop a conceptual framework for facilitating technology transfer partnerships from foreign to local construction firms in Ghana.

1.5 RESEARCH QUESTIONS

The following research questions are articulated based on identified knowledge gap to fulfill the stated aim and objectives of the study.

1. What are the critical technology transfer typologies pertinent to the construction industry?
2. What are the channels for the transfer of technology from foreign to local construction firms in Ghana?
3. What are the underlying risk factor confronting technology transfer partnerships applicable to the construction industry?
4. What are the underpinning success factors inherent in technology transfer partnerships?
5. What are the key factors inhibiting the absorption of technology transfer and how to incorporate a conceptual framework to facilitate the flow of technology?

1.6 SCOPE OF STUDY

Geographically, the scope of the study was restricted to selected construction companies in Accra Metropolis, the capital of Ghana. This is because majority of contractors primarily operated in Accra. Also, given that economic growth is largely skewed towards the capital, more than 60% of the registered building contractors tend to operate officially in the Greater Accra region (Ahadzie, 2007; Ayisi, 2000). Hence, it is expected that the data to be obtained from the study gave a broader perspective of technology transfer partnerships in the construction industry. The infusion of publicly funded project and large private participants is purposeful, as this helped gathered enough empirical data on both categories of stakeholders in the construction industry to determine potential innovative technology transfer partnerships of infrastructure projects delivery in Ghana. The target respondents in this research included the Ghanaian construction sector and its associated professionals participating in TT programs. The number of construction projects involving TT

were obtained purposefully. This research focused only on the perceptions of transferees (Ghanaian) since TT initiatives were undertaken for improving the technology knowledge of local professionals. The selection criteria for the projects investigated were as follows: local firm involvement; technology acquisition objective explicitly or implicitly expressed by clients; and projects completed recently or currently under construction.

1.7 RESEARCH METHODOLOGY

In order to conduct a thorough and a robust research, the aim and objectives of the research were addressed by adopting the appropriate research philosophy to aid the collection of appropriate data and subsequently the analysis and interpretation of the findings. The research methodology adopted in this study was the mixed approach (qualitative and quantitative research) and consisted of extant literature which was elaborated based on the objectives of the research. The extant literature review helped to discover the academic paradigms supporting the subject area and to identify the channels to the flow of technology transfer partnerships. This helped identify innovative technology transfer mechanisms that enhanced delivery of infrastructure projects in Ghana and facilitate the conceptualization and contextualization of the study. The review was on credible and scientific data from the existing literature through journals, conference papers, publications of corporate bodies and textbooks. The quantitative research applied to both the fieldwork and desk study. This approach is also generated rich, detailed and valid data that contributed to in-depth understanding of the context of the research area (Fugar, 2008).

The review was supported by in-depth exploratory interviews to verify the typologies and enablers of TT identified in the literature and explored new areas which might not have been given expanded

view in literature. Triangulation involving qualitative and quantitative research strategies were adopted to elicit the relevant data from the research participants. The qualitative aspect of the study dealt with the exploratory interviews which helped in the identification of typologies, channel and enablers of TT in the Ghanaian context. Subsequently, a selfadministered structured survey questionnaire was conducted to collect primary data from the field. The questionnaires included the Likert scale rating of technology transfer mechanisms of infrastructure projects to allow easy categorization and synthesis. The results obtained from the literature review and in-depth interviews provided the framework and the basis for the development of the questionnaire. The statistical Packages for Social Sciences (SPSS version 16) and Microsoft Excel were used for the analysis of the raw data. Non-parametric statistical method involving chi-square (x^2) testing was adopted in analyzing the data. The chi-square (x^2) method was adopted because it was anticipated that the kinds of data to be derived from the survey were likely to be mostly nominal and ordinal data. The method was also adopted in testing the findings because of inadequate knowledge of the nature of the distribution of the population. To further analyze interrelationships among the large number of the strategic issues identified and to explain these issues in terms of their common underlying dimensions, factor analysis was employed.

1.8 JUSTIFICATION OF RESEARCH

Bleek & Ernst (1995) have pointed out that on a global scale, the volume of partnership activities have increased at a rate of 25 per cent per annum during the first half of 1990s. The popularity of partnerships as a method of building up new sources of competitive advantage has resulted in the

involvement of companies from many different countries collaborating together in various diverse settings. The diverse settings brought about by partnerships create unique knowledge sharing and learning opportunities for the partner firms (Naphiet & Ghoshal, 2005; Inkpen, 1998). This is confirmed by Harrigan (1986) who suggests that partnerships have been important in international business since 1975, particularly in technology intensive industries such as construction, computers, manufacturing and commercial businesses. In recently decades, Grant & Baden-Fuller (2004) have noted the increasing partnerships activity is a global trend that promotes collaboration between independent companies.

Szulanski (1996) established empirically that there are three major barriers to knowledge transfer within a firm: knowledge ambiguity, lack of absorptive capacity on behalf of the recipient and arduousness of relationship between the source and recipient of knowledge. Acquisition researchers acknowledge that all of these barriers may be present in the acquisition context (Bjorkman *et al.,* 2007; Schoenberg, 2001; Bresman *et al.,* 1999), yet no comprehensive study of their relevance has been conducted.

This study is the first attempt in Ghana to explore technology transfer partnership in Ghana and to develop a framework to facilitate the flow of technology from foreign to local construction firms in Ghana. This study enabled the researcher to bridge the knowledge gap in understanding the success and risk factors of technology transfer partnerships in the construction industry. As a pioneering research, the study formed the basis to spur further researches in the area of technology transfer partnerships.

Finally, the justification for this research as far as the academia is concerned lies in the fact that the literature review served as a knowledge gathering exercise on technology transfer partnerships which are scattered in different writings in to one solid body for the development of the construction industry which enhanced teaching and learning as far as lecturers and students are concerned in universities and polytechnics. This research also provided results that was relevance to academia and motivate others to delve deeper in terms of this subject area.

1.9 ORGANISATION OF RESEARCH

The structure of the dissertation was divided into ***six (6)*** independent interrelated chapters, in the following outline: ***Chapter one***, titled "General Introduction to the Research", presented the background to the research and states the problem warranting this research. The research questions, research aim, objectives, and scope are all contained in this chapter. ***Chapter two*** dealt with the phenomenon of TT which covered the channels, risks and success factors of TT in the Ghanaian construction context. ***Chapter three*** provided detailed discussion on conceptual framework which led to the construction of cogent hypotheses for the research. The dependent variables used are the enablers of TT which consisted of the Transfer Environment; Learning Environment; Transferor Characteristic; Transferee Characteristics; and the value-added creation factors (Project performance; Economic performance and Knowledge advancement).

Again, ***chapter four***; the research methodology described the research philosophy, sample population, sample size determination, sampling technique questionnaire design and administration. Detailed discussions was provided on the data collection analytical tools that would employed. Philosophically, the position of the research ontologically was objectivism. It is clear

that the core issues that significantly affect the partnerships of construction firms are real that the core issues that significantly affect the partnerships of construction firms are real and not the inventions of the researcher. Epistemologically, the research involved the scientific identification and analysis of all the core issues that affect the partnerships of construction firms in Ghana. In keeping with this epistemological philosophy, which is scientific in nature, the research can be replicated. From the axiological position of the research, the values and perceptions of the researcher played no role in the recognition of facts and their subsequent interpretations to be made in developing a conceptual framework for technology transfer partnerships in Ghana.

The statistical tools used for the analysis include: relative importance index, factor analysis (Principal component analysis), descriptive statistics consisting of the mean and standard deviation, the chi-square (x^2) test for significance. ***Chapter five*** presented the empirical analysis of data and discussions from the field survey that answered all the research objectives and questions. ***Chapter six*** was labelled "Conclusion and Recommendations" wraped up the entire research endeavor by reviewing the main contributions of the research to knowledge. Policy recommendations and limitations of the study was outlined. Indicators to future research directions was also be clearly defined. The simplified version of the conceptual framework of the research process for the study has been demonstrated in ***figure 1.1*** below.

Chapter One	**General Introduction**: Background, Problem Statement, Aim, Objectives, Justification, Scope, Methodology and Organization of study.
Chapter Two	**The Phenomenon of technology transfer**: Definitions, channels, risks factors and success factors of technology transfer partnerships.

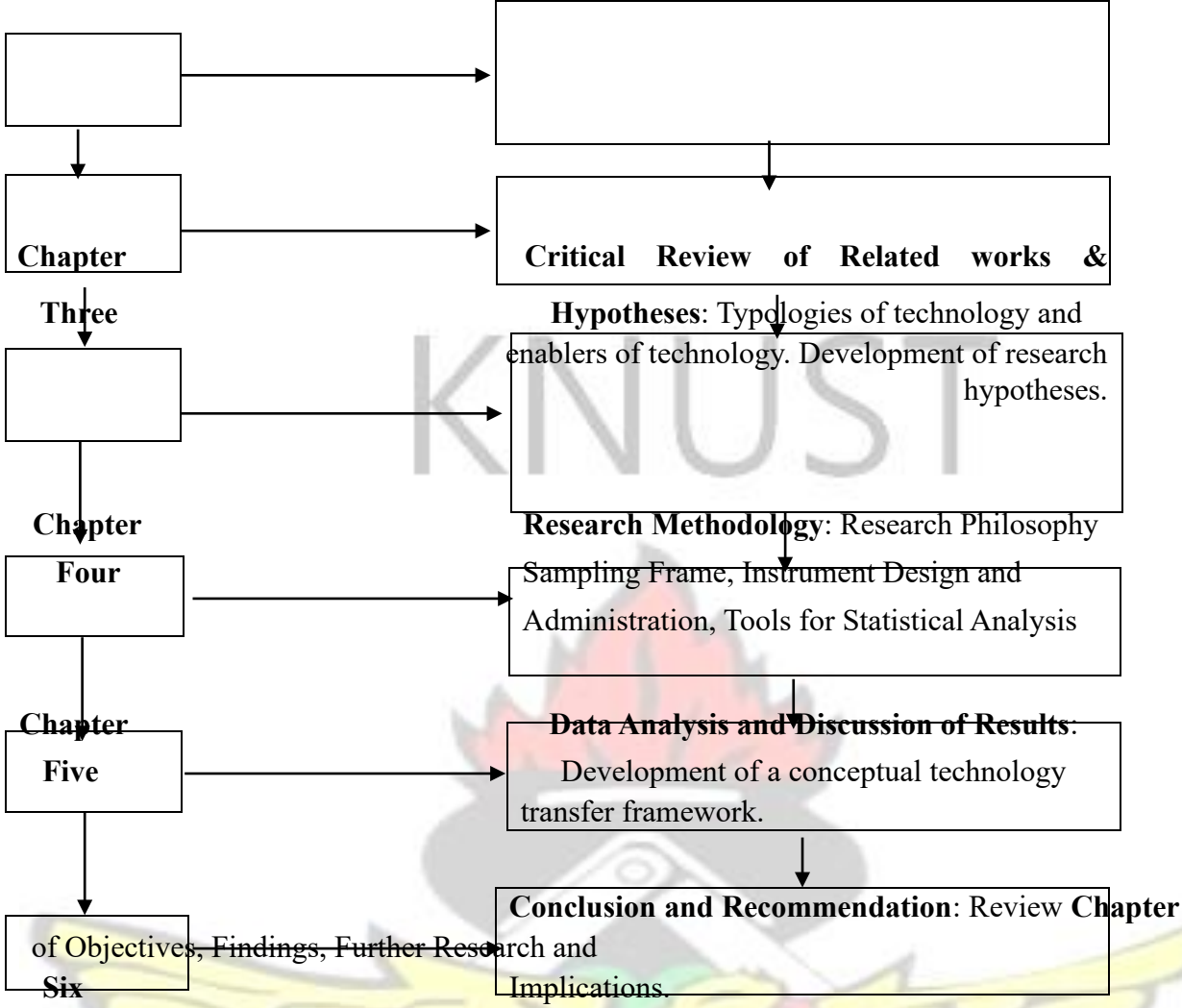


Figure 1.1: Conceptual framework of the Research Organization
Source: Authors' Construct (2015)

1.10 CHAPTER SUMMARY

As indicated in the preceding section, this chapter discussed the general introduction to the research. In addition, the background and the problem statement of this research were presented. The chapter also introduced the research aim, objectives, research questions, and the scope of the research. In other to achieve the aim of the study, the research objectives were established and a summary of the methodology adopted for the study was presented in the chapter. Chapter one concluded with discussions on the justification of the study and the organization of the research.

CHAPTER TWO

TOWARDS THE UNDERSTANDING OF TECHNOLOGY TRANSFER

2.1 INTRODUCTION

This chapter aims to introduce the concept and theory of the TT process and identify its typologies, fundamental characteristics and anatomy. It will discuss the realm of TT in terms of the origin of TT as a paradigm. This chapter starts by the conceptual definitions of technology and TT; a general overview of the Ghanaian construction industry; conceptual dimensions of TTPs; and finally, the review focuses on the risks and success factors facilitating TT.

2.2 CONCEPTUAL EXPLANATION OF TECHNOLOGY

According to Kumar et *al.* (1999), technology consists of two primary components: a physical component which comprises of items such as products, tooling, equipment, blueprints, techniques, and processes; and the informational component which consists of know-how in management, marketing, production, quality control, reliability, skilled labor and functional areas. This suggests the perceptions regarding the nature of technology and the difficulty of finding an all-embracing definition. UNCTAD (1985) claimed it as "systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service." Similarly, Tatum (1988) see construction technology as the combination of construction methods, construction resources, work tasks, and project influences that define the manner of performing a construction operation.

2.3 CONCEPTUAL EXPLANATION OF TECHNOLOGY TRANSFER

The concepts of the TT have been discussed in many different ways based on the disciplines of research and according to the purposes of the research (Bozeman, 2000). Gibson & Smilor (1991)

opined TT is often a chaotic, disorderly process involving groups and individuals who may hold different views about the value that technology. TT is a complex, difficult process even when it occurs across different functions within a single product division of a single company (Zaltman *et al*., 1973; Kidder, 1981; Smith & Alexander, 1988). TT is commonly acknowledged to be a complex process that needs time to evolve (Agmon & von Glinow, 1981). TT is a crucial and dynamic factor in social and economic development. Abbot (1985) claimed TT as "the movement of the science from one group to another, such movement involving its use". Simkoko (1989) affirmed that TT for construction industry as "the planned conveyance and acquisition of technical knowledge and techniques of construction firms". This implies that there is no true TT until the technical knowledge received from the donor has been put into effective use.

2.4 GENERAL OVERVIEW OF THE GHANAIAN CONSTRUCTION INDUSTRY

The Government of Ghana (GoG), as in many countries is the major underwriter of the construction industry and exercises its control through two construction ministries (Eyiah & Cook, 2003). The Ministry of Water Resources, Works and Housing (MWrWH) formerly

Ministry of Works and Housing (MWH) is responsible for housing infrastructure whilst the Ministry of Transportation (MoT) formerly Ministry of Road and Transport (MrT) is responsible for roads and civil related infrastructure (Ghana Highway Authority, 2004). The Ghanaian building construction firms comprises a large number of enterprises of various sizes as registered and categorized by the MWrWH as D1K1,D2K2,D3K3,D4K4. Based on factors such as annual turnover, equipment holding, personnel, the D1K1 class of contractors are termed as larger firms, whereas D2K2 construction firms are medium and D3K3 and D4K4 are small firms (Edmonds *et al*., 1984). The larger firms, according to MWrWH are registered as financial class 1,capable of undertaking projects up to US$500,000 or GH¢750,000.00, while the small firms (financial class

3) are also capable of undertaking projects up to US$200,000 or GH¢300,00.00 or class 4 to undertake projects up to US$75,000 or GH¢112,500.00.

2.5 CONCEPTUAL DIMENSIONS OF THE TECHNOLOGY TRANSFER PARTNERSHIPS (TTPs)

Turin (1973) identified in his matrix of construction industries in developing countries, "international-large" projects which are large and complex. Edmonds & Miles (1984) and the World Bank (1984) are among authors who have observed that "international" or "foreign" contractors among large construction firms in developing countries. Turin (1973) and Drewer (1980) advised developing nations to use their construction work to support the growth and development of their indigenous contractors so that they can replace the foreign firms. On the other hand, Moavezadeh & Hagopian (1984) argued to the fact that the dominant position of the foreign companies and urged developing countries to use foreign firms on a long-term basis to undertake the large and complex projects. Abbott (1985) studied the TT potential of the operations of foreign contractors in developing countries. Moavenzadeh & Hagopian (1984) see foreign contractors as the sole factor influencing the development of the construction industries. Similarly, Raftery *et al.* (1998) suggested that in the long term, the gap between local construction firms and their foreign counterparts in technology, finance and management knowhow, could be filled through TT, for example, via joint ventures among the two groups of firms.

2.6 THEORY OF TECHNOLOGY TRANSFER

The philosophy and theories that can be identified behind TT are the process of transferring explicit or tacit knowledge (Li-Hua, 2000; Nonaka & Takeuchi, 1995), as well as technologies transferred from one place to another by various means, e.g. imitation, socialization (Nonaka &

Takeuchi, 1995). TT evolved as a practice before it became recognized as a profession. Therefore, there is as yet no agreement regarding an overarching definition that includes all of the elements and processes involved between technological innovation and product production (Lane, 2003). To clarify the TT theory in more detail, the next three subsections will demonstrate the main typologies of technology, and the fundamental characteristics of TT operations.

2.6.1 Technology Typologies

Zeleny (1986) points out that the technology consists of three interdependent, co-determined and equally important components: hardware-the physical structure and logical layout of the equipment or machinery that is to be used to carry out the required tasks; software-the knowledge of how to use the hardware in order to carry out the required tasks; and brain warethe reasons for using the technology in a particular way. A further extension of the understanding of technology components is given by Sharif, (1994), Ramanathan (1994), Sharif & Ramanathan (1995), The Technology Atlas Team (1987) and the Asian and Pacific Center for Transfer of Technology (1989). They state that technology consists of four interrelated and interacting components which are (1) object-embodied form or "Techno ware"; (2) human-embodied form or "Human ware; (3) document or record-embodied form of "Info ware"; and (4) institutionembodied form or "Orgaware".

2.6.1.1 Techno ware

Techno ware is object embodied physical facilities. It comprises a material transformation subsystem and an information processing subsystem (Zeleny, 1986). The material transformation subsystem performs desired mechanical operations that the techno ware has been designed to perform. Techno ware amplifies human powers and controls for transformation operations. In a

business enterprise, techno ware changes through a process of periodic substitution of old by new (Ramanathan, 1994). In general, the degree of techno ware sophistication corresponds to the increasing complexity of the physical facilities for transformation operations and other functions such as scale of operations, interrelationships among operations, types of conversions, energy requirements, quality of outputs, safety and environmental soundness of operations etc (Ramanathan, 1994). For example, an information-processing subsystem carries out a three stage control sequence namely, sensing-analysis-actuation. The information processing subsystem may be completely or partially built into the techno ware (Sharif & Ramanathan, 1995).

2.6.1.2 Human ware

Human ware is the person embodied human abilities. It consists of skills, craftsmanship, expertise, and creativity. It is needed to realize the potential of techno ware and consists of "contact human ware" and "support human ware" (Sharif, 1994). Human ware changes through a process of progressive learning of new things. Usually level of competence of all individuals engaged by the organization. The competencies are in terms of skill level (derived from general education and specific training), appropriateness of training, achievement orientation, extent of relevant experience, productivity orientation, creativity potential and the motivation of the personnel (Sharif, 1994). Human ware sophistication is important to understand the technology properly and utilize in proper need. It includes ability to comprehend and use work-specific technology components, ability to mobilize setup and utilize technology components for work, ability to optimize use of available technology components for all tasks (Sharif, 1994).

2.6.1.3 Info ware

Info ware is record embodied documented knowledge. These are facts and formulae, design parameters, specifications, manuals, theories etc. It represents the accumulated knowledge needed to realize the full potential of the techno ware, human ware and orga ware (Sharif, 1994). Sharif (1994) describes the utility as nature and type of knowledge (relevance, timeless and reliability of facts and figures), ease of retrieval of stored knowledge, extent of networking for updating, etc. The degree of info ware sophistication includes documented knowledge that provides awareness regarding technology components, manuals for the operation and maintenance of physical facilities, availability of facts and figures for acquisition and optimal performance, and access to the latest theories of techno ware, human ware and info ware and state-of –art knowledge for innovation (Sharif, 1994).

2.6.1.4 Orga ware

Orga ware is institution embodied organizational frameworks (Sharif, 1994). They are methods, techniques, organizational networks, and management practices. It changes through a process of evolving arrangements and practices. Orga ware sophistication is needed for additional increase of value, an increase of new management techniques, methods and relationships for the market competitiveness and self-reliance of the enterprise (Ramanathan, 1994). Orga ware sophistication includes tradition based work organization techniques and methods, education and experience based work facilitation techniques, systems analysis and operations research based optimization techniques and information technology based re-engineering and innovation techniques, and community based indigenous knowledge. It includes all the tacit knowledge embedded in the organization (Nonaka, 1994a). The critical need for the development of appropriate orga ware to make the best of advanced techno ware and meet the challenges of dynamic market conditions has

been the theme behind many authors such as those by Jaikumar (1986), Hayes & Jaikumar (1988), Cusumano (1988), Kanter (1989), Schmenner (1988) and Hill (1992). It should be emphasized that the four components are interrelated and influence each other. While the human ware is the center of all these activities, the orga ware is the environment that allows for all components to come together. The info ware can facilitate the process or its lack can slow it down.We can see the interrelationship and dependency of the four components of the technology in ***Figure 2.1***

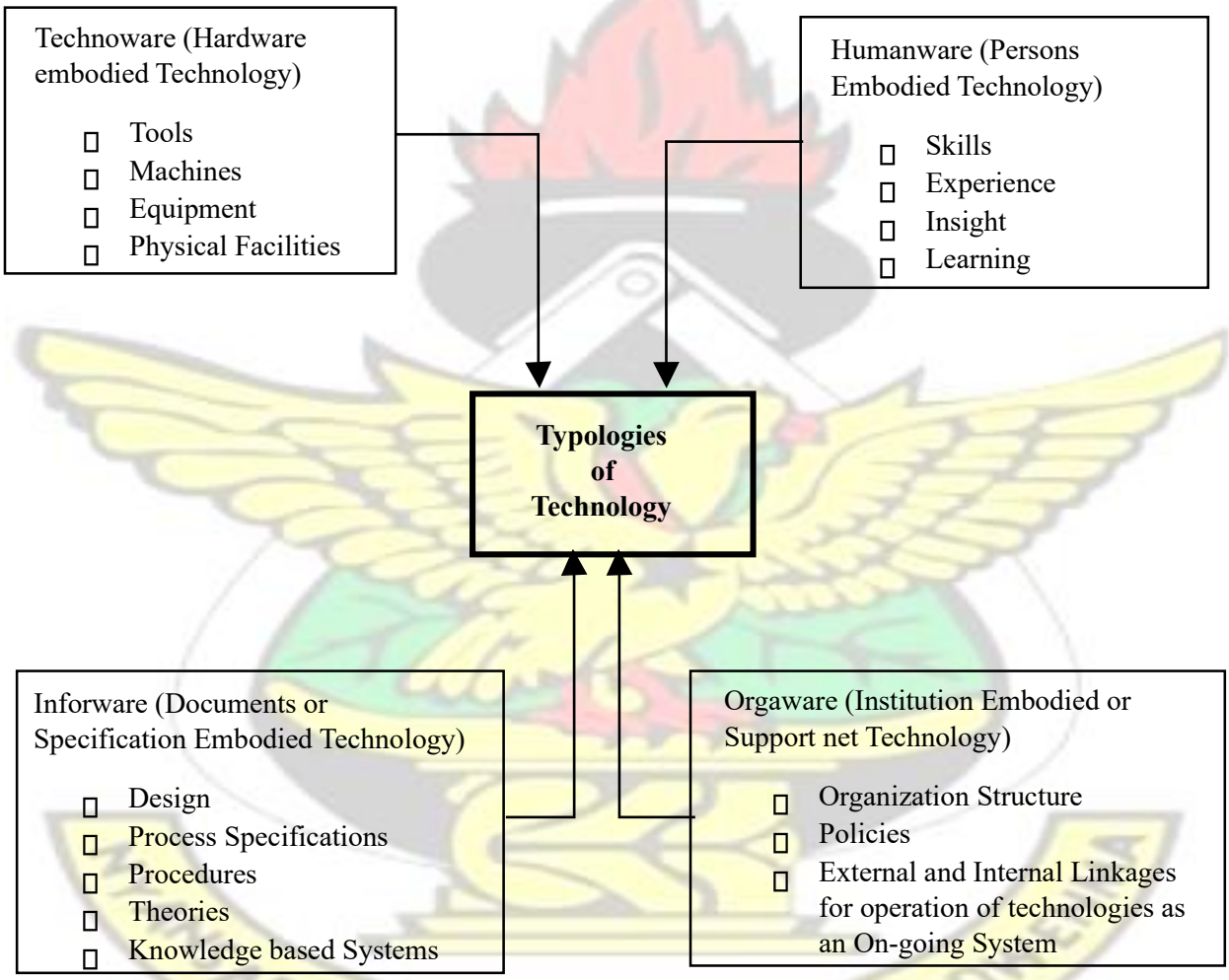


Figure 2.1: Relationships of technology typologies Source: Adapted from Huria, (2000)

2.7 THE TECHNOLOGY TRANSFER PROCESS

The TT process involves two basic models: the direct and indirect transfer models (UNCTAD,

1991). Others have referred to these as “unbundled” and “bundled” methods, respectively (Etele, 1985; Bhagwati, 1983). A multinational company will use any of the two methods depending upon the issues discussed in the subsequent section.

2.7.1 The Direct Transfer Method

In the direct transfer mode the recipient enterprise engages a number of separate transferor of technology to transfer it directly with the various elements of technical knowledge it needs. The transfer could be of individual technological elements or a combination of elements. An essential feature in the direct transfer method is the independence of the two parties in the transaction. The technology supplier and receiver are generally independent, non-affiliated enterprises. Another feature is the strictly legal contract of transaction. The transfer of technology takes a place under contractual agreement stating clearly the rights and obligations of the contracting parties.

2.7.1.1 Licensing Agreement

“Under a licensing agreement, a firm allows another company to use its brand name, trademark, technology, patent, copyrights, or other expertise” (Griffin, 1990, pp. 794). This agreement involves one company (the licensor) which possess intellectual property rights, e.g. technology, brand name, etc. allows another company (the licensee) to use or sell these rights in return for a financial reward (royalties). The licensee in this case agrees to operate under specified conditions in addition to the payment of fees and royalties. The fees and royalties are usually based on a percentage of sales or value-added (Bhagwati, 1983). Licensing relationships can be between independent business enterprises, parent companies, and wholly or partially owned subsidiaries, and joint ventures between private and/or public firms. According to Larson and Anderson (1994), “Licensing arrangements are generally associated with a greater degree of local, post transfer

innovation as compared to other forms of transfer" (pp. 548). As Third World countries gain in domestic technological capability, they are turning increasingly to licensing arrangements as a method of furthering domestic innovation. Charges made for technology transfered under a license agreement are referred to as fees. These are all rate charges upon either "gross" or "net" sales of the licensee. The rates charged in each case are set during negotiation for the transfer of technology. The rate set is generally a function of the relative bargaining powers of the contracting parties as determined by the technology supply demand relationship in the market (Bhagwati, 1983).

2.7.1.2 Machinery Supply Contract

The supply of goods, especially capital goods such as machinery and spare parts, has been a traditional way of transferring technology to developing countries. Many types of plant and equipment, hand-tools, transportation and communication devices and even consumer goods which the multinational company supplies in developing countries embody technologies which purchasers learn to use (Sirgurdson, 1990). Even simple equipment carries with it the design, composition of material used to produce it and, to a limited extent, the production method.The multinational company finds this method of transfer convenient and simple. In the first place, the company's risks are low as the payment for machinery is guaranteed (Sirgurdson, 1990). Secondly, its involvement in transmitting the embodied technology is restricted to the manuals of instruction accompanying the machinery except where a separate or an all-embracing contract which includes the provision of technical assistance is generally the prevalent one (Sirgurdson, 1990). The multinational company provides technicians to install the machinery and test-run it for the purchasers. Furthermore, technology embodied in machinery is just one aspect of technology required for productive activity. It follows, therefore, that the success of this method of transfer depends upon the availability of other complementary know-how (Sirgurdson, 1990).

2.7.1.3 Franchising

Franchising is a variation on licensing, which in certain is an improvement on the latter as it involves an ongoing relationship between the franchiser and the franchisee (Ramanathan, 1995). Whereas the pure form of licensing involves a one off-sale of intellectual property rights by the licensor to the licensee and subsequent loss of control by the former on the quality of the goods produced by the latter under license, franchising may involve many activities ranging from training of the staff of the franchisee to control over operations engaged in by the latter under the franchise agreement (Ramanathan, 1995). Franchising like licensing involves payment of royalties over time including an initial payment (Ramanathan, 1995).

2.7.1.4 Management Contracts

These include management, marketing and technical service contracts. These contracts involve transfer of skills and technology in return for a fee. If a product, technology or brand name has been sold under a licensing agreement, the licensee may need further assistance of plant and equipment, marketing etc (Ramanathan, 1995). One problem with this form of international business is the maintenance of a working relationship which is suitable to both parties to management contract (Ramanathan, 1995). A management contract is an arrangement where operational control is vested by contract in a separate enterprise which performs the necessary management functions for a fee. It is an effective way for the transferor to control an enterprise in a developing country without committing capital resources (Ramanathan, 1995).

2.7.1.5 Turnkey Contract

A turnkey project is one in which a foreign organization undertakes the construction of a production facility and turns the key to a domestic firm or some other organization when the facility is ready

for operation. Turnkey projects usually are more suited to a single activity production facility such as a cement factory, sugar refinery, steel mill, etc. A turnkey project may also include the training of domestic personnel to eventually take over the operation of the factory. It is worth noting that in a turnkey investment domestic personnel are able to operate the new plant but may lack the ability to set up a cement factory or a sugar refinery. The ability to reproduce or set up a production plant may indeed be more beneficial in terms of fostering selfsustaining development in the long run than having one from a turnkey arrangement in which the recipient only consumes or operates the technology involved. However, Kopelmanns (1970) argues that the advantage of having a number of separate contractual agreements is that they encourage the development of 'national technological capabilities'. Despite these arguments, it seems that much reliance upon 'turnkey' contracts may cause delays in indigenous development of those skills required to organize and set up production facilities in developing countries.

2.7.1.6 International Subcontracting (Outsourcing)

This occurs when a manufacturing firm in a developed country subcontracts the manufacture of parts, components, sub-assemblies or even final goods to a firm in an LDC to take advantage of lower labor costs or special incentives provided by the host government, e.g. tax breaks. This form of contract has its origins in the US companies that operated in Mexico in the 1950s and 1960s (UNCTACD, 1993). These companies would export parts and components, e.g. of electric or electronic goods to Mexico to be assembled into final goods, thus taking advantage of lower labor costs. The final products would be re-exported back to the US or exported to other countries (Shamsavari, 1973). Textiles, electronic goods and air-frame production are some of the examples of the sectors involved in international subcontracting (UNCTACD, 1993). The advantages for LDCs are immense as they acquire modern technology, have access to rich country export markets

and enjoy a high rate of economic growth. Originating companies benefit from low wages, skilled and disciplined workforce and tax breaks (UNCTACD, 1993).

2.7.1.7 Technical Service Agreement

Technical collaboration is an agreement used as a generic Term encompassing a wide variety of contractual agreements between a foreign company and a local enterprise for effective TT. In the context of TT, it is technical collaboration agreement which can be defined as a contractual agreement between two functioning entities of different nationalities for the sale and purchase of a wide variety of technical know-how (Ramanathan, 1995). Here the main features are local ownership of the entity and payment received by the transferor is in return for technical services rendered and not for equity contributions. It can take different forms, such as licensing, franchising, technical services agreement and engineering and construction agreements (Ramanathan, 1995).

2.7.2 Indirect Transfer of Technology

The direct transfer method, with its various contractual arrangements, is an attractive option despite its major limitations which included the lack of equity share control of the technology receiving firm by the transferor firm. This truncates the unified control structure most desired by the multinational company in its operations abroad and often puts the company in a difficult position with respect to policy-decision making. The second option of "Indirect Transfer" provides the condition for achieving this desire. Joint ventures and foreign direct investment (FDI) are major routs of indirect transfer routes.

2.7.2.1 Joint Ventures

Joint ventures have grown considerably since the 1960s. In fact while the former Soviet Union and Japan, as indicated above, transferred technology through licensing agreements and South American countries welcomed wholly-owned FDI from The USA and Europe (e.g. Ford Company investments in Brazil in 1950s and 1960s), the success of the Asian economies have largely been due to joint ventures between Japanese and American companies with domestic firms (e.g. South Korean firms producing Hyundai, Daewoo and Kia cars) or the former and the domestic government (Malaysia's car manufacturers) (Gwynne, 1990). Broadly, a joint venture may be defined as "a partnership formed by a company in one country with a company in another country for the purpose of pursuing some mutually desirable business undertaking" (Certo, 1986, pp. 521). In strategic alliances such as this, ownership is based on equity share. The partners in the alliance each provide a portion of the equity or the equivalent in physical plant, raw materials, cash, or other assets (Griffin, 1990).

2.7.2.2 Foreign Direct Investment (FDI)

Foreign direct investment (FDI) is one of the more frequently used channels of TT. An FDI is usually a long-term productive investment in foreign countries in which an investing multinational corporation exercises either full or partial management control of assets and production in the countries involved (Siddiqi, 2001; Mallampally & Sauvant, 1999). To attract FDIs, Third World countries are promising policy liberalization, political stability, privatization, and minimal government intervention. Where all or a portion of these conditions are assured, a foreign corporation may be motivated to set up production facilities in a Third World country. Among other things, multinational corporations invest in the Third World to protect an existing market or to create a new one, to bypass prohibitive barriers and import restrictions, to discover or protect raw

material sources, to renew a product's life cycle, to take advantage of cheap labour and skills, and to increase profits (Kaynak, 1985). While some argue that benefits include transfers of production technology, managerial expertise, skills, innovative capacity, and increasing access to global markets, others are less convinced and argue that any transfers to the Third World as a result of FDIs are mainly unintended leakage (Mittelman & Pasha, 1997). Whatever the argument, it is doubtful, from decades of experience, that FDIs are a significant source of capacity building and national capital formation in host Third World countries.

2.8 RISKS FACTORS CONFRONTING TECHNOLOGY TRANSFER

Although the importance of TT has been highlighted, the process of transferring technology is complex and demanding. At least at conceptual level, there are important factors that should be considered to successfully promote the transfer and dissemination of appropriate technology. Overlooking the critical factors may create the opportunity for impeding the development of local practitioners (Samli, 1985). The following factors discusses the underlying risks factors confronting TT between transferor and transferee firms in Ghana:

2.8.1 Current Weak Capacity

As we have indicated appropriate technology transfer promotes balanced industrial development, which is vital for achieving higher standard of living. However, the current weak capacity of transferee firms in accommodating transferred technological capabilities has become the major impediment to successful transfer of appropriate technology in Botswana. It is important to systematically identify those externally imposed and internally generated impeding factors for transferring technology to transferee firms in Ghana. Basically, these are the results of infrastructural and organizational problems (Osman-Gani, 1999).

2.8.2 Choice of Technology

In many cases, transferee firms are eager to import very advanced technological know-hows, which are beyond their effective utilization for operational advancement and performance improvement (Kedia, & Bhatgat, 1988).

2.8.3 Absorption Capacity

Most transferee firms lack infrastructural and organizational capacity to absorb the 1 transferred technological capabilities. Absorption capacity is the ability of a firm to recognize the value of new external technology, assimilate it, and apply it to commercial ends (Kedia, & Bhatgat, 1988).

2.8.4 Conflict of Interest

Both internal and external technology transferors may want to transfer technology that can give them financial benefit. On the contrary recipient firms wish to receive technology that will promote their industrial experience: improve their operational facilities, enhance their marketing capabilities and extend business networks (Reddy, 1996).

2.8.5 Incompatibility

External and internal transferors of j technology tend to transfer technological capability that cannot be easily communicated, understood and implemented by the recipient firms (Osman-Gani, 1999).

2.8.6 Technology Transplantation

Many technology transferors particularly those from the developed countries would like to direct transplant technology (i.e. the whole operation) rather than complementary technology that will

help transferee firms foster internally motivated technological capacity and entrepreneurship (Reddy, 1996).

2.8.7 Marketing Capabilities of Technology Transfer

TT will be less effective unless it is properly managed. The precarious position, lacks of strategic orientation, visioning, and poor organizational set-up of transferee firms are the main causes of poor absorption of technology. Marketing capabilities is the major variable that affects the TT process both negatively and positively (Osman-Gani, 1999). Marketing capabilities of TT includes planning, scheduling, programming, training, and making the operational environment ready for the newly obtained technology.

2.8.8 Industrial Experience

It is usually found that the objectives of a TT between a transferor and transferee do not match each other due to industrial experience. As a result, technologies that are transferred to the transferee cannot be used to solve relevant problems (Reddy, 1996). The mismatches between the transferor and the transferee may take place in the case of a transferee in a developing country needing only simple technologies to improve production processes serving local demands (Reddy, 1996). However, the transferor may expect more capabilities from the transferee. Improving quality and cost-effectiveness of inputs meeting international standards are required by the transferor. Thus, more advanced technologies are transferred to local firm transferees. As a result, the local firm cannot use the technologies efficiently. The solution for industrial experience is for a consulting firm to be hired to study the situation before the transfer takes place (Reddy, 1996). The study will result in appropriate kinds of technology being transferred to the transferee. It will be able to guarantee that the transferee can use new technologies efficiently. Furthermore, it

reduces costs in cases of obtaining new technologies but the transferee does not know how to use (Reddy, 1996).

2.8.9 Government Regulation

Government regulation can mostly be found in the third world and developing countries. It deteriorates investor confidence from developed countries. Most investors rely heavily on democracy and political stability because they expect money return from continuous investment policies (Reddy, 1996). Government regulations often mean changes in a country's policy. More importantly, entries of MNEs require a lot of money in building factories and setting up machinery. Thus, any perception of government regulation by investors leads to the abandon their investments in a host country (Reddy, 1996). As a result, financial inflows and new technologies will not go into the host country. The way investors may protect themselves from political and government regulations are by purchasing insurance from government sources and private insurance firms (Reddy, 1996).

2.8.10 Socio-economic Structure

Major problem in getting new technologies is the socio-economic structure of a transferee firm. High initial fees and royalty payments are the main barriers of the transferee in less developed countries. As a matter of fact, advanced technologies and the high price of technology acquisitions go hand in hand (Dyer & Ouchi, 1993). The transferees have to put more efforts into new installations, maintenances, and services. Thus, the lack of socio-economics structure by the transferee inhibits the TT. The solution for a lack of socio-economic structure by the transferee is the direct involvement of the transferor (Dyer & Ouchi, 1993). Generally, it is involving the transferor in the transferee's operations, for instance giving the transferor an equity relationship in

the transferee's organization. As a consequence, the transferor can make capital and equipment investments in the transferee's operations (Dyer & Ouchi, 1993; Monczka *et al.,* 1993).

2.8.11 Infrastructure

The infrastructure implies the necessary institutional makeup as well as the necessary physical conditions for transferring technology. If the country were to import first generation communication systems but does not have the necessary institutional structure to generate and desegregate the information, the transfer of such technology will be impeded (Samli, 1985). Thus, even though the most appropriate industry is decided upon, its transfer is not likely to be smooth if any of these barriers exist. As can be seen, almost all of these barriers are long-term related. None of these can be eliminated in very short period of time. However, it is necessary to create certain condition for the technology to be transferred and become effective in short run (Samli, 1985).

2.9 CRITICAL SUCCESS FACTORS FACILITATING TECHNOLOGY TRANSFER PARTNERSHIPS IN THE CONSTRUCTION INDUSTRY

Numerous CSFs were reported in several studies including mutual trust, effective communication, coordination, commitment of the senior management team, clear understanding, problem resolution, acting consistently with objectives, dedicated team, commitment to continuous improvement, good cultural fit, flexibility to change, technical expertise, commitment to quality, and complementary resources (Black *et al.,* 2000; Cheng *et al.,* 2000; Chan *et al*., 2004; Tang *et al.*, 2006).

2.9.1 Top management support

Commitment and support from top management has always been regarded as a pre-requisite for successful partnering projects. As senior management formulates the strategy and direction of business activities, their full support and commitment are critical in initiating and leading partnering spirit (Cheng *et al.,* 2000).

2.9.2 Clear definition of roles and responsibilities

A JV contract provides a legally bound, institutional framework in which each party's rights, duties, and responsibilities are codified and the goals, policies, and strategies underlying the anticipated partnership are specified. The completeness of the agreement between the companies in an alliance is an essential success factor that can avoid a great deal of trouble and conflict in future operations (Bing & Tiong, 1999).

2.9.3 Mutual decision-making and dispute resolution

Cooperation in the decision-making process and willingness to pursue mutually compatible interests is critical in meeting formal and informal obligations and in avoiding conflicts (Das & Teng, 1998; Luo & Park, 2004). High level of participation among parties may help them create a commitment to the mutually agreed solution (Cheng *et al.,* 2000). Conflicting issues are common among parties with incompatible goals and expectations. Conflict among partners tends to cause frustration which in turn results in dissatisfaction (Anderson, 1990).

2.9.4 Joint Action

Joint action refers to in-depth cooperation between a buying firm and its suppliers on activities that are important for improving the performance of both parties (Joshi & Stump, 1999). Joint action

has a direct positive impact on operational effectiveness.This results in improvements in product quality and decreases in operating costs (Li *et al*., 2006). From previous studies, for example, Liker & Wu (2000) found that joint action between a Japanese automaker and its suppliers in establishing a just-in-time delivery system led to benefits for both parties in terms of reducing operating costs through holding less inventory. Besides, the joint action can respond quickly to change in customer demands.

2.9.5 Effective coordination among partners

Coordination reflects the expectation of each party from the other parties in fulfilling a set of tasks (Mohr & Spekman, 1994).Good coordination resulting in the achievement of stability in an uncertain environment can be attained by sharing project information (Bayramoglu, 2001; Cheng *et al.,* 2000). The willingness and ability to provide and share information is a key factor in confirming an honest attitude and developing trust among partners.

2.9.6 Effective communication among partners

Successful alliance relationships are expected to exhibit higher levels of communication quality. Failure by partners to communicate effectively may lead to misunderstandings and suspicion, and eventually to poor economic results and dissolution (Doz, 1996). Effective communication skills can help organizations facilitate the exchange of ideas and visions, which can result in fewer misunderstandings and stimulate mutual trust (Cheng *et al*., 2000). The role of communication is crucial to the interface between a firm and its suppliers. Poor communication is a cause of supplier development failure because it undermines a firm's efforts to improve supplier performance (Modi & Mabert, 2006; Liker & Wu, 2000). Failure in communication leads to conflict and incorrect

strategies (Etgar, 1979). Good communication allows a firm to efficiently share information about cost management and strategic plans.

2.9.7 Trust among partners

Mutual trust can be defined as, critical to open the boundaries of the relationship as it can relieve stress and enhance adaptability, increase information exchange and joint problem solving and promise better outcomes (Cheng *et al*., 2000; Mohr & Spekman, 1994). Establishment of trust improves organizational learning and facilitates partnering success (Das & Teng, 1998; Park & Ungson, 1997; Parkhe, 1993).

2.9.8 Commitment to win-win attitude

Commitment can be described as the willingness of partners to exert effort on behalf of the partnering relationship (Mohr & Spekman, 1994). Commitment is necessary for success and is required at each step in the partnering process overcome initial uncertainties associated with a new project, market, or partner (Beamish, 1988). Committed partners will consider long-term gains rather than short-term advantages. Partners that are committed to the win-win attitude work harder to prevent differences affecting the performance, to create and maintain a good relationship with their partner and thus they are less likely to let differences in functional approaches result in conflicts and negatively affect performance (Chan *et al*., 2004).

2.9.9 Long-term orientation

Long-term orientation can be regarded as the willingness of the involved parties to integrate continuously to unanticipated problems (Cheng *et al*., 2000). Parties that are committed to longterm orientation are expected to balance the attainment of short-term objectives with long term goals and achieve both individual and joint missions without raising the fear of opportunistic

behavior (Mohr & Spekman 1994). A deep long-term relationship between a firm and its supplier is very important to TTs because it encourages information sharing between a firm and its suppliers. The more information sharing between firm and its suppliers leads to more efficient quality improvement and cost reduction (Li *et al*., 2006). From previous studies, for example, Lee & Humphreys (2006) found that trust played a crucial role in supplier development in China. A firm having a deep relationship with its suppliers is willing to invest its resources in developing supplier capabilities.

2.9.10 Shared corporate culture

Differences in management styles and organizational cultures may hinder the success of partnerships; however a cultural integration process may be useful in avoiding conflicts among the partners. Creation of a shared culture for a partnership is not very easy due to the projectbased nature of the construction industry. Therefore, partners can avoid possible problems by trying to understand the partners' way of thinking and behaving and to train their employees to foster cultural integration (Chan *et al.,* 2004).

2.9.11 Management Innovation

Partners generally seek technological, innovational, and managerial skills from foreign partners (Beamish, 1988). As strategic orientation determines organizational adaptability and innovativeness, it may affect not only the partner firm's strategic but also organizational behavior such as managerial style and long-term orientation, which may in turn influence mutual trust and collaboration between parties. The success of operations largely depends upon partner's learning capability and innovativeness (Chan *et al*., 2004).

2.10 CHAPTER SUMMARY

This chapter discusses the general phenomenon of TT and begins with an introduction and the conceptual dimensions of technology and TT. It covers the general overview of the Ghanaian construction and TT in the construction. Also, this chapter explores the theory of TT: the typologies of technology; the channels/modes of transfer of technology; the risks factors and lastly the success factor facilitating TTPs between parties in agreement.

CHAPTER THREE

CRITICAL REVIEW OF EXTANT MODELS AND HYPOTHESIS

3.1 INTRODUCTION

This chapter aims at providing an extensive literature review on the existing related TT models. It presented the optimal approach for TT between foreign (transferor) and local (transferee) countries. The review of the existing literature and related work identifies the limitations in the current understanding of the TT process that can be further explored. Reviewing related work in this study is essential to the research under study which attempted to resolve the research problem,

objective and research questions and develop a conceptual framework of TTPs anticipated to facilitate the flow of technology between developed and developing counties in Ghana. This chapter started by providing a general overview off the related work in TT. This was followed by identifying and describing five TT models, including (Calantone *et al*., 1990; Simkoko 1992; Saad *et al.,* 2002; Wang *et al.,* 2004; Waroonkun,, 2007). Finally, the evaluation of the five models revealed the potential options for designing a new TT model that can resolve the weaknesses and limitations of the related work by integrating more advanced factors and features.

3.2 OVERVIEW OF RELATED WORKS ON TECHNOLOGY TRANSFER

Due to the recent economic situations in developing countries, inter firm TT is debated as an important as well as controversial issue in the world economy (Calatone *et al.,* 1990). The importance of inter-firm TT in the world economy arises its ability to provide developing countries with a new technology that can improve and hence contribute to world economic growth (Yamashita, 1991). This can occur by importing the latest technologies in order to improve marketing and managerial skills, local labour skills, expertise and performance. According to Dunning (1983), the important missing elements of development in developing countries are the "acquisition of knowledge, R&D techniques, production technology, and marketing and managerial skills".

Over the past three decades, there have been many researchers that have studied the TT process and developed TT models. However, whilst these models were developed for the business and manufacturing sectors, there is absence of a comprehensive TT model developed specifically for modeling TTPs on construction projects in Ghana. Such framework would need to be developed through a process of justifying, grouping, linking and refining factors established across a number

of different industry sectors. This study utilized the factors from these existing TT models namely: Calantone *et al.,* 1990; Simkoko, 1992; Saad *et al.,* 2002; Wang *et al*., 2004; Waroonkun & Stewart, 2007. These five models discussed were particularly helpful when formulating the overall structure of the conceptual model and assisted with the identification of the main TT factors which impact on the TT process and the value it generates.

3.3 TECHNOLOGY TRANSFER MODELS

Many researchers have studied the TT process and a number of TT models have been developed. However, whilst many of these models were developed for the business and manufacturing sectors, there are common concepts and factors that they all share. Five noteworthy models have been chosen, which incorporate concepts and factors related to the proposed model in this research.

The ***first model*** (Calantone *et al.,* 1990), developed a comparative marketing framework for TT based on concepts formulated by Boddewyns' comparative marketing research (Boddewn, 1966; Boddewyn, 1981). This framework presents a system made up of five elements that describe the TT process. The framework describes the relationship between the elements as well as the macro factors which make up the elements.The ***second model*** (Simkoko, 1992), emphasizes technology acquisition, which is considered a backbone for the main target of the overall TT process. The case study of this model considers the TT process between Sweden (as a developed country) and developing countries such as Tanzania and Kenya. This model was chosen for this study because of the inter-firm relationship between developed (transferor) firm and developing (transferee) firm in terms of their experience on construction TT projects in developing countries specifically in Ghana. The ***third model*** (Saad *et al.,* 2002), for which the case study was Algeria, emphasizes extending the traditional project life cycle model to involve TT stages. This model was chosen

because of the TT factors in terms of culture, environment, national mentality, educational level. Moreover, policy, economic and governmental structures were equivalent in both firms. The ***fourth model*** (Wang *et al.,* 2004), was developed from semi-structured interviews with 62 multinational companies operating in China. Archives and publications on the firms operations were also examined in the model development and validation stages. The model also made distinctions between the transfer of tacit and explicit knowledge. Finally, the ***fifth model*** (Waroonkun, 2007) is the value-added model, in which the focus is on the ultimate performance of local staff when they work independently. Modeling will be developed through a process of justifying, grouping, preferring and refining factors established across the above-mentioned researchers models. ***Table 3.1*** highlights the reasons behind choosing these five research models and the justification of these choices.

Table 3.1: The five TT research models and the justification of choosing these models in this study

No	Model Name	Author	Year	Justification of Choice
1.	Comparative Marketing Framework	Calantone *et al.,*	1990	There were several important factors that have been identified that were adopted from this framework to produce the conceptual model for international TT in construction projects. In particular, this study adds value by introducing the concept that international TT is a dynamic iterative process. Moreover, the five –element system is effective in describing the general constructs that make up the international TT phenomenon.
2.	Technology Acquisition Model	Simkoko	1992	There were 12 countries chosen from Africa, South America and Asia. This variety would enrich the research resources considering the different cultural and language issues as well as the geographical distribution between transferor and transferee. The other remarkable characteristic of this model is the focus on knowledge acquisition.

3.	Extended TT Project Life Cycle Model	Saad *et al.,*	2002	Due to the similarity of the state regime (totalitarian) of both Iraq and Algeria back then. Furthermore, both countries share the same culture and language. The TT was in general industry. The remarkable characteristic of this model is the focus on extending the project life cycle by operating the project by local staff who have gained skills whilst their involvement with the foreign staff during the project implementation.
4.	Knowledge Transfer Model	Wang *et al*.,	2004	The model developed in this study, identified two stages in the transfer process. The first stage is focused on the parent's contribution of knowledge and the second stage on the subsidiary's acquisition of knowledge. Factors affecting the extent of knowledge contributed by the aren't are categorized into two groups: • Parents capacity to transfer • Parents willingness to transfer
5.	Value-Added Model	Waroonkun	2007	The remarkable characteristic of this model is the measure of the value-added after the project implementation phase is done. This measure is scaled by how qualified the local staff are to perform similar project in the future

Source: Authors' Construct (2015)

3.3.1 Comparative Marketing Framework (CM) (Calantone *et al*., 1990)

Calantone *et al.,* 1990 developed a comparative marketing framework for international TT based on concepts formulated by Boddewyns' comparative marketing research (Boddewyn, 1966; Boddewyn, 1981). This study is recognized as one of the more complete marketing frameworks of TT in recent times. This framework presents a system made up of five elements that describe the TT process. The framework describes the relationship between the elements as well as the macro factors which make up the elements. The description of these relationships conceptualizes the TT process. Each of the five elements are shown in ***figure 3.1*** and have been described below:

Environment: macro level factors identified in the environment element include prior experience of technology provider and the technology receiver, cultural factors, economic factors and political factors. This element describes both the environment from which the technology is being transferred from and transferred to. ***Actors:*** this element identifies the principal participants involved in the TT project. They include technology recipients and suppliers and organizations. Also, included in the actors element are those participants that are not principally involved in the TT project but have influence on the process such as government and nongovernment organizations (NGO). ***Structure****:* the structure element describes the relationships and interaction mechanisms between the actors involved with the TT process. The information and communication channels between the actors are impacted upon by the political, economic and business relationships between them. ***Process:*** this element is concerned with the actual negotiations between the technology recipients and providers. The negotiations are impacted upon by information and communications channels and cover the selection of technology, partner and mode of transfer from perspective of both recipients and providers. ***Functions****:* this element is concerned with the implementation of a conceived TT project. This includes evaluation and control of implementation as well as feedback on the success of the implementation. The environment elements macro-factors make an important contribution to his model as they have impact on all of the other factors within the TT framework.

The macro level environment factors are described below:

Prior experience*:* this factor is concerned with the prior experience of both technology provider and technology recipient. The previous experience of both parties gives an indication of the likelihood of success and insights into successful TT processes. The degree of prior experience of both parties and the ratio of experience between the parties has both negative and positive effects

on the process. ***Cultural factors:*** cultural differences between participants may have adverse effects on the success of the TT process. Cultural differences must be considered and understood for implementation of a successful program. ***Economic factors:*** economic factors such as level of economic development and stability have great influence on the TT process. It has also been recognized that rapid industrialization through TT is an important path to economic development of developing countries especially. ***Political factors:*** these factors include political systems, domestic political structure and relative power between state and non-government organizations. Interactions between recipients and suppliers are influenced by their relationships. These relationships also influence the organizations the work with both recipients and suppliers. The outcomes from TT will be channeled back to the macro-level factors as feedback trough the route shown in ***figure 3.1***. There were several factors that have been identified and were adopted to develop the conceptual framework for TT in construction projects. In particular, this study adds value by introducing the concept that TT is a dynamic iterative process.

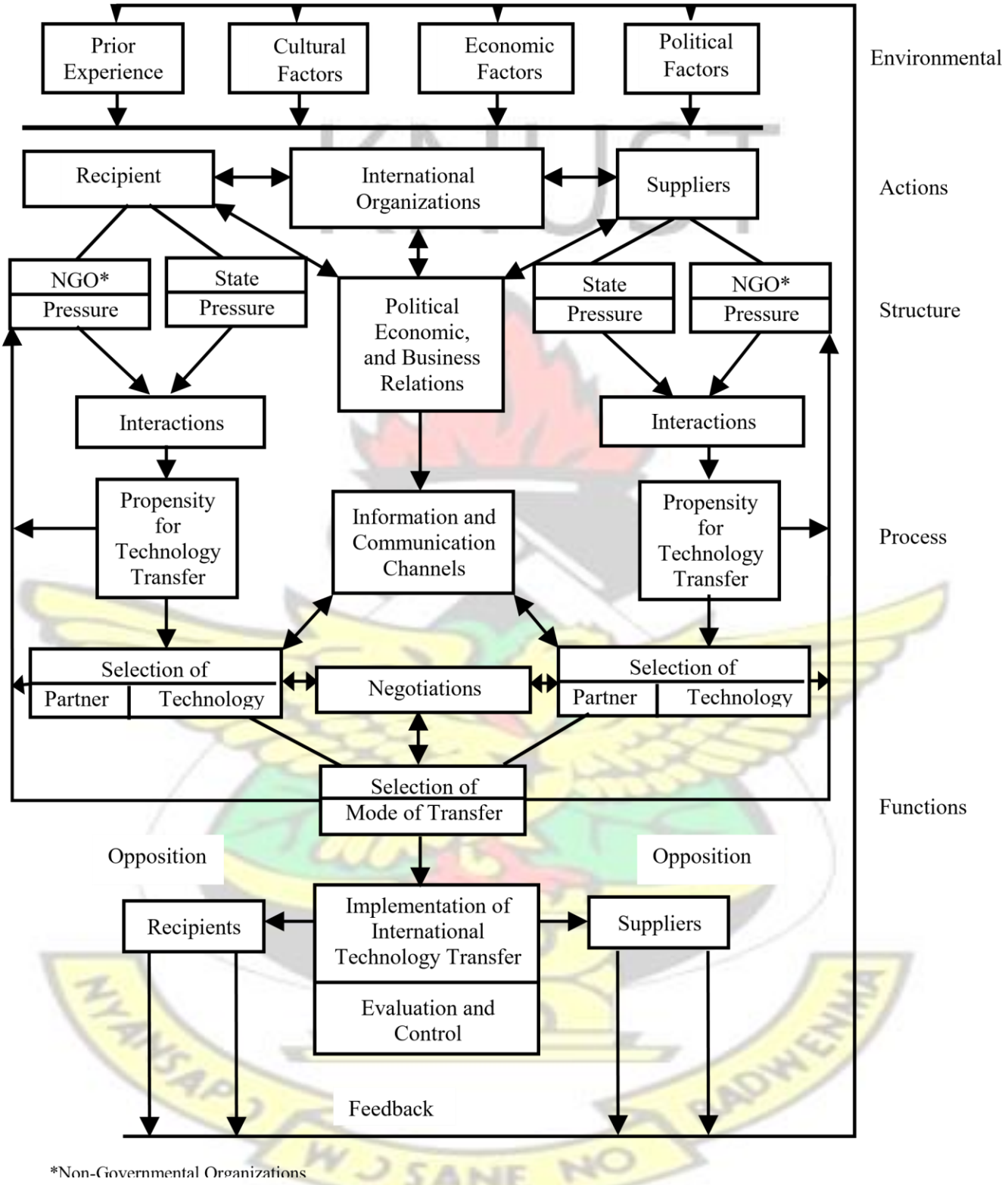


Figure 3.1 Comparative Marketing Framework (Calantone et al., 1990)

Source: Adopted from Waroonkun, 2007

3.3.2 Technology Acquisition Model (TA) (Simkoko, 1992)

Simkoko's research focused on TT in the construction industry of developing countries. Competence development through TT was closely examined to determine the influential factors that impact on this process. This model was based on case studies of 12 construction projects in the developing countries of Africa, South America and Asia in 1987. The selection criteria for the projects to be investigated were as follows: local firm involvement; technology acquisition objective explicitly or implicitly expressed by clients; and projects completed recently under construction. The data collection was separated into two phases. Phase 1 involved examination of project files and semi-structured interviews. Phase 2 involved site visits and further interviews with all projects participants. The objective of this research was to examine the impact of TT programmes and other internal and external environment factors on construction project performance. The technology acquisition process was identified as one of the main mechanisms for building up the missing technological and managerial competence of firms within developing countries. The research also investigated the effect of organizational form, the management team and construction technologies on the involvement of local firms. Specifically, this study identified the seven sets of variables that describe the construction project delivery process.

These factors have been presented in a research model as shown in ***figure 3.2.***

The seven factors that make up the Simkoko's model are described below:

i. **Project delivery system**: consists of organization methods used and overall project execution.

ii. **Project management teams:** concerned with the degree of integration of local and foreign project managers. Influence by organization forms and acquisition programs.

iii. **Transfer programs:** concerned with training costs and time, involvement of local contractors, employment of technical staff and supervision from management.

iv. **Client characteristics:** concerned with special requirements of clients, personal characteristics of the client, financial status, degree of involvement in project decisionmaking and objectives.

v. **Project characteristics**: concerned with project size, complexity, schedule, cost, risks and uncertainties.

vi. **Design and construction technologies:** concerned with construction methods, materials, equipment, resources, management techniques and past performance of construction technology.

vii. **Project performance**: concerned with competence development of local firms and was measured by the degree of involvement and impact on local employment.

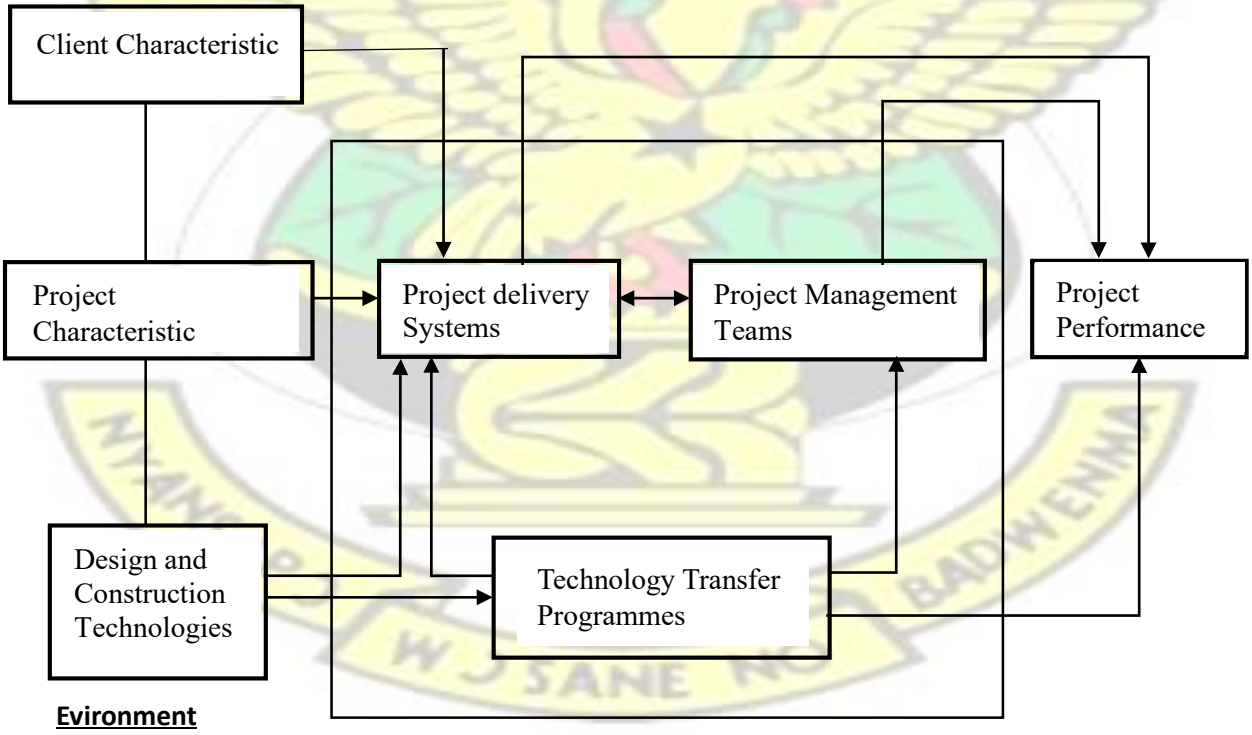


Figure 3.2: Technology Acquisition Model (TA) (Simkoko, 1992)
Source: Adapted from Al-Khazarji, 2013

3.3.3 Extended TT Project Life Cycle Model (ETT-PLC) (Saad *et al*., 2002)

Saad *et al.,* (2002) proposed to a TT model that aimed to refocus research attention in assessing TT projects based on the level of performance to better understand the TT process and its association with managerial practices in developing countries. The model was designed in an evaluation framework called the Extended TT project life cycle model (ETT-PLC) (***see figure 3.3***). The ETT-PLC model was used to analyses the TT process in Algeria over the last three decades. Two case studies were considered and compared based on two integrated mechanisms of TT used in Algeria between 19665 and 1990: *turnkey* and *product-in-hand*. The model significantly considers the contractual arrangements that govern TT projects. It assumes that the procurement and acquisition of hardware, software and knowledge are relevant to specific industrial and national cases. It also identifies a complex range of issues associated with the influence of multiple stakeholders on TT process. The complexity is further increased with the interfering of political, technological, cultural, social and organizational factors in TT process (Saad, 2002).

According to the ETT-PLC model, a manufacturing plant or an engineering system can be done by a sequence of logical steps: initiation; design and development; implementation; and handover. In a turnkey project, the technology supplier is fully responsible for the concept, design and execution stages. The supplier is in charge of making the choice of process design, as well as the selection delivery, installation and commissioning of machinery and the associated civil engineering and construction work. However, turnkey projects do not include training of local managers and workers and developing their skills. Therefore, the reliance is either on outside assistance for management and skilled operations or on inefficient operations by local staff due to the lack of skills (Saad, 2002). The turnkey contract puts an emphasis on acquiring hardware that is seen as

the only essential condition for TT. Such an approach would probably be successful in an environment containing adequate levels of skills, experience and knowledge. However, in Algeria during the 1970s, half of the workforce involved in production activities was illiterate, and there were no more than 250 engineers in the whole country (Saad, 2002).

The model presents an extended life cycle model (i.e. beyond the hand-over phase) to encourage the integration of these criteria into the decision-making processes. This can be seen as fundamental for TT projects. Also, he has argued that TT projects do not end with the handover phase; instead, TT projects are dynamic and shaped by interaction between various factors originating from many different sources. They are complex and risky in that they convey a great deal of uncertainty made up of technical, organizational, market, social, political and cultural factors. In this context, success is therefore not always guaranteed. The Algerian TT projects described in the case studies have essentially failed as a result of:

- Restricted availability of indigenous knowledge and information.
- Poor preparation procedures prior to negotiations.
- A lack of a proactive search for projects and partners.
- Selection of projects and partners not being based on national realities.
- Significant dependency on learning-by-doing and codified knowledge.
- Ignoring the dynamic dimension of TT process and the consolidation stage.

Consequently, this has led to a significant incompatibility between the imported technology and the recipient environment. This is why Saad's research challenges the traditional assessment approaches to project success and requires the need for an integrated approach that takes into consideration the key elements and stages of a TT project.

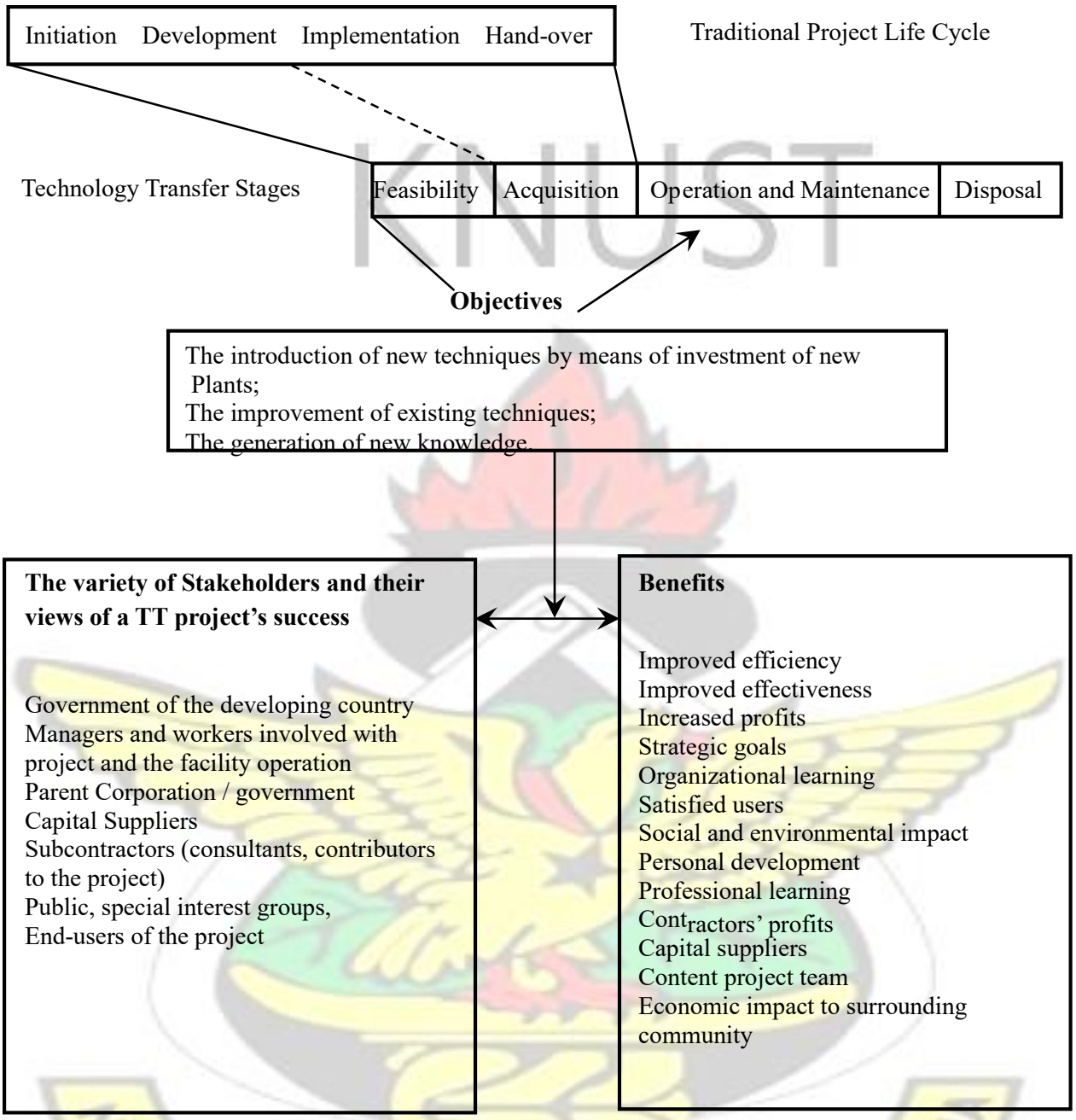


Figure 3.3: Extended TT Project Life Cycle Model (ETT-PLC) (Saad et al., 2002)

Source: Adopted from Al-Khazarji, 2013

3.3.4 Knowledge Transfer Model (KT) (Wang *et al*., 2004)

The research of Wang *et al*. (2004) followed from extensive previous research in the field of TT.

This model was primarily concerned with the transfer of knowledge from a multinational company

to a subsidiary. The Wang *et al.* (2004) model was developed from semi-structured interviews with 62 multinational companies operating in China. Archives and publications on the firms operations were also examined in the model development and validation stages. The transfer of both management and technical knowledge were the focus of this study. There are also distinctions made between the transfer of tacit and explicit knowledge. Explicit knowledge has been described as knowledge that can be codified and expressed in the form of data, technical specifications, manuals, universal principals, patents, etc. Tacit knowledge however is knowledge that is non-codifiable, and is deeply rooted in action, procedures, routines, commitment, ideals, values, and emotions (Nonaka, 1994).

The transfer of tacit knowledge often requires a process of demonstration, facilitated through face-to-face interaction and shared experiences between the transferor and the recipient (Roberts, 2002). The model developed (*see Figure 3.4*) identified two stages in the transfer process. The first stage is focused on the parent's contribution of knowledge and the second stage on the subsidiary's acquisition of knowledge. Factors affecting the extent of knowledge contributed by the parent are categorized into two groups:

Parent's capacity to transfer: The capacity of the parent to transfer refers to the firm-specific knowledge and the ability to impart that knowledge in a form that can be assimilated by the recipient. Such a capacity is primarily determined by the knowledge base of the parent and the competencies of those involved in the transfer process (expatriates).

Parent's willingness to transfer: The willingness of the parent to transfer determines the extent to which knowledge will be contributed. The willingness to transfer will be affected by the importance of the subsidiary and the ownership type. Knowledge transfer is a process that requires

commitment from both the transferor and the recipient. Therefore, the second stage of the model shows that, holding constant the extent of knowledge contributed by the parent, the result of knowledge transfer will also be greatly impacted by the subsidiary's capacity and intent to learn.

Subsidiary's capacity to learn: The subsidiary's capacity to learn is affected by the qualification of its employees and the emphasis on training.

Subsidiary's intent to learn: The learning intent of a subsidiary is affected by the intent of the employees and the link between learning and reward.

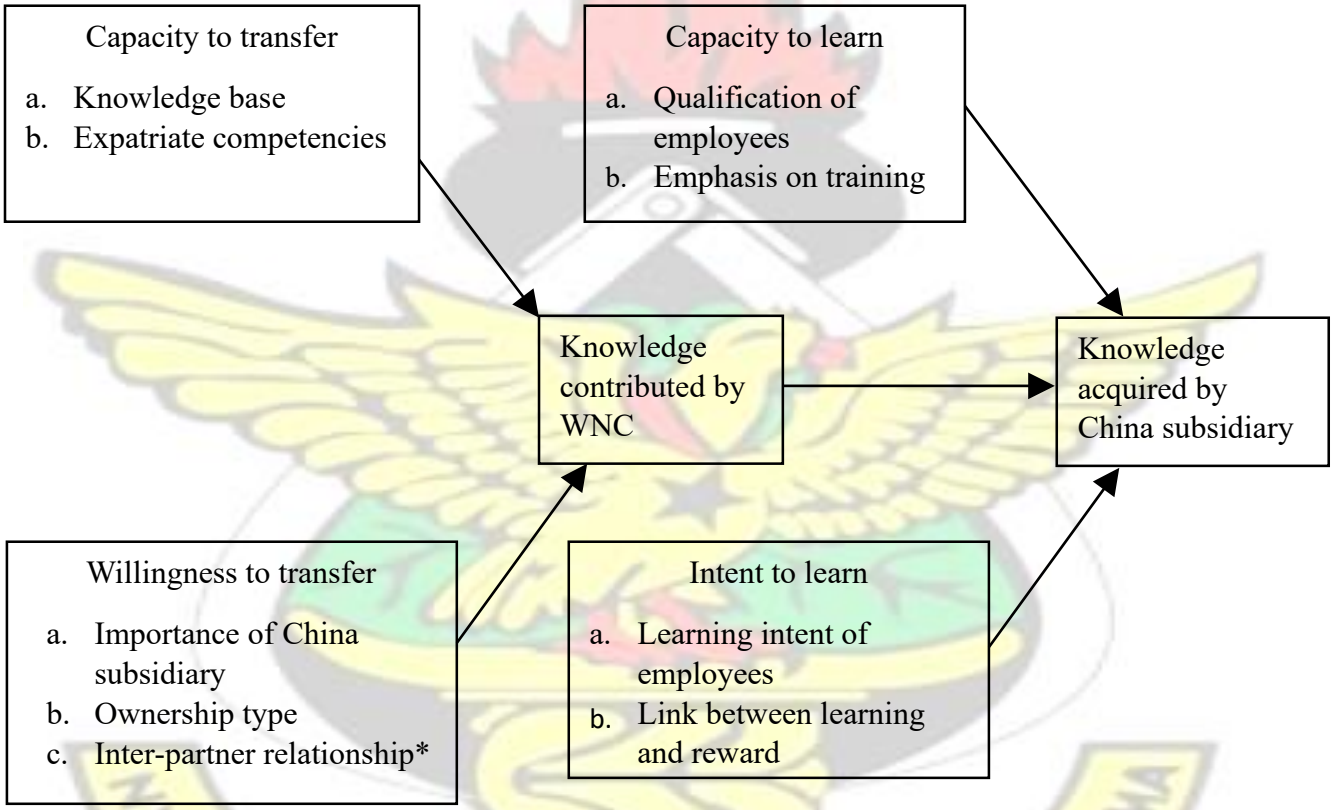


Figure 3.4: Knowledge Transfer Model (Wang *et al.*, 2004)
Source: Adopted from Waroonkun, 2007

3.3.5 Value-Added Model (VA) (Waroonkun, 2007)

Waroonkun (2007) focused on modelling an effective and appropriate model for TT within construction projects in Thailand. The new model is called the Value-Added model (VA). Although

a number of existing TT models were developed for the business and manufacturing sectors, Waroonkun stated the unawareness of any comprehensive TT model developed specifically for modelling TT in construction projects.

Waroonkun model was based on the literature review carried out by: Calantone *et al.,* 1990; Lin & Berg, 2001; Malik, 2002; Simkoko, 1992; and Wang *et al.,* 2004, and used their models to propose a conceptual model that emphasized the results from a questionnaire survey of 126 industry professionals from Thailand. Waroonkun (2007) states that over the last 20 years, numerous researchers have attempted to examine model the TT process (e.g. Calantone *et al.,* 1990; Lin & Berg, 2001; Malik, 2002). A large proportion of these studies was predominately focused on the business and manufacturing sectors. Some of these empirical and qualitative studies resulted in the development of a framework or model for the TT process. Waroonkun produced a TT model for Thai construction projects and aimed to incorporate all of the relevant factors that influence the effectiveness of the TT process and the resulting in the VA model (***See figure 3.5***). The factors identified were classified as enabling factors and TT value-added factors. The classification process resulted in identifying five definable factors (constructs), namely, ***transfer environment, learning environment, transferee characteristics, transferor characteristics*** and ***TT value added.***

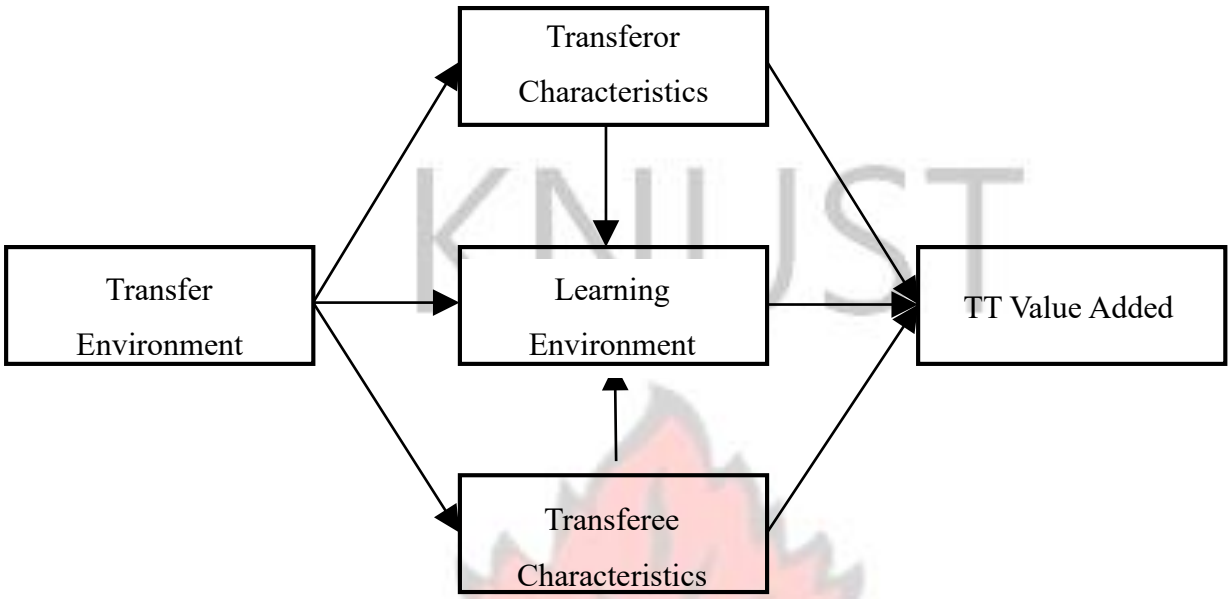


Figure 3.5: Value-Added Model (VA) (Waroonkun, 2007) Source: Adopted from Al-Khazarji, 2013

3.4 POTENTIAL FOR CONCEPTUAL TTPs FRAMEWORK

The study discussed five TT models that were reviewed in the literature can be abstracted as in ***table 3.2*** below,showing their main target, context, key concept, factors, and assumptions. Researchers as well as scholars have discussed and identified factors e.g. knowledge transfer attribute, the concept of absorptive capability and technological innovation that hinder TT process and its performance on individuals, industry and the economy as a whole. These factors have not been explicitly addressed in literature and their attribute with respect to the construction industry. In order to unveil these concepts, this study has been addressed as human resource dimensions that can enable this study develop a conceptual TTPs framework. However, all these elements that are highlighted and emphasized are eventually devoted to be factors in the success of the TT process as a whole. Thus, the effective and efficient factors of these models will be incorporated in the proposed framework of this research.

Table 3.2: A comparison between the five TT Models presented showing their main target, context, concept, factors, and assumptions.

	Comparative Marketing Model (Calantone, 1990)	**Technology Acquisition Model (Simkoko, 1992)**	**Project Life Cycle Model (Saad *et al.*, 2002)**	**Knowledge Transfer Model (Wang *et al.*, 2004)**	**Value-Added Model (Waroonkun, 2007)**
Target	Interaction between recipients and suppliers and international organisations.	Absorption of transferred knowledge to become rooted in the minds and skills of local staff.	The continuation of the project's performance by local staff.	This model was primarily concerned with the transfer of knowledge from a multinational company to a subsidiary	Highlight local staff the benefits of value added in order to undertake further projects independently with new technology.
Context	Complete marketing frameworks of TT in recent times.	TT projects from Sweden into developing countries such as Tanzania and Kenya.	TT projects in Algeria for the period 19651990.	TT model was developed from semi-structured interviews with 62 multinational companies operating in China	Highlighting TT initiatives within the construction sector and other industries in Thailand.
Key concept	Comparative marketing principles stated by Boddewyn to the field of international TT.	Knowledge acquisition is the inductor for success of the TT process.	Local staff performance in future projects based on product-in-hand.	The transfer of both management and technical knowledge were the focus of this study. There are also distinctions made between the transfer of tacit and explicit knowledge	Value added by TT that can be reflected in local staff performance.
Factors	The five elements that describe the TT process Environment; Actors; Structure; Process; Functions.	The seven factors that make up this model are: project delivery; project management; transfer programmes; client characteristics; design and construction technologies; and project performance factors.	The six factors that make up this model are: technical; organizational; market; social; political; and cultural factors.	The model developed in this study identified two stages in the transfer process. The first stage is focused on the parent's contribution of knowledge and the second stage on the subsidiary's acquisition of knowledge.	The five factors are namely: transfer environment; learning environment; transferee characteristics; transferor characteristics; and value-added factors.
Assumptions	The impact on the transfer process creating a continuous cycle of international TT development.	Involvement of local firms and personal working on international construction technology.	Product-in hand was obviously successful than turnkey mechanism.	The result of knowledge transfer will also be greatly impacted by the subsidiary's capacity and intent to learn	The final outcome is standard measure for local staff performance.

Source: Authors' Construct (2015)

3.5 ENABLERS OF TECHNOLOGY TRANSFER

3.5.1 Transfer Environment

The transfer environment is focused at the macro level of a country and its respective AEC sector. This factor is predominately concerned with the impact of country and project related factors on the TT process. This factor includes four sub-factors namely, the complexity of construction technology utilized by the transferor, mode of transfer, government policy and enforcement practices (***see Table 3.3***). The supporting literature for these sub-factors is provided in the following paragraphs.

The complexity of construction technology (advanced architectural and engineering design, construction methods, management techniques and technology, etc.) must be considered during the TT process (Lin & Berg, 2001; Simkoko, 1992; Calantone *et al.,* 1990). The complexity of construction technology sub-factor has been identified in several studies as an influential factor that impacts on the effectiveness of TT. The nature of technology to be transferred affects the communication efficiency and interaction patterns between the two parties during the TT process (Lin & Berg, 2001).

Government policy was concerned with the degree to which the government's policies and enforcement practices encourage TT to occur (i.e. subsidiaries, trade agreements, etc.) (Ganesan & Kelsey, 2006; Kumaraswamy & Shrestha, 2002; Ofori, 2000; Calantone *et al*., 1990). The host government's policies, regulations and enforcement practices can impact greatly on the effectiveness of TT initiatives, especially their political system and domestic political structure (Calantone *et al.,* 1990). Such policies should provide incentive to transferors to pro-actively disseminate knowledge to indigenous competitors. Inversely, the desire to acquire technology (i.e.

technology itself) can be the driver for changing government policy in developing countries (Kumaraswamy & Shrestha, 2002; Ofori, 2000).

The construction mode of transfer factor was principally concerned with the adopted construction mode of transfer (e.g. joint venture) for the project and its implications for the TT process (Ganesan & Kelsey, 2006; Calantone *et al*., 1990). The type of contractual arrangements between the two parties is key to allocating risk and responsibility of all aspects of the project (Ganesan & Kelsey, 2006). However, the construction mode of transfer adopted on the project can influence the degree to which TT performs. Typically, construction projects incorporating TT are procured by turnkey systems, direct licensing agreements, management contracting or joint ventures. For the larger and/or complex TT projects, alternative modes may be adopted such as licensing-cum joint venture, turnkey-cum-licensing, etc. (Calantone *et al.,* 1990).

From the above exposition, it will be appropriate to posit that: *Hypothesis 1*; *A significant key to successful transfer environment as an enabler of TT is dependent on: (H1a). Complexity of construction technology, (H1b). Construction mode of transfer, (H1c). Government policy and (H1d). Government enforcement.*

Table 3.3 Transfer Environment sub-factor

Sub-factor	Description	References
Complexity of construction technology	Concerned with the complexity of the technology (i.e. use advanced architectural and engineering design, construction methods, management techniques and technology, etc.) transferred on the project.	Calantone *et al*., 1990; Lin & Berg, 2001; Simkoko, 1992
Construction mode of transfer	Concerned with the construction mode of transfer (i.e. joint venture, turn-key projects, management contracting, etc.) adopted for the project and its implications for the TT process.	Calantone *et al*., 1990; Ganesan & Kelsey, 2006
Government policy	Concerned with the degree to which the government's policies and enforcement practices encourage TT to occur. (i.e. subsidiaries, trade agreements, etc.)	Calantone *et al.,* 1990; Ganesan & Kelsey, 2006; Kumaraswamy & Shrestha, 2002; Ofori, 2000
Government enforcement	Concerned with the degree to which the government's policies and enforcement practices encourage TT to occur. (i.e. subsidiaries, trade agreements, etc.)	Calantone *et al*., 1990; Ganesan & Kelsey, 2006; Kumaraswamy & Shrestha, 2002; Ofori, 2000

Source: Adapted from Waroonkum, 2007

3.5.2 Learning Environment

The learning environment is concerned with the relationship and communication between the transferor and transferee, and the effectiveness of implemented transfer programs. This factor includes four sub-factors namely; the relationship between transferor and transferee, communication between transferor and transferee, management of TT programs and composition of transfer programs (***see Table 3.4***). The learning environment is obviously an important and influential factor in the TT process and is directly impacted upon by the other three enabling factors. The supporting literature for these sub-factors is provided in the following paragraphs. The relationship between the transferor and transferee and its impact on the TT process is a major concern when managing TT (Fisher & Ranasinghe, 2001; Kumaraswamy & Shrestha, 2002; Lin

& Berg, 2001). For TT to be successful the transferor and transferee must have a good working relationship. They must be able to trust each other and communicate well to achieve their common goals. Culture difference, mutual trust, cooperation and communication among project participants contribute to project success (Chan *et al*., 2004; Tam, 1999).

TT can be properly functioned when the organizations involved in the TT process tried to build a culture of mutual trust through effective communication between transferor and transferee (Black *et al*., 2000; Malik, 2002). This culture can only be established through strong commitment from the senior management teams of both the host and foreign organizations (Black *et al*., 2000; Devapriya & Ganesan, 2002). The effective sharing of information is essential and only possible where a good relationship exists. Mutual frequent information sharing includes the formal as well as informal exchange of meaningful and timely information (Lin & Berg, 2001).

The management of the TT program, including the commitment from senior management to TT programs and the teamwork between the host and foreign project management team, was a major concern when technology was being transferred on construction projects (Black *et al*., 2000; Devapriya & Ganesan, 2002; Simkoko, 1992). The nature of TT generally requires the adoption of new management techniques, construction techniques and even a new way of thinking. The development of new 'technologies' in any environment requires not only commitment during the project planning and construction phases but also after the project is completed. Commitment from senior management was identified as a factor with high significance in the Black *et al.* (1990) study of factors responsible for successful partnering. Successful teamwork between the host and foreign project management team can also encourage the TT process (Simkoko, 1992). ***From the foregoing***, *it is necessary to hypothesize that: Hypothesis 2; A significant key to successful learning*

environment as an enabler of TT is dependent on: (H2a). Cultural differences, (H2b). Trust, (H2c). Communication, (H2d). Training programs and (H2e).

Teamwork.

Table 3.4 Learning Environment sub-factor

Sub-factor	Description	References
Relationship between transferor and transferee	Concerned with the relationship between the transferor and transferee and its impact on the TT process.	Fisher and Ranasinghe, 2001; Kumaraswamy and Shrestha, 2002; Lin and Berg, 2001
Communication between transferor and transferee	Concerned with the effectiveness of communication between transferor and transferee and its impact on the TT process.	Black et al., 2000; Devapriya and Ganesan, 2002; Ganesan and Kelsey, 2006; Malik, 2002; Nguyen et al., 2004
Management of TT program	Concerned with the management of the TT program, including the commitment from senior management to TT programs and the teamwork between the host and foreign project management team.	Black et al., 2000; Devapriya and Ganesan, 2002; Simkoko, 1992
Transfer programs Source:	Concerned with the details of the TT program agreement, including the amount of training provided to the transferee; the extent of employment of local subcontractors and the degree of supervision provided by the transferor.	Saad et al., 2002; Simkoko, 1992; Wang et al., 2004

Source: Adapted from Waroonkum, 2007

3.5.3 Transferor and Transferee Characteristics

The remaining two enablers are related to the characteristics of the transferor (foreigner) and transferee (host). These enablers are concerned with the degree to which the characteristics of the transferor and transferee encourage the TT process (Kumaraswamy & Shrestha, 2002). The

transferor characteristics factor includes four sub-factors, namely, willingness to transfer technology, level of experience, cultural traits and knowledge base (***see Table 3.5***). The transferee characteristics factor also includes four sub-factors, namely, intent to learn technology, level of experience, cultural traits and knowledge base (***see Table 3.6***). The supporting literature for these sub-factors is provided in the following paragraphs.

One of the essential elements to achieving successful TT is that the transferor is willing to transfer the appropriate technology and the transferee has every intention to adopt it (Benedetto *et al.,* 2003; Ganesan & Kelsey, 2006; Malik, 2002; Wang *et al*., 2004). The intent of the transferee to learn the new technology has been explored by Benedetto *et al.* (2003) and Wang *et al.* (2004). Intent to learn is divided into two categories in the Wang *et al*. (2004) model: (1) learning intent of employees; and (2) link between learning and reward. Malik (2002) also briefly discusses the issue of motivation which can be explained by the developed variable addressing the transferor's willingness to transfer technology.

The degree of experience of both the transferor and transferee should be a concern since the nature of this experience can impact significantly on the TT process (Lin & Berg, 2001). The experience of the technology receiver with cross communication can help it to build confidence with operations and its internal communication networks and thus increase TT effectiveness (Lin & Berg, 2001). Previous experience can increase the capability of the transferee to preserve core technology from the transferor; eventually resulting in the transferee becoming a serious competitor of the transferor (Lin & Berg, 2001).

The cultural traits of the two parties can have a significant impact on the communication effectiveness and hence the success of a TT project, especially if the two parties have major cultural differences such as those between Asian countries and Western countries. This concept has been identified as an important factor influencing the success of TT projects by several researchers. TT projects with a higher cultural gap between participating firms would expectedly have lower effectiveness (Lin & Berg, 2001). The appropriateness of the transferor and transferees cultural traits (i.e. leadership style, ego, etc.) for working in a partnership should be determined prior to embarking on the TT process (Fisher & Ranasinghe, 2001; Kumaraswamy & Shrestha, 2002; Makilouko, 2004).

The knowledge base of both the transferor and transferee in advanced construction management and technology has been identified as having an impact on the effectiveness of TT programs (Saad *et al*., 2002; Wang *et al.,* 2004). The capacity to transfer and adopt technology will depend on each individuals existing knowledge base and the gap between this knowledge level and the level required to utilize the transferred technology (Saad *et al*., 2002; Wang *et al*., 2004). For firms expanding into overseas markets, the knowledge base of both the technology provider and receiver is important for achieving outcomes from the TT process (Steensma & Lyles, 2000; Teerajetgul & Charoenngam, 2006). From the perspective of the transferor, the ability to contribute knowledge is a result of existing knowledge stock (Wang *et al*., 2004). Without a high knowledge base the transferor is limited in the amount of useful knowledge that they can transfer. On the other hand, if the transferee has a poor knowledge base they will have difficulty understanding and utilizing the new technology.

Drawing on from the above discussion, *it is appropriate to hypothesize that: Hypothesis 3; there exists a significant key relationship between transferor characteristics as an enabler of TT and: (H3a). Willingness to transfer, (H3b). Level of experience, (H3c). Cultural traits and (H3d). Knowledge base.*

Hypothesis 4; there exists a significant key relationship between transferee characteristics as an enabler of TT and: (H4a). Intent to learn technology, (H4b). Level of experience, (H4c). Cultural traits and (H4d). Knowledge base.

Table 3.5 Transferor Characteristics sub-factor

Sub-factor	Description	References
Willingness to transfer technology	Concerned with the transferor's willingness to transfer technology on the construction project.	Benedetto et al., 2003; Ganesan and Kelsey, 2006; Malik, 2002; Wang et al., 2004
Level of experience	Concerned with the transferors experience working on international projects.	Lin and Berg, 2001
Cultural traits	Concerned with the appropriateness of the transferor's management practices and work approach (i.e. leadership style, ego, etc.) for encouraging TT.	Fisher and Ranasinghe, 2001; Kumaraswamy and Shrestha, 2002; Makilouko, 2004
Knowledge base	Concerned with the transferor's knowledge base In advanced construction management and technology.	Saad et al., 2002; Wang et al., 2004

Source: Adapted from Waroonkum, 2007

Table 3.6 Transferee Characteristics sub-factor

Sub-factor	Description	References

Intent to learn technology	Concerned with the transferee's willingness to learn new technology from the transferor (foreigner).	Benedetto et al., 2003; Ganesan and Kelsey, 2006; Malik, 2002; Wang et al., 2004
Level of experience	Concerned with the transferee's experience working with foreigners.	Lin and Berg, 2001
Cultural traits	Concerned with the appropriateness of the transferee's management practices and work approach (i.e. leadership style, ego, etc.) for encouraging the TT process.	Fisher and Ranasinghe, 2001; Kumaraswamy and Shrestha, 2002; Makilouko, 2004
Knowledge base	Concerned with the transferee's knowledge base in advanced construction management and technology.	Saad et al., 2002; Wang et al., 2004

Source: Adapted from Waroonkum, 2007

3.5.4 Economic Advancement

One of the predominant reasons why governments in developing countries encourage TT initiatives is because they believe such initiatives can improve their living standards and economic prospects (San, 2004; Schnepp *et al.,* 1990). It should be noted here that economic advancement is a lagging factor that will typically occur in the long term once transferred knowledge has been absorbed and applied on a number of projects across the host country. Higher levels of performance will ultimately lead to greater economic advancement (Benedetto *et al*., 2003; Fisher & Ranasinghe, 2001). The economic advancement sub-factor is concerned with the degree to which TT programs have improved the competitiveness of host firms in the domestic and international market and with the degree to which TT programs has enabled the transferee to perform at a higher level (Benedetto *et al*., 2003). *Table 3.7* details these two subfactors as well as their description and support references.

From the exposition above, we can argue that a value added created with respect to competitiveness and performance improvement will cause an increase in economic advancement of the transferee firm and country. Hence it is appropriate to hypothesize that: *Hypothesis 5*; *A significant key to successful economic advancement as a degree of value creation is dependent on: (H5a). Competitiveness and (H5b) Performance improvement.*

Table 3.7 Economic Advancement sub-factor

Sub-factor	Description	References
Competitiveness	Concerned with the degree to which TT programs has improved the competitiveness of host firms in the domestic and international market.	Benedetto et al., 2003
Performance improvement	Concerned with the degree to which TT programs has enabled the transferee to perform at a higher level (i.e. better management skills, improved quality, etc.).	Benedetto et al., 2003

Source: Adapted from Waroonkum, 2007

3.5.5 Knowledge Advancement

Knowledge can be classified as being tacit or explicit (Nonaka, 1994). Tacit knowledge is acquired through collaborative experiences and interpretation of events and is difficult to articulate, formalize and communicate. In contrast explicit knowledge is codified and transferable in formal, systematic methods such as in rules and procedures (Cavusgil *et al*., 2003). Beyond the quantitative economic benefits achievable from TT, host AEC firms may also experience knowledge advancement at the individual and organizational level (Gilbert & Cordey-Hayes, 1996; Robinson

et al., 2005). The initial outcome of TT programs is the transfer of explicit and tacit knowledge to the host workers (Gold *et al*., 2001). This knowledge, if accepted, should lead to improved working practices in the immediate term and hopefully become the norm over the long term. The knowledge advancement sub-factor is concerned with the TT improvement in the tacit knowledge of local workers, the TT improvement of the local working practices and the impact of TT programs for improving the skills base of local workers over the longer term (Gilbert & Cordey-Hayes, 1996; Gold *et al*., 2001). *Table 3.8* details these three sub-factors as well as their description and support references.

From the exposition above, we can argue that a value added created with respect to improved knowledge, improved working practices, Long-term adoption of transferred skills will cause a change in knowledge advancement of the transferee firm and country. Hence it is appropriate to hypothesize that: *Hypothesis 6; A significant key to successful knowledge advancement as a degree of value creation is dependent on: (H6a). Improved knowledge, (H6b). Improved working practices and (H6c). Long-term adoption of transferred skills.*

Table 3.8 Knowledge Advancement sub-factor

Sub-factor	Description	References
Improved knowledge	Concerned with the TT-induced improvement in the tacit knowledge of local workers.	Gilbert and Cordey-Hayes, 1996; Gold et al., 2001

Improved working practices	Concerned with the TT-induced improvement of the local working practices.	Gilbert and Cordey-Hayes, 1996
Long-term adoption of transferred skills	Concerned with the impact of TT programs for improving the skills base of local workers over the longer term.	Gilbert and Cordey-Hayes, 1996

Source: Adapted from Waroonkum, 2007

3.5.6 Project Performance

It is generally accepted that the major objectives in construction projects are financial performance, schedule performance and quality performance. Improved performance in these key areas should result from effective TT (Chua *et al*., 1999; Devapriya & Ganesan, 2002). This factor is concerned with the impact of TT programs on the performance of TT projects. Specifically, this factor examines any improvements in the performance of financial, schedule and quality indicators. *Table 3.9* details these three sub-factors as well as their description and support references. Project outcomes are usually measured by comparing the project with certain predefined goals expressed in terms of time, cost and quality. Traditionally, project success criteria or objectives include project cost, completion time, the functional performance of the construction products, and the safety and quality of construction products (Simkoko, 1992). It is generally accepted that the major goals of a construction project are budget, schedule and quality (Chua *et al.,* 1999). The successful implementation of TT programs should lead to reductions in cost and time and improvements to product quality. Time and cost are always viewed from three perspectives; that of the owner, designer and contractor (Bubshait & Almohawis, 1994).

Table 3.9 Project Performance sub-factor

Sub-factor	Description	References

Financial performance	Concerned with the degree to which TT programs can help improve the financial performance of AEC projects.	Chua et al., 1999; Devapriya and Ganesan, 2002
Schedule performance	Concerned with the degree to which TT programs can help improve the schedule performance (i.e. on-time project completion, resource management, etc.) of AEC projects.	Chua et al., 1999; Devapriya and Ganesan, 2002
Quality performance	Concerned with the degree to which TT programs can help improve quality standards (i.e. less re-work, satisfied clients, etc.) On the transferee's future AEC projects.	Chua et al., 1999; Devapriya and Ganesan, 2002

Source: Adapted from Waroonkum, 2007

From the discussion above, we can argue that a value added created with respect to financial performance, Schedule performance, Quality performance will cause a change in knowledge advancement of the transferee firm and country. Hence it is appropriate to hypothesize that: *Hypothesis 7*; *A significant key to successful project performance as a degree of value creation is dependent on: (H7a). Financial performance, (H7b). Schedule performance and (H7c). Quality performance.*

Table 3.10: Technology Transfer Perspectives and Indicators

Perspectives	Description of indicators	References
Enablers		
Transfer Environment	Complexity of construction technology Construction policy Government enforcement	Calantone *et al*., 1990; Kumaraswamy and Shrestha, 2002; Ofori, 2000; Simkoko, 1992

Learning environment	Cultural differences Trust Communication Understanding Teamwork Management commitment Training programs Engaging local sub-contractors in TT Supervision of the TT process	Black *et al*., 2000; Devapriya and Ganesan, 2002; Fisher and Ranasinghe, 2001; Kumaraswamy and Shrestha, 2002; Lin and Berg, 2001; Malik, 2002; Simkoko, 1992; Wang *et al*., 2004
Transferor characteristics	Willingness to transfer technology Level of experience Cultural traits Knowledge base	Benedetto *et al*., 2003; Fisher and Ranasinghe, 2001; Kumaraswamy and Shrestha, 2002; Lin and Berg, 2001; Makilouko, 2004; Malik, 2002; Wang *et al*., 2004
Transferee characteristics	Intent to learn technology Level of experience Cultural traits Knowledge base	Benedetto *et al*., 2003; Fisher and Ranasinghe, 2001; Kumaraswamy and Shrestha, 2002; Lin and Berg, 2001; Makilouko, 2004; Malik, 2002; Wang *et al*., 2004
Value creation		
Economic advancement	Competitiveness Performance improvement	Benedetto *et al*., 2003
Knowledge advancement	Improved knowledge Improved working practices Long-term adoption transferred skills	Gilbert and Cordey-Hayes, 1996; Gold *et al*., 2001
Project performance	Financial performance Schedule performance Quality performance	Chua *et al*., 1999; Devapriya and Ganesan, 2002

Source: Authors' Construct (2015)

3.6 THE CONCEPT OF ABSORPTIVE CAPACITY – ORIGINS AND REFINEMENTS

Absorptive capacity is generally defined as the ability of the firm to utilize available information and knowledge that comes through the interaction with other organisations, such as other firms, users or knowledge providers (i.e. research institutions) (Cohen & Levinthal, 1990; Giuliani & Bell, 2005). It involves the ability to recognize the value of the information and knowledge deemed necessary for the firm's innovation process, to be able to acquire it, assimilate it, transform it and

exploit it (Todorova & Durisin, 2007). Thus, absorptive capacity increases a firm's access as well as usage of knowledge and information through collaboration with other actors. The absorptive capacity is a function of the firm's skill base, its internal technological effort and its linkages with external sources of knowledge (Lall, 1992). Absorptive capacity is furthermore moderated by regimes of appropriatability. Cohen & Levinthal (1990) as well as Zahra & George (2002) argue that the environment of a firm has a moderating effect on its incentive to invest in absorptive capacity. They argue that weak regimes, competitive spillovers, the efficacy of IP-rights and the ease of replication have a distinctive impact upon the firm's incentive to invest.

3.6.1 Attributes for Absorptive Capabilities

As TT involves the process of transmission and absorption of knowledge (Davenport & Prusak, 2000), the recipient's firm ability to absorb the knowledge transferred depends on the degree of their absorptive capacity. Past studies have shown that a low degree of technology recipient's absorptive capacity impedes both intra and inter-firm knowledge transfer (Cohen & Levinthal, 1990; Gupta & Govindarajan, 2000; Lane *et al*., 2001). There are many absorption capability attributes or factors that determine the performance of TT activity. A research carried out by United Nations (2005) found that a lack of sufficiently skilled labour force unable to assimilate and adapt new knowledge to local conditions is an impediment to foster TT. Meanwhile, a study by Mohamed *et al*. (2009) indicate that knowledge base factor, level of employee's readiness which include technical skills, experience and communication, and willingness to learn give affects to the TT performance.

3.6.1.1 Employee Capability

According to Monappa (2005), employees are recognized as the key to building a world-class organization and a finite resource for which organizations have to compete while Hong (1994) agree that employee is the most important entity because it plays a key role in acquiring new technology and integrating old and new technologies during the process of TT. Therefore, the employee's ability, based on their educational background, and acquired job related skills, may represent the prior knowledge which firm and organization needs to assimilate and use (Cohen & Levinthal, 1990). A study by Ashekele & Matengu (2008) on an SME manufacturing enterprise at the northern town of Rundu, Namibia found that relatively high levels of skill among employees provided impetus for a desire to be more competent. They also found that the willingness of employees to learn and adopt new technologies is an asset to firm's success.

3.6.1.2 Knowledge Sharing

A basic concept in the resource-based view of firm is that knowledge can be shared (Nonaka & Takeuchi, 1995). However, not much company includes knowledge sharing as part of its key component as knowledge sharing is considered as difficult to measure (Christensen, 2007). Van den Hooff & Van Weenen (2004) state that knowledge sharing is a process whereby individuals exchange their intellectual capital and collectively create new knowledge. Kim & Lee (2006) defined knowledge sharing capability as the ability of employees to share their work-related experience, expertise, know-how and contextual information with other employees within or across teams or work units. According to Sung & Gibson (2000), the success of TT occurs when knowledge and technology are shared and transferred across personal, department or organizational, and well accepted and understood by users. According to Li-Hua (2004) without knowledge sharing and transferring, TT does not take place as knowledge is the key to control technology as a whole. As articulated by Lall (2002), "developing countries obtain industrial

technologies mainly from the industrialized world, and their main technology problem is to master, adapt, and improve on the imported knowledge and equipment.

3.6.1.3 Working Culture

Working culture plays significant roles in influencing members of an organization in terms of commitment, loyalty and satisfaction. It also gives significant contributions by influencing the thought, feeling, Development of Absorption Capability Attributes for TT Performance: A Pilot Study in National Automotive Industry interacting and performance in the organization (Ungku Norulkamar *et al.,* 2005). Working culture includes the practice, beliefs, assumptions, principles, legends, and norms that affect how a person thinks, makes decisions, and carry out tasks within an organization (Zuliana & Khalil, 2008). Literature on change management explains that culture represents a core set of values governing the attitudes that employees adopt towards change and their approaches to the introduction of something new (Ang & Massingham, 2007). It dominates how employees interact, and how decisions are made (Simonin, 2004). Past studies reveal that a high degree of organization performance is related to an organization, which has a strong working culture (Kotter & Heskett, 1992; Denison & Mishra, 1995). Moreover, there are recent studies done have contributed significantly to the field of culture and performance studies. For example, a study by Raduan et al. (2008) on the high technology industry of the American, European, Japanese and Malaysian MNCs located in Malaysia discovered that there is possible relationship between cultures of all MNCs with organizational performance.

3.6.1.4 R&D Capability

Research and development, according to the Organization for Economic Co-operation and Development, refers to creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications (OECD,

2008). R&D capability has been defined as the firm's ability to reframe the present knowledge and produce new knowledge (Fleming, 2001). The investigation on the impact of R&D capability towards firm's performance has been documented by many authors. For example, a research done by Johansson & Loof (2008) found that investment in R&D capability, which represents firm's R&D strategy, associated with the firm's economic performance (productivity and profitability). Their study also argues that investment in hiring a stock of R&D knowledge labours reflects the R&D capability of an organization. Another study on innovation effectiveness by Chinho *et al*. (2011) concluded that different levels of firm's R&D capability leads decision makers to choose an appropriate commercialization strategy.

3.6.1.5 Communication Capability

Communication capability is the foundation for successful human interaction regardless of the setting in which it occurs (Marques, 2010). The importance of communication capability in the workplace becomes more profound as well (Cascio, 2000). It is not only demonstrated in the increasing number of research papers and books, but also in the inclusion of courses and workshops on organizational communication (Marques, 2010). Moreover, many managers have taken several initiatives to increase communication capability among their employees such as encouraging their employees to participate in courses and workshops that will increase and improve their interaction capability (Staples, 2001). Communication is defined by Narimah & Saodah (2002) as the sharing of information between two or more individuals or groups to achieve mutual understanding. Abdullah & Ainon (2002) have come out with a clear definition of communication as to transfer or deliver messages either by speech, actions, writings or images from the sender to the receiver.

From the discussion above, it is appropriate to hypothesize that: *Hypothesis 8*; *there exist a significant key relationship between absorptive capability and: (H8a). Employee capability, (H8b). Knowledge sharing, (H8c). Working culture, (H8d). Research and Development (R&D) capability and (H8e). Communication capability.*

3.7 KNOWLEDGE MANAGEMENT ENABLERS

The suggested research study will be utilized to explore the relationship between knowledge enablers and knowledge transfer. Although there is a lack of academic research to support it, there is a relationship between knowledge enablers and knowledge transfer. This session attempts to provide some viewpoints, and empirical results to identify this relationship. In this research, the researcher will suggest many enablers to support knowledge transfer. The model combines between the knowledge enablers as independent variables, and the knowledge transfer proposed on the dependent variable. In this study, the researcher divides enablers into four categories: organizational culture, information Technology, knowledge strategy and knowledge leadership following is a brief illustration of these enablers:

3.7.1 Organizational Culture

According to Wen-bao (2007) organizational culture is the common belief, conduct rules and values shared by all organizational members. Organizational culture is classified into three types: (1) Bureaucratic culture: means that most of the work in an organization is standardized and operates on the basis of control and power. Tasks are completed in proper sequence and enterprise ethic is specially emphasized. (2) Innovative culture: means that the work in an organization is challenging and innovative; organizational members are encouraged for adventure and initiative. (3) Supportive culture: means an open and harmonious working environment. Participation, teamwork and interpersonal relationship are specially emphasized.

Jennex & Olfman (2005) state "An organizational culture that support learning and the sharing and use of knowledge" cultures are altruism, reciprocity, trust, repute, openness, solidarity, sociability, motivation, commitment, and others. Organizational culture is a system shared by all organizational members that distinguishes the organization from other organizations.

3.7.2 Information Technology

According to Hein (2004), Brink (2003) and others, technology support refers to knowledge sharing by enabling the communication, collaboration provision of knowledge storing the accumulated knowledge and retrieve knowledge. Mohamed *et al.* (2009) found that information technology may serve as a cost effective and fast medium to acquire, store, share and transfer knowledge but it needs human's motive and willingness to engage in KM. Some researchers believes that IT Plays four different roles in knowledge management: 1-obtaining knowledge, 2-define, store, index, categories, 3- seek identify related content, 4- flexibly express the content based on the various utilization background (Safa *et al*., 2006; Cavana, *et al*., 2001; Zack, 1999). The example of IT facilities support is by providing groupware, online databases, intranet and virtual communities (Lin, 2007).

3.7.3 Knowledge Leadership

According to Nonaka & Toyama (2005) leadership is a vital knowledge creating which requires active commitment from all the members of the organization, not just from a few elites. Leadership links the context (ba) and the process (SECI) (Nonaka *et al.,* 2000). Leadership plays various roles in knowledge creating process such as: providing vision; creating, energizing and connecting and enabling and promoting the continuous spiral of knowledge creation. Von Krogh *et al.*, (2000) said that "managers in the knowledge economy will be figuring out what their company ought to know for the future". Also, we can argue that knowledge leadership is an important

enabler that helps knowledge transfer and enhances the partially knowledge creation in the company.

3.7.4 Knowledge Strategy

Strategies such as knowledge transfer strategy, knowledge creation strategy and customer focus strategy are some of the strategies which organizations consider as KM adopting strategies (Wiig, 1997). The strategy is associated with objectives, goals, the range of business that the company intends to pursue, plans, policies, decisions making and the kind of organization the company is oriented to be and related to in this respect, finely, the nature of contribution that the company intends to make to its shareholders, employees, customers and communities (Andrews, 1992).

From the discussion above, it is appropriate to hypothesize that: *Hypothesis 9*; *there exist a significant key relationship between knowledge transfer and: (H9a). Knowledge strategy, (H9b). Organizational culture, (H9c). Information technology and (H9d). Knowledge leadership.*

3.8 CHAPTER SUMMARY

The main aim of this chapter were to examine the effectiveness of past research in describing the TT process and to develop a conceptual model for TT in construction projects. In addition to the critical review of five existing TT models, numerous other studies were examined in order to identify all of the significant factors that can have an influence on the TT process and the value added from it. The five leading models of TT that were critically examined included (Calantone *et al.*, 1990 Simkoko 1992; Saad *et al*., 2002; Wang *et al*., 2004; Waroonkun, 2007). Each of these studies contributed to the development of the conceptual framework. Individually, none of these studies could completely describe the TT process in the construction context. However, with some modification these factors became essential building blocks for the developed conceptual framework.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter describes the background and reasoning behind the chosen research methodology. The chapter discusses the various steps undertaken by the researcher to explore the objectives of this research. Also, the chapter describes the proposed research method used for refining the conceptual framework and developing the final framework for TTP in the Ghanaian construction industry. The availability and selection of appropriate research design and method that would address the research problem and the key questions raised are also presented in this chapter. This includes the selection and justification for the choice of case study design (Single case study), mixed approach and framework validation. Methods and techniques used in data collection, analyses, and interpretation are also presented. In this chapter the "what is done", "why" and "how it was done" aspects of the research was the fundamental point of this chapter. In this respect, the research methodological terms and concept was thoroughly discussed followed by the exposition of their application in the research process.

4.2 PHILOSOPHICAL TRADITIONS AND CONSIDERATIONS

Guba & Lincoln (2004) categorize research paradigms into four namely: positivism; post positivism; critical theory and constructivism. Apparently, situating this research within its philosophical tradition would require discussions on the diversity of available philosophical continuum as a backdrop to this research. According to Guba (1990), a paradigm is a basic set of beliefs that guide an action. Denzin & Lincoln (1998) were of the view that a paradigm consists of three main elements namely: epistemology, ontology and methodology. However, Creswell (1994) and Collis & Hussey (2003) philosophical thinking revolves around ontological, epistemological, axiological and methodological assumptions.While ontological, epistemological and axiological assumptions position the philosophical stance of a research, rhetorical and methodological assumptions are concerned with language and process of the research respectively (Thurairajah *et al.,* 2006). Consequently, such philosophical matters of ontology, epistemology, axiology and methodology assumptions needs to be addressed explicitly since they shape the choice of research instruments (Christou *et al.,* 2008).

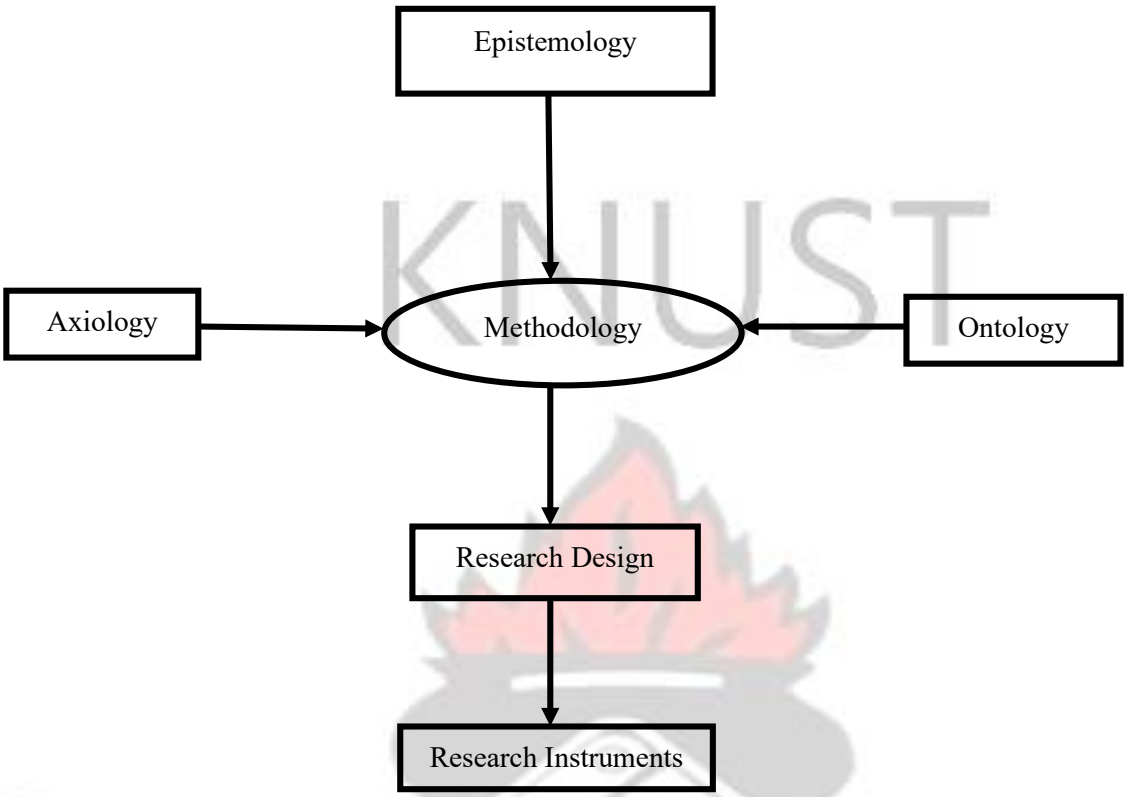


Figure 4.1: Foundations of Research
Sources: Adopted from Owusu-Manu (2008)

Ontological position enable the researcher to decide whether the reality is objective and external to the researcher, or socially constructed and only understood by examining the perceptions of the human actors (Collis & Hussey, 2003; Thurairajah, *et al.,* 2006). Blaikie (1993) however describes the root definition of ontology as 'the science or study of being' and develops this description for the social sciences to encompass 'claims about what exists, what it looks like, what units make it up and how these units interact with each other'. Although there is considerable blurring of research philosophy, it should be noted that, two main traditions of philosophies exit namely; positivism and social constructionism (Harty & Leiringer, 2005; Thurairajah, *et al.,* 2006). While positivist argue that the world exists externally and its properties should be measured through

objective methods, social constructionist hold the view the view that the reality is not objective and exterior but is socially constructed and given meaning by people (Easterby-Smith, *et al.,* 2003). However, Fitzgerald & Howcroft (1998) indicate that there are relativist and realist ontological positions. Positivist ontological assumptions as realist whist social constructionist as relativist or idealist (Johnson & Duberly, 2000).The relativist position at the ontological level holds to the multiple existences of realities as subjective constructions of the mind. The perception of reality is directed by socially transmitted terms and varies according to language and culture. Concepts, such as right and wrong, goodness and badness, or truth and falsehood are, therefore, not absolute but change from culture to culture and situation to situation (Fitzgerald & Howcroft, 1998).

Epistemology is a research philosophy branch which controls the structure and processes of social research (Sarantakos, 2005). Epistemology informs the methodologies about the nature of knowing or about what counts as a fact and where knowledge is to be sought (Campana, 2010).

Simply put, epistemology is the science of knowing (Babbie, 1995). Gall *et al*. (2003) added that epistemology is about studying the nature of knowledge and the process of acquiring knowledge and its validation. Epistemological issues deal with the question of knowledge acceptability in a discipline. It is "how we know" and the methods through which knowledge are acquired. Epistemological position can be positivist or interpretivist. The positivist epistemological position advocates the application of natural sciences method to the study of social reality and beyond. It is of the belief that the world conforms to fixed laws of causes and effects, and complex issues can be tackled using simplified or fundamental approach. The position emphasizes on objectivity, measurement and repeatability. It is, therefore, possible for the researcher to be objective from a detached position of the research situation. Neutral observation of reality must take place without bias from the researcher (Fitzgerald & Howcroft, 1998; Bryman, 2004). The interpretivist

epistemological position is contrary to the positivist and hence critical to the application of scientific model to social study. It advocates the absence of a universal truth and places more emphasis on the realism of context. The researcher is immersed in the research situation and the values and beliefs of the researcher become the driving force in the interpretation of findings (Fitzgerald & Howcroft, 1998; Bryman, 2004).

Axiological positioning is concerned with values. Axiology considers the philosophy surrounding the reality, as to whether research philosophy is 'value free' or value driven. If the choice for what to study or how to study is examined by objective criteria, it can be described as value free research. On the other hand value laden is driven by subjective criteria. (Pathirage *et al.,* 2005). Finally, the methodology of a research also determines the philosophical paradigm adopted.

4.2.1 Philosophical Position of the Study

The research phenomenon under consideration and the key research questions influences the type of paradigm that has to be adopted (Pollack, 2007, *cited by* Yankah, 2013). The research philosophy is principally concerned with the assumptions that a researcher brings to an investigation (Dainty, 2007). The conceptual framework is also strategic in deciding which paradigm to follow (Miles & Huberman, 1994).

Table 4.1 Summary of Philosophical considerations

Ontological considerations	
Realist	**Relativist**
External world comprises pre-existing hard and tangible structures Structures exit independent of individual's ability to acquire knowledge	Existence of multiple realities as subjective construction of the mind Perception of reality is directed by varying socially transmitted terms
Epistemological considerations	
Positivist	**Interpretivist**
Application of natural science methods to the social reality and beyond	Absence of universal truth and emphasis on study of realism of context

World conforms to the law of causation and issues can be resolved by reductionism	Understanding and interpretation come from complex researcher's own frame of reference

Axiological considerations

Positivist	**Social consideration**
Research and science are value free	Research and science are value laden i.e. values influence research

Sources: Adopted and modified from Baiden (2006)

Analyzing the above philosophical traditions and consideration in relation to the research objectives of this study, the philosophical position of this study is described as follows;

Epistemologically, this study adopted positivist tradition. This research was of the belief that the complex interactions of technology practices of construction firms could be explored through systematic but simplified steady approach. Also, positivist makes it possible to establish the convergent of the study in relation to the literature and theory. This will make it possible for the study to be replicated with relative ease if necessary. For the positivists, through the accumulation of verified facts, scientific knowledge is established (Bryman, 1992 *c.f* OseiHwedie, 2010).

At the ontological level, this research adopted a realist position. This is because variables that explain TT strategies and practices of firms were largely existed in literature. However, these variables have not been effectively utilized in the context of construction industry of developing countries. Also, this research viewed the investigation to be conducted as practical rather than abstract. Moreover, understanding of success and risk factors of TT in the Ghanaian construction industry exists as external facts that are beyond the reach and influence of the researcher.

Axiologically, this research this value free since the choice for what to study or how to study is examined by objective criteria. Also, while taking a realist view in ontological assumption, it holds positivist stance in epistemological tradition with value free axiological position (***see figure 4.2***).

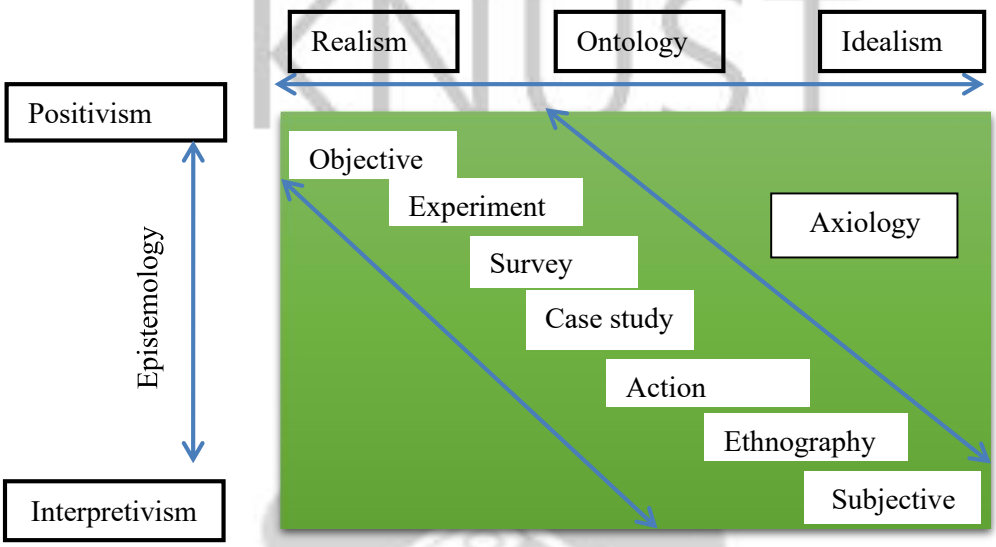


Figure 4.2: Research Philosophical Assumptions
Source: Adopted from Pathirage (2005)

4.2.2 Method of Scientific Inquiry and Reason

Deductive and inductive reasoning are different but equally valid routes to drawing conclusions in a scientific research (Babbie, 2008). These approaches involve logic (theory) and observation (data) and how these two pillars of science are related in a piece of research. Having adopted the positivism, it is appropriate to reason along the line of deductive logic in the conduct of this research in attempt to unravel the phenomenon of TT which is a social and quantitative dynamic in nature. This is because, social issues and intrinsic (psychological) issues affect technology which is numerically communicated. Deductive reasoning operates from a general to specific perspectives drawing conclusions based on facts (Burney, 2008, this position is supported by adoption of deductive reasoning, a stance advocated by Collis & Hussey (2003) that deduction allows the expectation of a phenomenon; likewise, Robinson (2007) sequentially outlined deductive logic in research as deduction of hypothesis from theory; operationalization of the hypothesis (how the variables are to be tested) to determine the relationship between specific

concepts and variables; testing the hypothesis; confirmation or modification of the outcomes; and verification of the theory using the findings.

4.3 RESEARCH STRATEGY AND APPROACH

The strategy for this research is divided into several parts. These parts are, respectively, theoretical (i.e. analytical) and empirical (i.e. collection of qualitative and quantitative data). The theoretical part will focus on analysing the literature review of TT in general and reviewing relevant existing TT models which in turn led to the conceptualisation framework for the study at hand. Whereas the empirical part will focus on experimental data collection gathered from two main streams. These streams are Case Study (qualitative data collection) and Survey (quantitative data collection). The case study was undertaken by organising face-to-face interviews with construction professionals engaged in TT. The research uses case studies as its research strategy. Seppänen (2009) states, according to Yin (2003), that "a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident".

The research method must be designed in a robust manner to achieve valid data for each aspect of the project. The selection of this study's research design was guided by philosophical assumptions, an evaluation of previous studies and the research aim and objectives. Decision making about the research approach, strategy and design is fundamental to both the philosophy underpinning the research and the contributions that the research is likely to make (Thurairajah *et al.,* 2006, Harty & Leiringer, 2007). There exist many types of research approaches and data collection methods to achieve the desired objectives of a study of this nature. For instance, questionnaire surveys can collect a large number of responses within a relatively short time, but it is difficult to avoid the

confounding variables of the research. The case study method of observation is very useful for studying subjective processes but this represents only a small number of cases of the research. For this research design, both of these data collection methods will be utilised at different stages of the research program. Utilising both of these approaches should ensure that the developed model for TT in construction projects is reliable and valid. Also, before proceeding with the design, it is important to discuss briefly the two main research strategies; qualitative and quantitative research since this study utilise both types of research.

4.3.1 Qualitative Research

Qualitative research is naturalistic; it attempts to study the everyday life of different groups of people and communities in their natural setting; it is particularly useful to study educational settings and processes. "….qualitative research involves an interpretive, naturalistic approach to its subject matter; it attempts to make sense of, or to interpret, phenomena in terms of the meaning people bring to them (Denzin & Lincoln, 2003). This means that in qualitative studies, researcher study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them. According to Jean (1992) qualitative research is "….a form of social interaction in which the researcher converses with, and learns about the phenomenon being studied". In other words, the researcher is part of the research process and is actively involved in creating the meaning of reality (Crotty, 1998).

In qualitative research, different knowledge claims, enquiry strategies, and data collection methods and analysis are employed (Creswell, 2003). Qualitative data sources include observation and participant observation (fieldwork), case studies, interviews and questionnaires, documents and texts, and the researcher's impressions and reactions (Bryman, 2004). Data is derived from direct

observation of behaviours, from interviews, from written opinions, or from public documents (Sprinthall *et al.,* 1991). Written descriptions of people, events, opinions, attitudes and environments, or combinations of these can also be sources of data. Again, qualitative research examines the patterns of meaning which emerge from the data and these are often presented in the participants own words (Denzin & Lincoln, 1994). The goal of qualitative research is to discover patterns, which emerge after close observation, careful documentation, and thoughtful analysis of the research topic (Patton, 1990).

Drawing on from the above works cited, qualitative research is a systematic inquiry into the nature or qualities of complex social group behaviours by employing interpretive and naturalistic approaches. Qualitative study lends itself to thick narrative description of the group behaviours in the group's natural environment. It attempts to be non-manipulative and takes into account the unperturbed views of the participants as the purpose is generally to aim for objectivity. Qualitative research are most appropriate when the researcher wants to become more familiar with the phenomenon of interest, to achieve a deep understanding of how people think about a topic and to describe in great detail the perspectives of the research participants.

4.3.2 Quantitative Research

According to Wadsworth (1997), quantitative research is the systematic scientific investigation of quantitative properties and their relationships. Quantitative research approach however looks at past words, actions and records to their mathematical significance and quantifies the results of these observations (Cresswell, 1994). Wadsworth (1997) stated that quantitative research is about "how many; to what extent, or how much aspect which involves counting and other data analysis. The objective of quantitative research is to develop and employ mathematical models, theories, *hypotheses* concerning the natural phenomena (Sarantakos, 2005). Quantitative research makes

use of questionnaires, surveys and experiments to gather data that is revised and tabulated in numbers, which allows the data to be characterized by the use of statistical analysis (Hittleman & Simon, 1997). Quantitative researchers measure variables on a sample of subjects and express the relationship between variables using effect statistics such as correlations, relative frequencies, or differences between means. Measurement process is key to quantitative research because it provides the basis for connection between empirical observation and mathematical expression of quantitative *relationships* (Gall *et al*., 2003). The quantitative research generally uses critical approaches such as the generation of models, *theories and hypotheses*; the development of instruments and measurement; experimental control and manipulation of variables; *collection of empirical data*; modeling and analysis of data; and evaluation of results (Gall *et al*., 2003). This means that quantitative research results can be generalized to a larger population within acceptable error limits. A positivist, objectivist and realist approach investigate and *explain how one variable affects another* (Creswell, 2005). ***Drawing on from the above discussion***, It allows for a design to evolve rather than having a complete design in the beginning of the study because it is difficult if not impossible to predict the outcome of interactions due to the diverse perspectives and values systems of the researcher and participants, and their influence on the interpretation of reality and the outcome of the study. However, all quantitative research requires a hypothesis before research can begin.

Table 4.2 below shows a summary of major differences between quantitative and qualitative approaches to research.

	Quantitative Research	**Qualitative Research**
Objective	Gather factual data and study relationships between facts and relationships in accordance with theory.	Study issues in depth and detail and seeks to gain insight and understand people's perceptions

Orientation to the role of theory to research	Deductive and thus associated with verification of theory and hypothesis testing.	Inductive and geared towards the generation of theory from specific instances.
Common data collection techniques	Questionnaires, tests and existing databases.	Interviews, observations and documents.
Data characteristics	Hard data, structured, large sample size, analysed using statistical methods.	Soft data, descriptive, less structured analysed using nonstatistical methods.
Outcome	Conclusive findings used to recommend a final course of action.	Exploratory and/or investigate and findings are contextual.

Sources: Bryman (2004), Fellow and Liu (2003), Naoum (2002), Neuman (2003) and Sherif (2002)

4.3.3 Research Strategy Adopted for this study

It has been earlier discussed that the methodological issues concerning every kind of research is best answered with careful consideration of the theoretical concepts of the research: the aim, objectives, hypothesis and research questions under consideration (Bryman, 1992; Denzin & Lincoln, 1994).

In this thesis, a mixed approach was adopted based on the philosophical and practical reasons as discussed above. While the quantitative approach provides us with a snapshot of phenomena, the qualitative approach provided the contextual information and human subject information to interpret and inform the qualitative results. The use of both methods provides richer understanding of phenomena and an explanatory account of triangulation an illuminates significant research findings. According to Tashakkori & Teddlie (2003), the mixed method is a research design with philosophical assumptions as well as methods of scientific inquiry. As a methodology, it involves philosophical assumption that guides the direction of collecting and analysing data and the mixture of qualitative and quantitative approaches in man phases of the research problem and process. Its

central premises is that the use of mixed approach provides better understanding than either approach alone.

Mixed method was considered to be appropriate for this study because it helped to demonstrate a useful predictive process and provided a better understanding of the forms, channel and human resource dimensions of TT. The use of mixed approach helped to confirm the findings of both the qualitative and quantitative approaches (Flick, 2009). Hence, the research findings could be used to establish a better understanding of the factors that needed to be considered in developing sustainable absorptive capability in the Ghanaian construction industry.

4.4 SELECTION OF RESEARCH DESIGN

In diffusion research, two major research approaches are applicable- Variance research and Process research depending on the aim of the research (Gopalakrishnan & Damanpour, 1994; Subramanian & Nilakanta, 1996). Whereas variance research involves data gathering and analysis that consists of determining the covariance (correlations) among a set of variables, process research seeks to determine the sequence of a set of events over time (Rogers, 2003). Consequently, variance research involves quantitative methods which measure variables by assigning numerical values to behavior and process research involves qualitative methods.

By adopting positivism as the paradigm underpinning this study, the epistemological, ontological and axiological assumptions dictated that either; case studies, surveys and experiments would be most ideal as the research method (***see Figure 4.2***). However, experiments would not be an appropriate choice because they are carried out usually in a laboratory setting where the investigator can manipulate behaviour directly, precisely and systematically (Yin, 2003). Thus, in view of the nature of investigation associated with this research, experiment was discounted as an appropriate option. In surveys, samples are examined through questionnaires while case studies

involve an empirical enquiry that investigates a contemporary occurrence within a real life context (Yin, 2003).

Moreover, Yin (2009)'s selection of a research method is based on three conditions: a) the type of research question posed, b)the extent of control an investigator has over actual behavioral events, and c) the degree of focus on contemporary as opposed to historical events. Going by Yin's (2009) first condition, some of the questions that the empirical portion of the research focused on were "what" questions that centered on the frequencies, incidence or prevalence of the phenomenon rather than the need for operational links that needed to be traced over time hence surveys and archival analysis were possible choices. Surveys were however selected as a more appropriate choice given that the issue of inquiry is a contemporary one and because relevant accumulated documents or archives on TT in the Ghanaian construction industry were not available. There was also a "how" and "why" question which favours the use of case studies, experiments or histories. However, case study was selected because of the lack of control of the researcher over events and the fact that the phenomenon studied was a contemporary one. The choice of the case study strategy was also informed by the complex and multivariate nature of the explanatory theory employed in the research and the presence of many more variables than data points. A situation that is overcome by the case study since the inquiry embraces this complexity by investigating the phenomenon within its real life context.

In the conduct of this research, the choice of the survey and case study methods were appropriate in the light of the aim of the study which was to explore technology transfer partnerships in Ghana, and to develop a conceptual framework for facilitating the flow of technology from foreign to local

construction firms in Ghana. The survey was a cross-sectional one with data collected at one point in time rather than over time and involved the use of a structured self-administered questionnaire.

4.4.1 Case Study Design

The case study research method is highly suited to bringing us to an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research (Soy, 1997). Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. Researchers have used the case study research method for many years across a variety of disciplines. Social scientists, in particular, have made wide use of these qualitative and quantitative research methods to examine contemporary real-life situations and provide the basis for the application of ideas and extension of methods.

The case study research method has been found to be an ideal methodology when a holistic, indepth investigation is needed. There have been various investigations about the concept of case studies, particularly in sociological studies. It has also been noticeable increase in the construction field. Researchers such as (Yin, 2003; Gerring, 2006) and others who have investigated the concept of methodology have also proposed procedures that can be followed by researchers as well-developed and tested as any in the scientific field. Whether the study is experimental or semi-experimental, methods of data gathering and analysis tend to ignore some details. The richness of the data to be collected may, however, limit the number of cases that can be studied. The selection is often based on their representativeness of cases (Fellows & Liu, 2003; Bryman 2004). Case studies, on the other hand, are designed to reveal the details of the experience and opinions of the participants by using multiple sources of data (George, 2005; Seidman, 2005; Gerring, 2006; Hancock, 2006).

4.5 SURVEY PROCESS

Cohen *et al.* (2005) observed that researchers who adopt positivist perception use a range of traditional options such as surveys and questionnaires. According to Isaac & Michael (1997), survey research is an avenue for answering questions that have been raised, to solve problems that have been posed or observed, assess needs and goals set, to determine whether or not specific objectives have been met, to establish baselines against which future comparisons can be made, to analyze trends across time, and generally to describe what exist, in what amount and in what context. Kraemer (1991) opined that survey research is used to quantitatively describe specific aspects of a given population which consist of relationship between variables. Kraemer (1991) further pointed other characteristics of survey research by asserting that the data required for the survey research are collected from people by using certain portion of the population from which findings can later be generalized back to the population. According to Glasow (2005) independent and dependent variables are used to define the scope of survey research; and that before the commencement of the research, the researcher must predicate a model of relationship existing among the variables.

In keeping with the above works demonstrated in extant literature, the rationale for adopting the survey process for this study is embedded in the philosophy of the researcher that the survey process enables data to be gathered from large number of respondents in order to generalize the results of the study. Again, the survey process was adopted because of its ability to allow for the aggregation of the opinions and attitude of respondents on the various facets of construction stakeholders under investigation.

4.5.1 Research Scope Questionnaire Survey and Targeted Respondent

The target respondents in this research include the Ghanaian construction sector and its associated professionals participating in TT programs. This research focuses only on the perceptions of transferees since TT initiatives are undertaken for improving the technology knowledge of local professionals. The selection criteria for the projects to be investigated were as follows: local firm involvement; technology acquisition objective explicitly or implicitly expressed by clients; and projects completed recently or currently under construction.

The research was conducted in Accra the administrative and political capital of the Republic of Ghana. The population of Accra constitute 16.3 per cent of the population of Ghana (Ghana Statistical Service, 2012). Accra is also the capital of the Grater Accra region of Ghana bounded by the Central Region, Volta Region, Eastern Region and the Gulf of Guinea. Accra is the key industrial hub of Ghana, being home to every aspect of the Ghanaian economy ranging from agriculture to tertiary services like the consultancy industry. Construction is one of the key industrial sectors in Accra. This phenomenon is underpinned by its industrial nature and the concentration of job seekers in the construction sector by people migrating from the rural areas. As construction activities boom in Accra, it implies that more professionals including quantity surveyors in the construction industry will gravitate towards the Greater Accra. On a whole, a total number of 120 questionnaires were sent, out of which 94 were retrieved which represent 78% response rate.

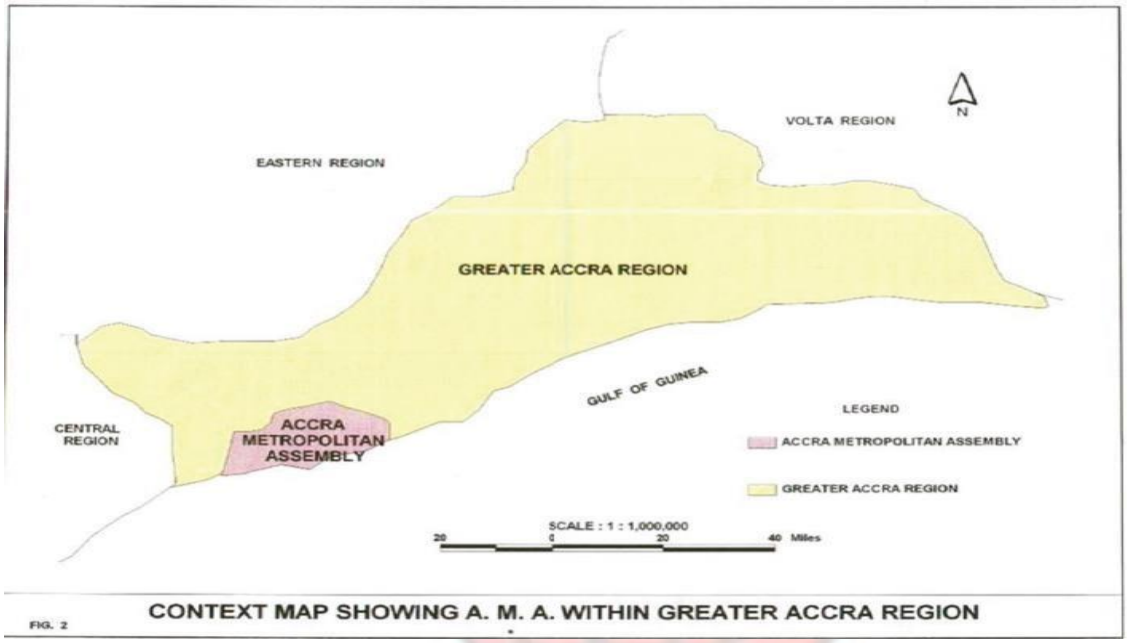


Figure 4.3: Map of Greater Accra Region (Source: UN-HABITAT, 2009)

4.5.2 Sampling Technique and Sample Size Determination

The general aim of all sampling methods is to obtain a sample that is representative of the target population. By this, the information derived from the sample survey is the same (allowing for inevitable variations in the estimates due to imprecision) as we would find if we carried out a census of the target population. When selecting a sampling method we need some minimal prior knowledge of the target population; with this and some reasonable assumptions we can estimate a sample size required to achieve a reasonable estimate of population characteristics. The term "sample" means a part of a whole (population) drawn to reflect the remaining (Naoum, 1998). Thus, sampling refers to the process of selecting a quota of the population to characterize the entire population. A sample, then, consists of a subject of the units that constitute the population (Polit & Hungler, 1999) and normally used in large-scale survey research for the sake of economy and accuracy (Weisberg & Bowen, 1977). However, research studies use simply a small fraction of the population, referred to as a sample. This is because using a sample is more practical and less costly than collecting data from the entire population. Polit & Hungler (1999) asserted that, the major

risk of using a selected sample is that it might not adequately reflect the behaviours, traits, or beliefs of the population.

The sampling technique for this endeavour based on its purpose, design, and practical implication of the research topic is purposive sampling. Simply put, the researcher decides what needs to be known and sets out to find people who can and are willing to provide the information by virtue of knowledge or experience (Bernard, 2002; Lewis & Sheppard, 2006; Tongco, 2007). In the context of this research, this strategy involves identifying the construction professionals involved in designing, constructing, or administering TT process.

Purposive sampling refers to strategies in which the researcher exercises his or her judgment about who will provide the best perspective on the phenomenon of interest, and then intentionally invites those specific perspectives into the study. Purposive sampling can be very useful for situations where you need to reach a targeted sample quickly and where sampling for proportionality is not the primary concern. With a purposive sample, you are likely to get the opinions of your target population, but you are also likely to overweight subgroups in your population that are more readily accessible. More so, snowball sampling was utilized in attaining the sample size because of the difficulties encountered in assessing the population size of the class. Snowball sampling is a technique for finding research subject (Atkinson & Flint, 2001). This strategy viewed as a response to overcome the problems associated with concealed or hardto-reach populations. The process based on the assumption that a 'link' exists between the initial sample and others in the same target population, allows series of referrals made within a circle of acquaintance (Berg, 1988; Atkinson & Flint, 2001). Hence, the snowball sampling was used for identifying respondents with rich information that are relevant to the study. This process continued for a total number of 120 questionnaires, out of which 94 were retrieved for data analysis.

4.6 RESEARCH PROCESS

As indicated early in previous section of this thesis, the research questions to be addressed were derived from an exploratory and in-depth literature reviews. These reviews provided the relevant theoretical background and framework to undertake the research. Having determined the philosophical viewpoint, research strategy and design, the research processes adopted to meet the objectives of the research are outlined. These objectives were developed to achieve the aim of the research indicated. This study considers case studies design to facilitate developing a conceptual framework based on examining a number of construction project with both international and local collaboration. The research designed consists of four fundamental stages: (1) literature review; (2) modelling (conceptual model development); (3) single case study (interview: qualitative data) and (questionnaire survey: qualitative data); and (4) refining and validation of the model.

Stage I: The literature review has been conducted on the basis of available literature, including thesis, conference and journal sources. This analysis of literature has three parts: firstly, the phenomenon of TT are explored; secondly, the review of existing construction TT models; thirdly, conducting reviews and conceptualizing models for TT based on knowledge and absorptive capability. This literature review is based predominantly on secondary data that has been evaluated and analyzed for crafting policy development for construction TT.

Stage II: Modelling (Conceptual Model Development) – The aim of this stage is to develop a conceptual model for vertical TT in construction projects and determine the main factors and sub-factors of this model based on the literature review undertaken in previous chapter. ***Stage III: (Case studies: interview & questionnaire survey)*** – The aim of this stage is data collection including single case and multi-case studies followed by an analysis of the empirical data. Case

studies were conducted for local companies that were carrying out construction projects with developed companies. ***Stage IV: (Model Refinement and Validation)*** – This stage aims to refine and validate the conceptual model for vertical TT in construction projects through a series of project-based case studies where vertical TT was implemented.

Table 4.3: Main Research Design Focusing on the Following Research Tasks and Outcomes

Stage	Description	Outcomes
Literature Review	Review of phenomenon of TT towards the understanding of TT Review of TT research in the construction field and other related research areas Review of extant TT models to create a new model which is relevant to construction projects	Understanding of human effective factors that impact on the TT process and its outcomes
Conceptual Model	Extracting effective human resource dimensions Taking into account the cultural impact	Conceptualising model of TT in Ghanaian construction industry
Data collection Single Case Study (projects) Survey questionnaire Analysis	Conducting an in-depth (face-toface) interview Conducting questionnaire survey throughout selected within the boundaries of this research study Collecting empirical data Statistical analysis was used	Justification of the conceptual model Improved understanding of TT enablers, human factors and their impact on the outcome
Model Refinement & Validation	Refining and finalizing the model for TTP in construction projects	Validation of the model for TTP in construction projects

Source: Researcher's Construct (2015)

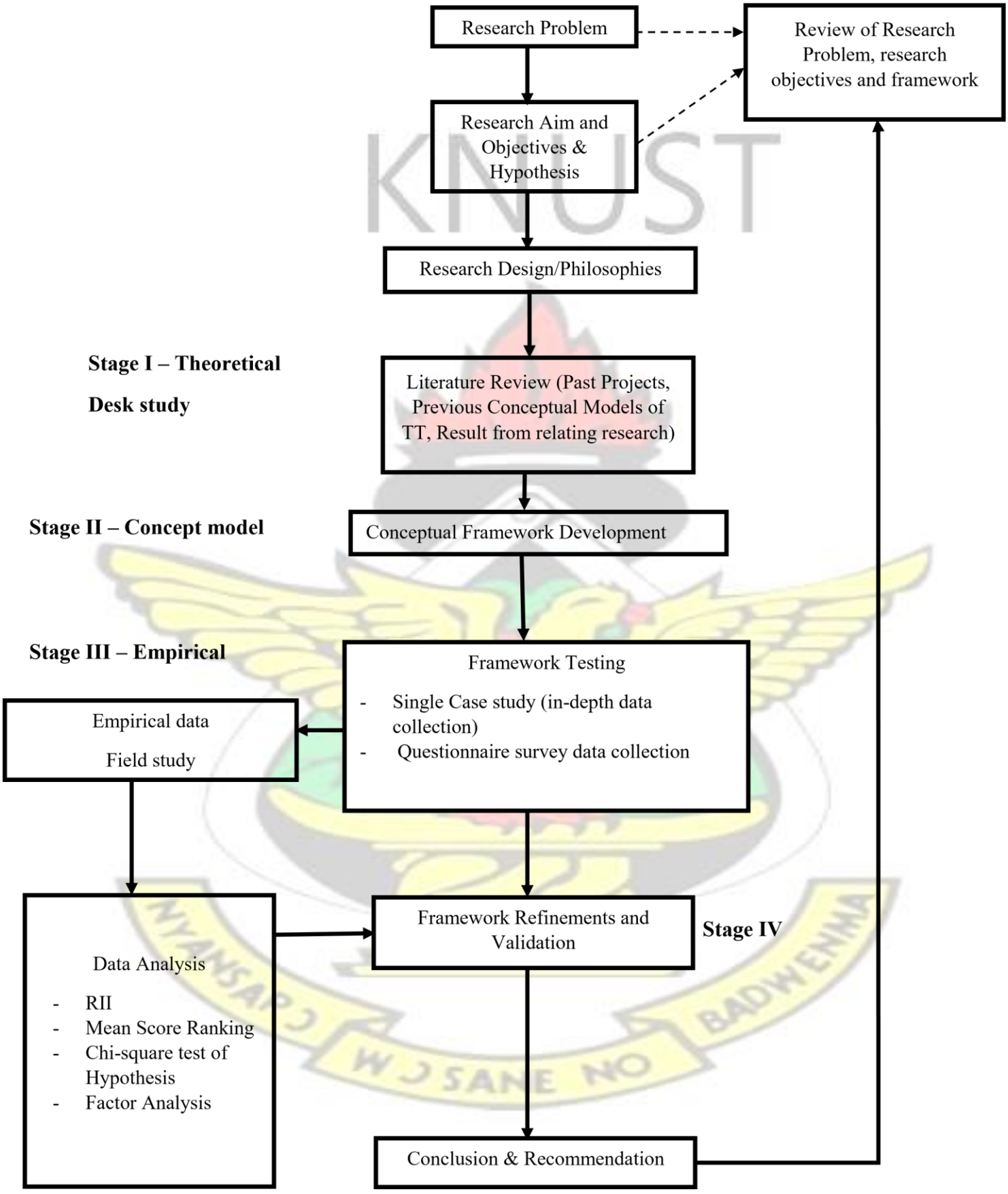

Research Problem
Review of Research Problem, research objectives and framework
Research Aim and Objectives & Hypothesis
Research Design/Philosophies
Stage I – Theoretical
Desk study
Literature Review (Past Projects, Previous Conceptual Models of TT, Result from relating research)
Stage II – Concept model
Conceptual Framework Development
Stage III – Empirical
Framework Testing
- Single Case study (in-depth data collection)
- Questionnaire survey data collection
Empirical data
Field study
Data Analysis
- RII
- Mean Score Ranking
- Chi-square test of Hypothesis
- Factor Analysis
Framework Refinements and Validation
Stage IV
Conclusion & Recommendation

Figure 4.4: Road map of Research phases
Source: Researcher's Construct (2015)

4.7 DATA COLLECTION METHODS

This aspect of the research methodology addresses data collection instruments, methods, and procedures. It provides exhaustive explanations to each of the methods used in addressing the aims, objectives, and research questions. Data gathering is crucial in research, as the data contributes to a better understanding of a theoretical background (Bernard, 2002). It then becomes imperative that selecting the manner of obtaining data and from whom the data will be acquired be done with sound judgment, especially since no amount of analysis can make up for improperly collected data (Bernard *et al.,* 1986; Tongoco, 2007). It should be noted that clear description of these important components of the research design and methods are critical to communicating what was done in addressing the research concerns.

4.7.1 Sources of Data

It has been mentioned earlier that multiple sources of information were used to address the research goals. However, this approach was time consuming and relatively expensive as compared to single source of data. The approach for collecting data in this study was divided into two main parts. The first discusses the desk study and the second talked about the field survey. The desk study forms an essential aspect of the research since it sets the pace for the development of the field survey instrument using questionnaires and interview (Fadhley, 1991). The secondary data obtained from reviewed literature on the area of study includes; brochures, magazines, reports, relevant books obtained from libraries, journals, articles, and published works of interest. The field survey involved with the collection of empirical data. A multiple approach of data gathering was adopted for the purpose of this study which focuses on questionnaires and interviews.

4.7.2 Development of Questionnaires

The questionnaire were designed to address the aim, objective and research question of this study. It was essential to establish the information to gather for relevant questions to be solicited (Oppenheim, 1996). Contemplations of appeal to respondents ease of reading and supplying the required data guided the format of the questionnaires. This enhanced proper usage of time during the data collection. The questionnaire designed includes; close-ended questions, open-ended questions and scaled response questions. The five-point likert response scale employed, measures the strength or intensity of respondent's opinion. The questionnaires were personally administered by the researcher. Creswell (2005) opined that quantitative research uses an instrument to measure variables in a study; this instrument consists of specific questions and response alternatives or possibilities that the researcher has established as a priori to the study. According to Campana (2010), survey questionnaires are adopted to generalize the results collected from a smaller number to a larger number. Survey questionnaires also aim at one or more groups of people in obtaining their opinions and attitudes concerning a phenomenon under study (Funnell, 1996). Survey questionnaires have numerous advantages consisting of the ability to access a large number and geographically dispersed population; gathering of data by means of voluntary participation devoid of compulsion or force; reduction of researcher bias; and minimization of time requirement for the respondent and the researcher (Creswell, 2005). A good questionnaire consists of questions that elicit different types of information from respondents (Gall *et al*., 2003). Questionnaires must be kept short, questions organized in easy manner and avoiding double-barreled questions (Gall *et al*., 2003).

The design of an effective survey questionnaire is hinged on four critical pillars namely question wording, categorization, coding of variables and general acceptance (Sarantakos, 2005). Survey

instrument design must be preceded by firstly defining clearly the focus of the study; and secondly, translating the study objectives into measureable factors that contribute to the focus of the research (Salant & Dillman, 1994). According to Fowler & Floyd (1995) a good question is one that produces answers that are reliable and valid measures of something that we want to describe. McIntyre (1999) observed that survey questions must use words that commensurate the educational levels of respondents. Fowler & Floyd (1995) added that both the question and the response options must be clear to both the respondent and the researcher. The wording should prevent alternative interpretations or incomplete sentences that would allow misinterpretation (Salant & Dillman, 1994; Fowler & Floyd, 1995). Survey questions should not be combined where the respondent might wish to answer affirmatively for one part, and negatively for the other part (Glasow, 2005).

4.7.2.1 Questionnaire Format

Available literature suggests that the optimum length of questionnaire ranges from one side of A4 paper to eight pages of A4 paper (Naoum, 1998; Oppenheim 2000; Saunders *et. al*., 2000; Fellows & Liu, 2003; Polgar & Thomas, 2005). This research however designed a questionnaire covering five pages as provided in the Appendix 1A.

4.7.2.2 Content of Questionnaires

The next step after having identified the respondents for the questionnaire and their characteristics was to focus on the design of the actual questions that solicited the requisite information for the study. The way in which the survey questions were presented would affect the quality of the responses and therefore it was important to ensure that the right questions were asked, well understood and stated in the right way (Wahab, 1996). The questionnaire consisted of eleven (11) questions mainly closed-ended and scaled-response type and the questions were type-setted on

standard A4, white colour sheets with front cover page. The questions were further divided into three (3) sections, mainly, section A, B and C. While section A solicits information regarding the background and firm characteristics, Section B looks at the typologies, mode of transfer, risk factors and success factors facilitating TT in the construction industry. The last section was on evaluating the new knowledge, absorptive capability and technological innovation (a conceptual framework) in the Ghanaian construction industry. The full detail of the questionnaire is attached as an appendix to this research study (***See Appendix 1A***).

4.8 DATA ANALYSIS METHODS

4.8.1 Inferential Analysis: Hypothesis Testing

Inferential analysis intends to make generalizations from a sample to the wider population (Gabrenya, 2003). Inferential analysis largely dwells on the deployment of statistical techniques in testing hypothesis to derive implications from a research (Baddie & Halley, 1995; Kolawole, 2001). They are equally suitable for data obtained through the utility of nominal scale of measurement; ordinal measurement and processed in ranked order of 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and indefinitely. Non-parametric analysis is also suitable when the research does not have idea about the nature of the distribution (Siegel, 1988). Hypothesis testing is a technique adopted by researchers to draw conclusion on the results of a data collected in a research investigation in order to make useful conclusions on a population of interest (Deveries, 2007). Hun (2010) asserted that a hypothesis is an assumption about the characteristic of a particular population of interest.

Testing hypothesis for a research study is also aimed at the utilization of the sample data to infer from the results to determine the level of real relationship between variables. According to Kochanski (2005), hypothesis testing is apposite for critical application or for drawing conclusion. Hypothesis testing results into either 'null hypothesis (H_o) or the alternative hypothesis (H_1); for which the *p*-value is the probability of obtaining a result as large as that observed in the sample if

the null hypothesis were true; and *Alpha,* the probability of falsely rejecting the null hypothesis Typically, the alpha is set at .05 or .01(Anglim, 2007). The *p*-value is about the statement of values that never occurred; it is computed based on the distribution of the test statistic assuming the null hypothesis is true (Anderson *et al*., 2000). According to Anderson *et al*. (2000), the appropriate interpretation of the *p-value* is based on the probability of the data given the null hypothesis is not the converse. The ***p-value*** indicates the degree of consistency of the data with the null hypothesis (Ho) (Anderson *et al*., 2000). Similarly, the *p*value is perceived as the degree of risk that researchers take in rejecting the null hypothesis

According to Anglim (2007), if the *p*-value is less than alpha (*for instance* .05), the probability of the null hypothesis being true is low, hence reject the null hypothesis and accept the alternative hypothesis. According to Anderson *et al*. (2000) a test statistic is first calculated from the sampled data and judged against its hypothesized null distribution to assess the consistency of the data with the null hypothesis; if the values of the test statistic are more extreme, then it implies that the sample data are not consistent with the null hypothesis. In addition, an arbitrary level (α) is set as a cutoff to serve as the basis for deciding statistically significant and statistically non-significant results (Anderson *et al*., 2000).

4.8.1.1 Adoption of Chi Square Test for Hypotheses Testing

Two key underlying assumptions of the Chi-square test state that the sample size must not be less that 5 (Champion, 1970); and samples must be achieved through independent observation (Adeyemi, 2009). Chi-square test is appropriate for an entire population irrespective of whether the data fits normal distribution (Adeyemi, 2009). The Chi-Square test is a non-parametric test of significance targeted at testing the relationship between two variables (Adeyemi, 2009).

Scheaffer (1999) observed that the chi square test indicates the relationship in data. According to Zibran (2007), the chi-square test is appropriate for ascertaining association or independence of facts given by the formula:

$$X^2 = \frac{(O_I - E_I)^2}{E_I};$$

Where Oi= observed frequencies; E_i= expected frequencies; i= 1, 2, 3…….n, and n= number of cells in the contingency table. Zibran (2007) concludes that the chi-square test helps in ascertaining whether the classifications on a given population are dependent on each other or not.

Drawing on from the above extant literature extensively, the Chi-Square test is adopted for this research as a result of the scale of measurement adopted in data collection which is mainly ordinal. Another reason for using the chi square to test hypothesis is the objective of ascertaining the relationship between TT as the main dependent variable and independent variables which have the potential of affecting collaboration of TT. Chi-square Test was conducted using the SPSS to determine if significant relationships exist between dependent and independent TT variables. TT is the main dependent variable and factors relating to TT are independent variables; in this case independents variables are all variables within the concept of absorptive capability; human resource dimensions; and forms and channels on how technology and knowledge are received from transferor firms.

4.8.2 Framework Development: Utilizing Factor Analysis

Factor analysis is a standard mathematical procedure that aims at transforming a large set of variables that are possibly correlated into a smaller number of uncorrelated variables called principal components (Norusis, 2000; Child, 1990; Gorsuch, 1983). The suitability of it is such that the number of variables in a study must be in the range of 20 to 50 (Po-Yi & Chen, 2004). Factor analysis is conducted for varied purposes including: exploring a content area; structuring a domain; evaluation of construct validity; hypothesis testing; mapping unknown concepts;

classifying or reducing data; development and enhancement of instruments scales; formulating theories; screening or transforming data; define relationships; control variables (Ahadzie *et al.*, 2007; Love *et al.,* 2004; Norusis, 2000; McCauley *et al*., 1994; Tucker & MacCallum, 1993).

According to Williams *et al*. (2012), the reasons for factor analysis are to reduce the number of variables; to discover and evaluate the dimensionality of a theoretical concept; to ensure the simplification and effectiveness of analysis and interpretation; to determine the relationship between variables; to examine the validity of a scale; to address phenomenon of high correlation between two or more variables; to develop conceptual framework and to confirm or reject theories. According to Chang & Chen (2004), factor analysis must be conducted in accordance with these procedures: ***Bartlett's Test of Sphericity*** to test for the existence of common factors within a collected data to necessitate the conduct of the factor analysis. ***Estimation of common factors*** to ascertain the suitability of the sampled questionnaire for the factor analysis, the principal component factor analysis is adopted as it has assumed popular usage (Po-Yi & Chen, 2004). Most studies adopt '1' as the common factor for value for the diagonal line of the matrix; ***extraction of components***, exploratory factor analysis is adopted for the identification of new attributes or variables to develop a framework, the method of principal axes is used to extract common factors; factor extraction is categorized as common factor model and component model also christened principal component analysis (PCA) (Gorsuch, 1983). Common factor models are used for the identification of dormant variables responsible for relationship between measured variables in a study; and the target of the PCA is to reduce the number of variables by linear combination to uphold essentially original measures (Conway & Huffcutt, 2003). ***Deciding common factor number***, the factor analysis combine variables that are highly correlated and the representation of their meanings, for instance Chang & Chen (2004) adopted the value of '1' as the benchmark for

the selection of common factors in their study on evaluating the performance of VE study using factor analysis.

Other means of determining the number of factors in factor analysis include the scree test, parallel analysis; a priori theory; and the retention of variables that produce high proportion of variance explanation (Conway & Huffcutt, 2003). The scree plot is irrelevant in most cases as it allows for the subjectivity of the researcher in the interpretation of the plotted line to determine the number of factors; hence an alternative to the scree plot is the deployment of parallel analysis by comparing correlation matrices to eigenvalues and in this case of parallel analysis factors derived from the real data must be greater than the eigenvalues (Fricker *et al*., 2012). The common factor model is suitable for deriving meaning for the variables observed (Conway & Huffcutt, 2003). ***Selection of rotation method*** is necessary when the factors are more than one to acquire deduce solution (Conway & Huffcutt, 2003) to curtail the problems associated with interpretation. The main rotation methods include the orthogonal rotation method and oblique rotation method, the ***oblique method*** was adopted by (Chang & Chen, 2004). Oblique rotations are more favored than orthogonal rotations. A simple structure approach is advocated by Fabrigar *et al.* (1999) in which each factor has a set of variables with high loadings and the other set of factors with low loadings.

4.8.2.1 Interpretation of Factor Analysis Results

The interpretation of the results churned out by factor analysis is guided by the following criteria, common degree which is determined by the conduct of the Barlett's test in which the KMO value is used to ascertain the suitability of the variables for factor analysis. A KMO value above 0.5 implies that the Barlett's test is appropriate of the original variables (Po-Yi & Chen, 2004). Communality coefficient provide the options pertaining to the retention of the factors, which is a useful way of establishing how many factors should be retained in the analysis (Child, 1990;

Gorsuch, 1983). When an indicator variable has a low communality, the factor model is not working well for that indicator and possibly it should be removed from the model (Field, 2005; Love *et al*., 2004; Child, 1990). If the communality exceeds 1.0, there is a spurious solution, which may reflect too small a sample or the researcher has too many or too few factors (Field, 2005; Norusis, 2000). The eigenvalues for a given factor measures the variance in all the variables which is accounted for by that factor. The ratio of eigenvalues is the ratio of explanatory importance of the factors with respect to the variables (Field, 2005; Tucker & MacCallum, 1993; Child, 1990). Conventionally, if a factor has a low eigenvalue, then it is contributing little to the explanatory of variances in the variables and may be ignored as redundant with more important factors. This suggests that high factor eigenvalue of a variable indicates high relative explanatory important of that variable. In conformity with Kaiser's recommendation, eigenvalues of more than 0.5 were considered as having significant importance. The rotated and unrotated factors of interpreting results indicated that, the rotation factor solution is displayed by default and is essential for interpreting the final rotated analysis.

However, the unrotated factor solution is useful in assessing the improvement of the interpretation due to rotation (Gorsuch, 1983). Rotation suggests the behaviour of the variables under extreme conditions and maximizes the loading of each variables on one of the extracted factors whilst minimizing the loading on all other factors and it is best factor output solutions for interpreting factor analysis (Field, 2005; Child, 1990; Joreskog, 1969). Subsequently, Varimax rotation was adopted for this study because the factors are expected to be independent (Field, 2005).

4.9 CHAPTER SUMMARY

This chapter has discussed research methods and given reasons for the options selected to achieve the research aims and objectives. The chapter also described the research design and methodology, including the philosophical positions of the research, research strategy, and research design

adopted for this study. The methods and techniques which were used in the data collection and analyses were also presented. The chapter concluded with the research process and covered issues such as scope of questionnaire survey, data sources, sampling and sample size determination, questionnaires development, content of the questionnaires, questionnaires distribution, and data analytical tools.

CHAPTER FIVE

DATA ANALYSIS AND DISCUSSION OF RESULTS

5.1 INTRODUCTION

This chapter of the research details the analysis and the discussion of the results obtained after the administration of the research instruments; the semi-structured interview and the survey questionnaire which generated data to provide the basis for this chapter. This chapter is divided into two sections. The first section deals with the single case study interview that was held prior to the questionnaire survey. The second section captured detailed analysis of the survey questionnaire. Utilizing the survey questionnaire provided the information on the critical TT typologies, channel, risk factors, success factors and enabler of TT process. These information were very crucial for the analysis and improved the validity and reliability of the research. Also, these information were pivoted around the objectives of this study.

The nature of data analyzed in this chapter is purely primary data; primary data is significant in this domain of TT because of their ability to be closer to the layer of truth (Leedy & Ormrod, 2005). The logical reasoning in this analysis is mixed method relying on the data collected using

both the interview and questionnaire crafted as a result of the general review of extant literature and critical related existing models or concepts to postulate critical TT hypotheses to be tested to enable inferences to be made for generalization. As earlier noted three main statistical analyses (chi-square test (X^2) of significance, factor analysis and mean score ranking) were undertaken, in addition to the initial descriptive statistics conducted.

5.2 DESCRIPTIVE ANALYSIS AND PRESENTATION OF BACKGROUND INFORMATION

This phase of the analysis seeks to enquire into the background of respondents in order to discover the degree of credible information they have acquired as a result of TT process. It consists of the firm status; years of firm existence; experience of construction professional; TT incorporation with foreign partners. Results from the background information were presented using descriptive analysis which involves frequencies and percentages. The purpose of these response from respondents were to help provide an understanding of the profiles of the respondents and generate confidence in the precision and reliability of data collected.

5.2.1 Firm Status of Respondents' Organizations

It is often argued that the effect of legal organization affect the behaviour of the firm activity (Owusu-Manu, 2008). The conventional types of legal organization considered in this study were enterprises/sole proprietorship, private limited liability, and partnerships/joint venture. These types of firms have been mentioned by Owusu-Manu (2008) as popular legal forms of businesses in both developed and developing countries. As presented in ***Table 5.2.1***, when the respondents were asked to indicate the type of legal organization of their firms, a high majority of the respondent representing 57.4 percent were observed to be operating as private limited liability firms (PLF), 28.7 percent also indicated enterprises/sole proprietorship, and the remaining 13.8 percent indicated partnerships/joint venture.

This explains that nature of firms in the construction industry is largely private owned hence majority of construction stakeholder found themselves in these calibre of firms. The results emphasised the perceived advantage of PLF as a good signal that portrays credibility and formality of operations or represents an indication of future growth of the firm (Cassar, 2004).

Storey (1994) & Cassar (2004) argued that while some may consider the benefits of PLF, a critical factor for the choice of legal form of business, the limited liability gain is fictional in reality. The reason for the private limited company being in the majority in this regard as far as Ghana is concerned relates to the fact that construction industry firms belong to a sector in which the government is the largest employer operating with public procurement regulations which do not recognize sole proprietorship. Similarly, sole proprietorship is most suitable where the market is limited, localised and where customers give importance to personal attention and individuals prefer owning their businesses as a result of prestige and enjoyment of profits.

Table 5.2.1: Firm Status

	Firms Status	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Enterprise/Sole proprietorship	27	28.7	28.7	28.7
	Private Limited Company	54	57.4	57.4	86.2
	Partnership/Joint Venture	13	13.8	13.8	100.0
	Total	**94**	**100.0**	**100.0**	

Source: Researcher's Survey (2015)

5.2.2 Years of Firm's Existence

The years of existence for that matter the age of firms has been recognized as a critical factor in the life of every business establishment. Empirical studies have been conducted to investigate the relationship between age of firm and the firm's real activity variables, including growth, financing pattern and employment. These studies have addressed the question of what happens to a firm as it ages. Cabral & Mata (2003) demonstrated that the firm size distribution moves towards the right hand side as firms' age. Previously, other authors have considered age of vendor firms as a proxy measure for the reduction of asymmetric information between a firm and its financiers (Elliehausen & Wolken, 1993; Berger & Udell, 1998). ***Drawing from these experiences***, and anchored on the assumption that, the age of the firm would also affect firms' social obligations, it was important to explore the age levels of the firms that were involved in the survey.

Drawing on from Table 5.2.2, respondents represented by 33.0 percent of the firms involved with the survey have been in existence for a period of less than 10 years. Meanwhile, 14.9 percent of the firm have been in existence between the periods of 10-20 years. Whilst 37.2 percent have been in existence between the periods of 21-30 years, and lastly represented by 14.9 percent of firm have been in existence for over 30 years. The results give indications that the existence of the firm have reasonable experience. Also, the age of the firm will determine the experiences of its employees in the acquisition of knowledge and technology in the TT process.

Table 5.2.2: Years of Firm Existence

Years of Existence		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under 10 years	31	33.0	33.0	33.0
	10-20 years	14	14.9	14.9	47.9

21-30 years	35	37.2	37.2	85.1
Over 30 years	14	14.9	14.9	100.0
Total	**94**	**100.0**	**100.0**	

Source: Researcher's Survey (2015)

5.2.3 Experience of Professional

The intent of this part of the background information was to ascertain the working experience of the respondents. A respondent's years of experience in an organisation is necessary as respondent acquire more knowledge on research area. This information gave relevance to the kind and quality of information that would be given out. Moreover, the working experience can give an idea about the knowledge and TT capabilities of the respondents.

Drawing on from Table 5.2.3, respondents represented by 22.3 percent of the survey have less than 5 years working experience. Meanwhile, high majority represented by 43.6 percent of the respondents have working experience between the periods of 5-10 years. Whilst very few of 11.7 percent have working experience between the periods of 11-15 years, respondents represented by 22.3 percent have working experience between the periods of 16-20 years. The results give indications that respondent in this survey have reasonable experience and a plausible conclusion therefore is that the respondents are experienced in TT process. This spread of respondent years of experience should provide a balanced view on how the TT process is perceived by the actual Ghanaian construction sector.

Table 5.2.3: Experience of Professional

Years of Experience		**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Less than 5 years	21	22.3	22.3	22.3

5-10 years	41	43.6	43.6	66.0
11-15 years	11	11.7	11.7	77.7
16-20 years	21	22.3	22.3	100.0
Total	**94**	**100.0**	**100.0**	

Source: Researcher's Survey (2015)

5.3 EVALUATING TECHNOLOGY TRANSFER PARTNERSHIPS (TTPS)

Construction technology embraces the material, plant and equipment, organizations, procedures and information systems used in planning, designing, constructing, maintaining, repairing, altering and demolishing of buildings and infrastructure. Construction technology development involves both imaginative solutions to specified problems and the development of alternatives to existing materials, methods. Simkoko (1992) has suggested that one of the principal objectives of commissioning or undertaking construction projects, particularly for clients in developing countries, is that the projects might facilitate the technology-acquisition process. The TT and acquisition process enables clients, firms and institutions in developing countries to master, adapt and further develop the acquired design and construction technologies and management techniques. Consequently, the technology-acquisition process is regarded as one mechanism for building up missing technological and managerial competence within firms in developing countries (Simkoko 1989). In order to achieve the specific objectives (***see section 1.3.2***), this part was analyzed using the mean score ranking and the relative important index (RII) to rate the significance level of each of the variables grouped under each sub-headings. The procedure, findings and relevant discussions are as follows.

5.3.1 Typologies of Technology

It was deemed necessary to establish from the major stakeholders (design & construction professionals) the typologies of technology received from transferor firms. It was considered also

that knowledge and technology of this kind would provide some basis to have an insight into what type of technology the various stakeholders deliver to the Ghanaian construction industry.

Successively the respondents were asked to rate their level of significance of the typologies of technology from 1 to 5, where 1 represents Not significant, 2 represents Less significant, 3 represents Moderately significant, 4 represents Significant and 5 represents Very significant.

In evaluating the results for the typologies of technology in Ghana, this research was interested in the factors that constitutes technology typologies in order of their significance. Hereafter, in establishing the relative significance of the variables the mean score as well as the RII were used. The typologies of technology consists of four interrelated and interacting components which are (1) human-embodied form or "Human ware"; (2) object-embodied form or "Techno ware"; (3) document or record-embodied form or "Info ware"; and (4) institution-embodied form or "Orga ware". This approach is considered useful in this study in relation the transfer of any technology. Although it has its limitations in terms of providing somehow fragmentized view of technology, it offers a very clear picture of the various aspects that need to be covered for a TT to be successful. It also emphasizes the various functions associated with the use of technology.

Table 5.3.1 below shows a summary of statistical mean score ranking conducted to evaluate the apparent significant or otherwise of the variables as agreed in the responses of the population based on the mean, standard deviation and standard mean error.

Table 5.3.1: Typologies of Technology

	Valid	Mean	Std. Deviation	Std. Error	∑W	RII	Rankings
Human ware	**94**	**4.50**	**0.635**	**0.065**	**423**	**0.90**	**1**
Skills	**94**	4.37	0.622		411	0.87	2
Experience	**94**	4.37	0.622		411	0.87	3
Insight	**94**	4.23	0.754		398	0.85	4
Learning	**94**	4.59	0.694		431	0.92	1
Techno ware	**94**	**3.93**	**0.975**		**369**	**0.79**	**4**
Tools	**94**	4.27	0.930		401	0.85	1
Machines	**94**	3.90	1.192		367	0.78	3
Equipment	**94**	4.12	1.025		387	0.82	2
Info ware	**94**	**3.99**	**0.823**		**375**	**0.80**	**2**
Design Parameters	**94**	3.89	1.112		366	0.78	4
Specification	**94**	4.00	0.776	0	376	0.80	3
Procedure	**94**	4.07	0.858		383	0.81	2
Knowledge based systems	**94**	4.20	0.957				
Manuals	**94**	3.62	0.893		340	0.72	5
Theories	**94**	3.56	1.022	0.105	335	0.71	6
					372	**0.79**	**3**
				0.064			
				0.064			
				0.078			
				0.072			
				0.101			
				0.096			
				0.123			
				0.106			
				0.085			
				0.115			
				0.08			
				0.089			
				0.099	395	0.84	1
				0.092			

Organ ware	**94**	**3.96**	**0.105**	**0.105**			
Organizational structure	**94**	3.98	0.994	0.103	374	0.80	3
Policies	**94**	4.06	1.105	0.114	382	0.81	2
Contracts	**94**	3.89	0.967	0.100	366	0.78	4
Techniques	**94**	4.14	0.979	0.101	389	0.83	1
Organizational networks	**94**	3.61	1.080	0.111	339	0.72	6
Management practices	**94**	3.63	1.136	0.117	341	0.73	5

Source: Researcher's Survey (2015)

Drawing on from table 5.3.1 above, the result revealed that human ware emerged first as the most significant type of technology with a mean of 4.500, with RII of 0.900 and a standard deviation of 0.635; info ware types of technology was second with a mean of 3.990, with RII of 0.800 and standard deviation of 0.823; organ ware forms of technology was regarded third in order of significance by respondents having a mean score of 3.960, RII of 0.790 and a standard deviation of 0.105; and lastly techno ware was fourth with a mean of 3.930, RII of 0.790 and a standard deviation of 0.975.

Since all the mean values of the typologies to technology (i.e. human ware, organ ware, info ware and techno ware) were all above the population mean (i.e. 3.5 in this regards), it is conceivable to consider them as equally significant as far as typologies of technology in the Ghanaian construction industry is concerned. The fact that the standard deviations are all less than 1.0 indicates that there is little variability in the data. Alternatively, standard deviation values of less than 1.0 indicated consistency in agreement among the respondents of the reported level of results. Hence, it is therefore concluded that, all the various independent variables under the typologies of technology

(i.e. human ware, organ ware, info ware and techno ware) are all significant in the development of framework for TTP's in the Ghanaian construction industry.

5.3.2 Channels/Modes of Transfer of Technology

It was reckoned necessary to establish from the major stakeholders (design & construction professionals) the channels/modes of TT effectively used between transferor and transferee firms in TTPs agreements. It was deliberated also that inter-firm TT is the transfer between large, foreign and local-based firms in the construction sector. It has been recognized that informal TT occurring through this non-market mediated route provides opportunities for local-based firms to learn new technologies from foreign-based firms (Lall, 1980; Hill, 1985). Wong (1991) divided forms of inter-firm TT into two types namely: direct and indirect transfer methods. Successively the respondents were asked to rate how often they are involved in the channel of transferring technology from 1 to 5, *where 1 represents Not Often, 2 represents Less Often, 3 represents Moderately Often, 4 represents Often and 5 represents Very Often.*

In evaluating the results for the channels of TT in Ghana, this research was interested in the direct and indirect methods of inter-firm TT and how frequently they occur among contraction parties in agreement. Hereafter, in establishing the frequent occurrences of these variables the mean score as well as the RII were used.

Table 5.3.2 below shows a summary of statistical mean score ranking conducted to evaluate the apparent occurrence of the variables as agreed in the responses of the population based on the mean, standard deviation and standard mean error.

Table 5.3.2: Channels/Modes of Transfer of Technology

	Valid	Mean	Std. Error	Std. Deviation	∑W	RII	Ranking
	94	**3.15**	**0.097**	**0.939**	**296**	**0.63**	**2**
	94	2.77	0.138	1.339	260	0.55	7
	94	3.12	0.14	1.359	293	0.62	5
Machinery Supply Agreement	94	2.82	0.132	1.278	265	0.56	6
Direct Transfer Method							
Licensing Agreement							
Technical Service Agreement							
Engineering and Construction Agreements	94	3.17	0.158	1.536	298	0.63	4
Management Contracts	90	3.87	0.069	0.657	348	0.77	2
Turnkey Contracts	90	3.93	0.118	1.12	354	0.79	1
Franchising	90	2.34	0.132	1.256	211	0.47	8
International Subcontracting (Outsourcing)	90	3.76	0.106	1.009	338	0.75	3
Indirect Transfer Method	**90**	**3.83**	**0.12**	**1.134**	**345**	**0.77**	**1**
Joint Venture	90	4.18	0.129	1.223	376	0.84	1
Foreign Direct Investment(FDI)	90	3.63	0.143	1.353	327	0.73	3
Partnership	90	3.64	0.142	1.352	328	0.73	2

Source: Researcher's Survey (2015)

Drawing on from table 5.3.2 above, the result revealed that the indirect method of transfer emerged first as the most frequently occurred channel of TT with a mean of 3.830, with RII of 0.770 and a standard deviation of 1.134; and the direct method of transfer followed with a mean of 3.150, RII of 0.630 and a standard deviation of 0.939. This result is in consistence with (UNCTAD, 1991) which publicized that in most cases, multinational company when unrestrained will prefer TT through the indirect method of transfer to any other form of transfer. It revealed that the choice of channel of TT may be limited by various factors including government legislation, industry structure and competition. Given this, a multinational company would prefer transfer channel which it would be under its effective control, such as a whollyowned subsidiary to any other form of channel under which effective control over the channel of transfer enables the

firm to adapt operational activities in host country to changes in domestic and world market conditions unforeseen when the transfer arrangements were made. In view of these discussion, the turnkey contracts was the most often mechanism for direct method of TT because it involves a foreign organization undertaking the construction of a production facility and turns the key to a domestic firm or some other organization when the facility is ready for operation. Turnkey projects usually are more suited to a single activity production facility such as a cement factory, sugar refinery, steel mill, etc.

5.3.3 Risk Factors confronting Technology Transfer

Although the importance of TT has been highlighted, the process of transferring technology is complex and demanding. At the conceptual level, there are important factors that should be considered in construction professionals in developing countries, specifically in Ghana is to successfully promote and improve its innovative construction technologies through transfer and dissemination of appropriate technology.TT can be expensive if critical factors are not properly considered during TT decision making process. Overlooking the critical factors may create the opportunity for impeding the development and performance of transferee firms (Samli, 1985). ***Drawing on from the above discussion***, respondents were asked to severity of the challenges confronting TT within contracting parties in agreement from 1 to 5, where 1 represents Not Severe, 2 represents Less Severe, 3 represents Moderately Severe, 4 represents Severe and 5 represents Very Severe. In evaluating the results of this research, the mean score ranking as well as the RII were used.

Table 5.3.3 below shows a summary of statistical mean score ranking conducted to evaluate the apparent severity of the variables as agreed in the responses of the population based on the mean, standard deviation and standard mean error.

Table 5.3.3: Risk factors confronting TT

Risk Factors	Valid	Mean	Std. Error	Std. Deviation	∑W	RII	Ranking	
Infrastructure	94	3.61	0.160	1.547	339	0.72	5	
Current weak Capacity	94	3.55	0.132	1.275	334	0.71	7	
Choice of technology	94	3.61	0.108	1.050	339	0.72	6	
Absorptive Capacity	83	3.08	0.147	1.336	256	0.62	12	
Industrial Experience	94	3.85	0.093	0.903	362	0.77	3	
Marketing Capabilities	94	3.10	0.140	1.353	291	0.62	11	
Transplantation	94	3.47	0.158	1.536	326	0.69	8	Technology
Socio-economic structure	94	3.17	0.149	1.442	298	0.63	9	
Government regulation	94	3.83	0.096	0.935	360	0.77	4	
Conflict of Interest	82	4.27	0.085	0.771	350	0.85	1	
Incompatibility	81	3.86	0.119	1.069	313	0.77	2	

Source: Researcher's Survey (2015)

Drawing on from the table 5.3.3 above, the result revealed that most of challenges confronting TTPs between transferor and transferee firms had their mean values above the population mean (i.e. 3.5 in this regards), it is conceivable to consider them as equally severe as far as construction TT in the Ghanaian construction industry is concerned. The standard error associated with all the means were relatively closer to zero suggesting that the sample chosen is an accurate reflection of the population. Hence, it is therefore concluded that, all the various independent variables under the challenges confronting TTPs are all significant in the development of framework for TTPs in the Ghanaian construction industry. Baranson (1969) argued that a sustained relationship between the parties involved is a factor influencing the effective transfer.

5.3.4 Critical Success Factors Facilitating Technology Transfer

The strong interest for developing countries to expand their access to technologies is understandable in light of rapid technological changes in the global economy. The ability to learn

from foreign technology, adapt to, and import them into domestic competition is critical for achieving sustained economic transformation and productivity growth (Maskkus, 2004). The literature regarding the success of construction TT is extensive. The majority of the research compiled is concerned with diffusion, modification, and improvement of the existing technology (Ahmed, 1993; Williams, 1990; Rosemberg, 1985); while others have explained success as a measure of the economic value found through the amount of sales of the product(s) (Autio, 1995; Purwanti, 1994); a measure of the operation of the technology (Kumar, 1995; Madu, 1992); and the acquisition of the knowledge and skills associated with the technology (Wong, 1995).

Successively the respondents were asked to rate their level of significance of the critical success factors of TT from 1 to 5, *where 1- represents Not significant, 2- represents Less significant, 3- represents Moderately significant, 4- represents Significant and 5- represents Very significant.* In evaluating the results for the critical success factors (CSF) of TT in Ghana, this research was interested in the factors that constitutes the ability of the transferee firm to receive the technology and knowledge in order of their significance. Hereafter, in establishing the relative significance of the variables the mean score as well as the RII were used. ***Table 5.3.4*** below shows a summary of statistical mean score ranking conducted to evaluate the apparent significance of the variables as agreed in the responses of the population based on the mean, standard deviation and standard mean error.

Table 5.3.4: Critical Success Factors Facilitating TT

Critical Success Factors	Valid	Mean	Std. Error	Std. Deviation	∑W	RII	Ranking
Long-term Orientation/Relationship	94	3.65	0.103	1.002	343	0.73	10
Top Management Support	94	4.10	0.108	1.048	385	0.82	5

Clear Definition of Roles	94	3.67	0.073	0.709	345	0.73	9
Mutual decision-making	94	4.29	0.093	0.899	403	0.86	4
Effective Coordination among partners	94	4.44	0.099	0.957	417	0.89	1
Trust	94	4.09	0.11	1.064	384	0.82	6
Effective Communication	94	4.04	0.088	0.854	380	0.81	7
Shared Corporate Culture	94	4.39	0.073	0.707	413	0.88	2
Commitment among partners	94	4.33	0.075	0.724	407	0.87	3
Management Innovation	94	3.71	0.116	1.123	349	0.74	8
Joint Action	94	3.36	0.121	1.172	316	0.67	11

Source: Researcher's Survey (2015)

Drawing on form the table 5.3.4 above**,** it was found that construction TTPs CSFs are most strongly influenced by the relationship between effective coordination among contracting partners in agreement and shared corporate culture with a mean and RII values of 4.44; 4.39 and 0.89; 0.88 respectively and, whilst the relationship between joint action is least significant with a mean value of 3.36 and an RII value of 0.67. It was also found that commitment among partners; mutual decision making; top management support were all significant CSFs facilitating TT in construction industry. Supported by these findings were the studies that propose cultural differences as a factor to the success of TT, since national culture and social norms often create problems to the success of TT (Rubin, 1993), the models on cultural factors to TT (Bosselmann, 2006; Reddy, 1977), and the study on the importance of culture on the effectiveness of TT across firms (Rubin, 1993). Research results also explained why TT led to change, with change being inevitable to the entire society when introduction of new production methods, procedures, and techniques led to new production relationships, class disruption, and adoption of a new culture (Al-Ghailani, 1995). As noted from the literature, culture, in general, is viewed by scholars and researchers as the most powerful factor in the success or failure of TT. These results added an empirical value to the

previous research on TT from the point of view of the transferee country. The results of this study will help management and various decision-makers regarding the importance of coordination, cultural, and commitment as factors on the success of TT. The results of this study also provide a greater understanding for stakeholder in the Ghanaian construction industries regarding coordination, cultural, and commitment as factors as being vital to the success of the transfer of technology to Ghana. This information will enhance the effectiveness of the decision-making process for these professionals and, perhaps, increase their efficiency and success of TT.

5.4 DESCRIPTIVE ANALYSIS AND PRELIMINARY TEST

Prior to the main non-parametric test of the study, preliminary descriptive analysis such as mean ranking and standard deviations of each of the enablers of TT was conducted to help provide a clearer picture of the consensus reached by the respondents outcome of the survey; and the results are tabulated in ***Table 5.4***. For each of the enablers of TT, the null hypothesis was that each variable was insignificant (H0: U = U0) and the alternative hypothesis was that the variable was significant (HA: U > U0); where U0 is the population mean and drawing from Ling (2003), the U0 was fixed at 3.5. Thus, based on the five-point Likert rating scale, and consistent with Ling (2003) and Ahadzie *et al.* (2007); an enabler of TT variable was deemed important if it had a mean of 3.5 or more. Where two or more variables have the same mean, the one with the lowest standard deviation traditionally assume the highest importance (Field, 2005). The standard error is the standard deviation of sample means and it is a measure of how representative a sample is likely to be of the population (Ahadzie *et al*., 2007; Field, 2005). A large standard error reflects a lot of variability between means of different samples and a small standard error suggests that most sample means are similar to the population mean and so the sample is likely to be an accurate reflection of the population (Field, 2005). The standard error associated with all the means is

relatively close to zero suggesting that the sample chosen is an accurate reflection of the population (***see Table 5.4***).

Table 5.4: Descriptive Statistics of the Enablers of Technology Transfer

Enablers of Technology Transfer	N	Mean	Standard Deviation	Standard Error
Transfer Environment	**94**	**3.83**	**0.542**	**0.056**
Complexity of Construction Technology	94	4.03	1.348	0.139
Construction Mode of Transfer	94	3.87	0.779	0.080
Government Policy	94	3.84	0.794	0.082
Government Enforcement	94	3.73	0.819	0.084
Learning Environment	**94**	**4.18**	**0.486**	**0.050**
Cultural Differences	94	4.09	0.900	0.093
Trust	94	4.38	0.749	0.077
Communication	94	4.60	0.493	0.051
Training Programs	94	4.59	0.710	0.073
Teamwork	94	4.65	0.480	0.049
Transferor Characteristics	**94**	**4.32**	**0.469**	**0.048**
Willingness to transfer	94	4.32	0.608	0.063
Level of Experience	94	4.38	0.570	0.059
Cultural traits	94	4.01	0.810	0.084

Knowledge base	94	4.21	0.902	0.093
Transferee Characteristics	**94**	**4.30**	**0.545**	**0.056**
Intent to learn Technology	94	4.50	0.582	0.060
Level of Experience	94	4.20	0.649	0.067
Cultural traits	94	3.79	0.411	0.042
Knowledge base	94	4.27	0.778	0.080
Economic Advancement	**94**	**4.45**	**0.666**	**0.069**
Competitiveness	94	4.05	0.795	0.082
Performance improvement	94	4.38	0.735	0.076
Knowledge Advancement	**94**	**4.26**	**0.915**	**0.094**
Improved Knowledge	94	4.17	1.012	0.104
Improved working practices	94	4.18	1.116	0.115
Long-term adoption of transferred skills	94	4.07	0.858	0.089
Project Performance	**94**	**4.01**	**0.577**	**0.060**
Financial Performance	94	3.89	0.577	0.059
Schedule Performance	94	3.89	0.910	0.094
Quality Performance	94	4.20	0.404	0.042
Absorptive Capability	**94**	**4.11**	**0.679**	**0.070**
Employee Capability	94	4.11	0.956	0.099
Knowledge Sharing	94	4.36	0.701	0.072
Working Culture	94	3.66	0.712	0.073
Research and Development(R&D) Capability	94	3.71	1.001	0.103
Communication Capability	94	4.36	0.620	0.064
Knowledge Transfer	**94**	**4.15**	**0.463**	**0.048**
Knowledge Strategy	94	4.01	0.711	0.073
Organizational Culture	94	3.95	0.556	0.057
Information Technology	94	4.26	0.604	0.062
Knowledge Leadership	94	4.00	0.703	0.073

Source: Researcher's Survey (2015)

Drawing on from Table 5.4 above, since all the enabler of TT (Transfer Environment, learning environment, Transferor Characteristics, Transferee Characteristics) and the degree of value creation (Economic Advancement, Knowledge Advancement & Project Performance) have their mean values above the accepted population mean of 3.5, it is plausible to conclude that they all constitute deem necessary to the development of the conceptual framework for TTPs in the Ghanaian context. The standard error associated with all the means were relatively closer to zero

suggesting that the sample chosen is an accurate reflection of the population. Finally, from the results in ***Table 5.4***, the standard deviations of a large majority are less than 1.0 signaling that, there is little variability in the data collected and consistency in agreement among the respondents. However, it is important to draw attention to the variables *Complexity of construction technology; Improved Knowledge; Improved working practices and Research and Development capability (R&D),* which had a standard deviation more than one (indicating 1.348; 1.012; 1.116 and 1.001 respectively) suggesting that there might be differences to how these variables were interpreted by the respondents. Further discussion on the chi-square test below provides plausible explanation for this. Thus, based on the descriptive statistics alone using the mean score ranking, it could be confidently concluded that the variables identified as the enablers of TT process through the literature review and the interviews reflect the views of the respondents.

5.5 INFERENTIAL ANALYSIS: HYPOTHESES TESTING

Hypothesis testing is a technique adopted by researchers to draw conclusion on the results of a data collected in a research investigation in order to make useful conclusions on a population of interest (Deveries, 2007). Hun (2010) asserted that a hypothesis is an assumption about the characteristic of a particular population of interest. Testing hypothesis for a research study is also aimed at the utilization of the sample data to infer from the results to determine the level of real relationship between variables. According to Kochanski (2005), hypothesis testing is apposite for critical application or for drawing conclusion. The chi-square test (a non-parametric test) was chosen because of uncertainty about the nature of distribution of the population.

5.5.1 Testing of Research Hypotheses

5.5.1.1 Hypothesis Category 1

H_o1: A significant key to successful transfer environment as an enabler of TT is not dependent on: (H1a). Complexity of construction technology, (H1b). Construction mode of transfer, (H1c). Government policy and (H1d). Government enforcement.

$H_1 1$: A significant key to successful transfer environment is dependent on: (H1a). Complexity of construction technology, (H1b). Construction mode of transfer, (H1c). Government policy and (H1d). Government enforcement.

The rationale for this first category of hypotheses was to confirm whether the independent variables identified in literature and the interview conforms to the dependent variable (i.e. transfer environment) to a successful enabler in the TT process in Ghanaian context. The ChiSquare test conducted with regards to *Hypothesis Category 1* above is demonstrated in Table H1 below; the result revealed that there exist a significant relationship between the transfer environment and complexity of construction technology ($X^2 = 50.170^a$, $X^2\alpha = 7.815$, df = 3, $p < 0.05$); government policy ($X^2 = 99.957^a$, $X^2\alpha = 7.815$, df = 3, $p < 0.05$); and government enforcement ($X^2 = 71.702^a$, $X^2\alpha = 7.815$, df = 3, $p < 0.05$). Since, $X^2_{cal} > X^2\alpha$ (7.815) at $p < 0.05$ in the cases of the group variables (*Complexity of construction technology*, *Government policy, Government enforcement)*, we reject the null hypothesis $H_0 1$ at a significance level of 0.05.

Therefore there exist a significance relationship between transfer environment as an enabler of TT and the Complexity of construction technology; Government policy; and Government enforcement. However there is significant evidence that the independent variable "construction mode of transfer" ($X^2 = 3.340^b$, $X^2\alpha = 5.991$, df = 2, $p > 0.05$). Since $X^2_{cal} < X^2\alpha$ (5.991) at $p >$

0.05, accept the null hypothesis in terms of this group variable (construction mode of transfer). ***Drawing on from the above***, the results confirm that government policy and enforcement is essential for achieving outcomes from the TT process. Governments in several developing countries are currently encouraging TT initiatives in an attempt to improve their industries, living standards, and economic prospects. This objective could only be achieved if host employees and professionals perform at a higher level and become more competitive locally within construction producing countries and the construction market, eventually becoming a competitor of the foreign companies. Host and foreign companies with idealistic characteristics for TT need to be carefully selected to ensure that the host nation has the best chance for receiving the most tacit and implicit knowledge from the process. Also, the construction mode of transfer does not have any impact on the transfer environment as well as the outcome from the TT process.

Table H 1: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Complexity of construction technology	50.170[a]	3	0.000	Reject
2. Construction mode of transfer	3.340[b]	2	0.188	Accept
3. Government policy	99.957[a]	3	0.000	Reject
4. Government enforcement	71.702[a]	3	0.000	Reject

Source: Researcher's Survey (2015)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 23.5.
b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 31.3.

5.5.1.2 Hypothesis Category 2

H_o2: A significant key to successful learning environment as an enabler of TT is not dependent on: (H2a). Cultural differences, (H2b). Trust, (H2c). Communication, (H2d). Training programs and (H2e). Teamwork.

$H_1$2: A significant key to successful learning environment is dependent on: (H2a). Cultural differences, (H2b). Trust, (H2c). Communication, (H2d). Training programs and (H2e). Teamwork.

The Chi-Square test conducted with regards to *Hypothesis Category 2* above is demonstrated in Table H2 below; the result revealed that there exist a significant relationship between the learning environment and cultural differences ($X^2 = 55.617^a$, $X^2\alpha = 7.815$, df = 3, $p < 0.05$); trust ($X^2 = 69.149^a$, $X^2\alpha = 7.815$, df = 3, $p < 0.05$); training programs ($X^2 = 56.447^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$); and teamwork ($X^2 = 8.340^c$, $X^2\alpha = 3.841$, df = 1, $p > 0.05$). Since, $X^2_{cal} > X^2\alpha$ (7.815; 5.991; 3.841) at $p < 0.05$ in the cases of the group independent variables (*Cultural differences, Trust, Training programs and teamwork)*, we reject the null hypothesis $H_0$2 at a significance level of 0.05. Therefore there exist a significance relationship between learning environment as an enabler of TT and the Cultural differences; Trust; Training programs; and teamwork. However there is significant evidence that the independent variable "communication" ($X^2 = 3.447^c$, $X^2\alpha = 3.841$, df = 1, $p > 0.05$). Since $X^2_{cal} < X^2\alpha$ (3.841) at $p > 0.05$, accept the null hypothesis in terms of this group variable of communication.

Drawing on from the above, the results confirm that cultural differences, trust, training programs and teamwork are essential during the learning process of TT. This is because mutual trust and training programs build around host and foreign countries will greatly enhance the host firms' knowledge advancement, working practices and overall performance over the long-term. Also, achieving success when transferring highly complex technology will be more likely to occur when the host has a positive attitude toward working with foreigners, a strong knowledge base of

construction technology, and their technical and managerial training practices stimulate the TT process. This results are in line with previous studies (Gopalakrishnan & Santoro, 2004; Santoro & Bierly, 2006) that describe trust as the glue that foster transferor and transferee alliances.

Table H2: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Cultural Differences	55.617[a]	3	0.000	Reject
2. Trust	69.149[a]	3	0.000	Reject
3. Communication	3.447[c]	1	0.063	Accept
4. Training Programs	56.447[b]	2	0.000	Reject
5. Teamwork	8.340[c]	1	0.004	Reject

Source: Researcher's Survey (2015)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 23.5.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 31.3.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 47.0.

5.5.1.3 Hypothesis Category 3

H_o3: There exist no significant key relationship between transferor characteristics as an enabler of TT and: (H3a). Willingness to transfer, (H3b). Level of experience, (H3c). Cultural traits and (H3d). Knowledge base.

$H_1$3: There exist a significant key relationship between transferor characteristics as an enabler of TT and: (H3a). Willingness to transfer, (H3b). Level of experience, (H3c). Cultural traits and (H3d). Knowledge base.

The Chi-Square test conducted with regards to *Hypothesis Category 3* above is demonstrated in *Table H3* below; the result revealed that there exist a significant relationship between the transferor characteristics and willingness to transfer ($X^2 = 31.043^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$); Level of

experience (X^2= 37.362[b], $X^2\alpha$ = 5.991, df = 2, $p < 0.05$); cultural traits (X^2 = 37.660[a], $X^2\alpha$ = 7.815, df = 3, $p < 0.05$); and knowledge base (X^2= 101.745[d], $X^2\alpha$ = 9.488, df = 4, $p < 0.05$). Since, $X^2_{cal} > X^2\alpha$ (5.991; 7.815; 9.488) at $p < 0.05$ in the cases of all the group independent variables (*willingness to transfer, level of experience, cultural traits, and knowledge base)*, we reject the null hypothesis $H_0$3 at a significance level of 0.05. Therefore there exist a significance relationship between transferor characteristics as an enabler of TT and the willingness to transfer; level of experience; cultural traits; and knowledge base.

Drawing on from the above discussion, the results confirms that there exist a significant key relationship between transferor characteristics as an enabler of TT and willingness to transfer; level of experience; cultural traits; and knowledge base. This is due to the fact that achieving success when transferring technology and knowledge will be more likely to occur when the transferor has experience working with transferee, a strong willingness to transfer on construction technology and their cultural traits stimulate the TT process. Foreign companies that have experience working with local companies, a strong knowledge base and are willing to transfer their knowledge will create robust bonds with local workers, which are based on mutual trust, communication and understanding.

Table H3: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Willingness to transfer	31.043[b]	2	0.000	Reject
2. Level of experience	37.362[b]	2	0.000	Reject

3. Cultural traits	37.660[a]	3	0.000	Reject
4. Knowledge base	101.745[d]	4	0.000	Reject

Source: Researcher's Survey (2015)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 23.5.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 31.3.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.8.

5.5.1.4 Hypothesis Category 4

H_o4: There exist no significant key relationship between transferee characteristics as an enabler of TT and: (H4a). Intent to learn technology, (H4b). Level of experience, (H4c). Cultural traits and (H4d). Knowledge base.

$H_1$4: There exist a significant key relationship between transferee characteristics as an enabler of TT and: (H4a). Intent to learn technology, (H4b). Level of experience, (H4c). Cultural traits and (H4d). Knowledge base.

The Chi-Square test conducted with regards to *Hypothesis Category 4* above is demonstrated in Table H4 below; the result revealed that there exist a significant relationship between the transferee characteristics and intent to learn technology ($X^2 = 38.064^b$, $X^2\alpha = 5.991$, df = 2, $p <$ 0.05); level of experience ($X^2 = 56.447^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$); cultural traits ($X^2 = 31.021^c$, $X^2\alpha = 3.841$, df = 1, $p < 0.05$); and knowledge base ($X^2 = 55.532^a$, $X^2\alpha = 7.815$, df = 3, $p < 0.05$). Since, $X^2_{cal} > X^2\alpha$ (3.814; 5.991; 7.815) at $p < 0.05$ in the cases of all the group independent variables (*intent to learn technology, level of experience, cultural traits, and knowledge base)*, we reject the null hypothesis $H_0$4 at a significance level of 0.05. Therefore there exist a significance relationship between transferee characteristics as an enabler of TT and the intent to learn technology; level of experience; cultural traits; and knowledge base.

Drawing on from the above, the results confirms that there exist a significant key relationship between transferee characteristics as an enabler of TT and intent to learn technology; level of experience; cultural traits; and knowledge base. This is due to the fact that achieving success when transferring technology and knowledge will be more likely to occur when the transferee has intention to learn technology and knowledge, level of experience to receive the technology transferred, and their cultural traits stimulate the TT process. Additionally, the transferee must have a sufficient technology capability maturity before a transferor will see value in dispensing their technology and knowledge. Moreover, the results confirm that appropriate host characteristics are essential for technology learning capability.

Table H4: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Intent to learn Technology	38.064[b]	2	0.000	Reject
2. Level of experience	56.447[b]	2	0.000	Reject
3. Cultural traits	31.021[c]	1	0.000	Reject
4. Knowledge base	55.532[a]	3	0.000	Reject

Source: Researcher's Survey (2015)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 23.5.
b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 31.3.
c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 47.0.

5.5.1.5 Hypothesis Category 5

H_o5: A significant key to successful economic advancement as a degree of value creation is not dependent on: (H5a). Competitiveness and (H5b) Performance improvement.

$H_1$5: A significant key to successful economic advancement as a degree of value creation is dependent on: (H5a). Competitiveness and (H5b) Performance improvement.

The Chi-Square test conducted with regards to *Hypothesis Category 5* above is demonstrated in Table H5 below; the result revealed that there exist a significant relationship between economic advancement and competitiveness ($X^2 = 102.277^d$, $X^2\alpha = 9.488$, df = 4, $p < 0.05$); performance improvement ($X^2 = 64.213^a$, $X^2\alpha = 7.815$, df = 3, $p < 0.05$). Since, $X^2_{cal} > X^2\alpha$ (7.815; 9.488) at $p < 0.05$ in the cases of all the group independent variables (*competitiveness; and performance improvement)*, we reject the null hypothesis $H_0$5 at a significance level of 0.05. Therefore, there exist a significance relationship between economic advancement as a degree of value creation and competitiveness; and performance improvement.

Drawing on from the above, the results confirms that there exist a significant key relationship between economic advancement as a degree of value creation and competitiveness; and performance improvement. Also, it should be noted that in order to gain economic advancement, transferred knowledge has to be absorbed and applied on a number of projects across the host country. A predominant reason to encourage TT initiatives by governments of developing countries is to improve living standards and economic prospect of people (Steward & Waroonkun, 2007). Therefore host workers and professionals should be performed at a higher level and become more competitive in the domestic and international market to achieve this objective (Fisher & Ranasinghe, 2001).

Table H5: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Competitiveness	102.277^d	4	0.000	Reject

2. Performance improvement	64.213[a]	3	0.000	Reject

Source: Researcher's Survey (2015)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 23.5.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.8.

5.5.1.6 Hypothesis Category 6

H_o6: A significant key to successful knowledge advancement as a degree of value creation is not dependent on: (H6a). Improved knowledge, (H6b). Improved working practices and (H6c). Long-term adoption of transferred skills.

$H_1$6: A significant key to successful knowledge advancement as a degree of value creation is dependent on: (H6a). Improved knowledge, (H6b). Improved working practices and (H6c). Long-term adoption of transferred skills.

The Chi-Square test conducted with regards to *Hypothesis Category 6* above is demonstrated in Table H6 below; the result revealed that there exist a significant relationship between knowledge advancement and improved knowledge ($X^2 = 89.830^d$, $X^2\alpha = 9.488$, df = 4, $p < 0.05$); improved working practices ($X^2 = 81.319^d$, $X^2\alpha = 9.488$, df = 4, $p < 0.05$); and long-term adoption of transferred skills ($X^2 = 83.128^d$, $X^2\alpha = 9.488$, df = 4, $p < 0.05$) Since, $X^2_{cal} > X^2\alpha$ (9.488) at $p < 0.05$ in the cases of all the group independent variables (*improved knowledge; improved working practices; and long-term adoption of transferred skills)*, we reject the null hypothesis $H_0$6 at a significance level of 0.05. Therefore, there exist a significance relationship between knowledge advancement as a degree of value creation and improved knowledge; improved working practices; and long-term adoption of transferred skills.

Drawing on from the above, the results confirms that there exist a significant key relationship between knowledge advancement as a degree of value creation and improved knowledge; improved working practices; and long-term adoption of transferred skills. As cited by Gilbert & Cordey-Hayes (1996), beyond the quantitative economic benefits achievable from TT, host construction firms may also experience knowledge advancement at the individual and organizational level (Steward & Waroonkun, 2007). This knowledge which can be transferred as implicit and tacit knowledge should lead to improve working practices in the immediate term and hopefully become the norm over the long term (Steward & Waroonkun, 2007).

Table H6: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Improved Knowledge	89.830[d]	4	0.000	Reject
2. Improved Working Practices	81.319[d]	4	0.000	Reject
3. Long-term adoption of transferred skills	83.128[d]	4	0.000	Reject

Source: Researcher's Survey (2015)

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.8.

5.5.1.7 Hypothesis Category 7

H_o7: A significant key to successful project performance as a degree of value creation is not dependent on: (H7a). Financial performance, (H7b). Schedule performance and (H7c). Quality performance.

$H_1$7: A significant key to successful project performance as a degree of value creation is dependent on: (H7a). Financial performance, (H7b). Schedule performance and (H7c). Quality performance.

The Chi-Square test conducted with regards to *Hypothesis Category 7* above is demonstrated in *Table H7* below; the result revealed that there exist a significant relationship between project

performance and financial performance (X^2 = 127.936[b], $X^2\alpha$ = 5.991, df = 2, $p < 0.05$); schedule performance (X^2= 57.489[d], $X^2\alpha$ = 9.488, df = 4, $p < 0.05$); and quality performance (X^2= 33.362[c], $X^2\alpha$ = 3.841, df = 1, $p < 0.05$) Since, $X^2_{cal} > X^2\alpha$ (9.488) at $p < 0.05$ in the cases of all the group independent variables (*financial performance; schedule performance; quality performance)*, we reject the null hypothesis $H_0$7 at a significance level of 0.05. Therefore, there exist a significance relationship between project performance as a degree of value creation and financial performance; schedule performance; and quality performance.

Drawing on from the above, the results confirms that there exist a significance relationship between project performance as a degree of value creation and financial performance; schedule performance; and quality performance. Financial performance, schedule performance and quality performance are generally accepted as major objectives of a construction project. The effective TT should improve the performance of these key areas (Devapriya & Ganesan, 2002). Language and cultural barriers seems to be significant factor which affect the level of TTPs to Ghanaian construction industry. Most of the time host workers and foreign workers use different languages which decrease the mutual understanding between the parties due to lack of effective communication.

Table H7: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Financial Performance	127.936[b]	2	0.000	Reject
2. Schedule Performance	57.489[d]	4	0.000	Reject
3. Quality Performance	33.362[c]	1	0.000	Reject

Source: Researcher's Survey (2015)

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 31.3.
c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 47.0.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.8.

5.5.1.8 Hypothesis Category 8

H_o8: There exist no significant key relationship between absorptive capability and: (H8a). Employee capability, (H8b). Knowledge sharing, (H8c). Working culture, (H8d). Research and Development (R&D) capability and (H8e). Communication capability.

$H_1$8: There exist a significant key relationship between absorptive capability and: (H8a). Employee capability, (H8b). Knowledge sharing, (H8c). Working culture, (H8d). Research and Development (R&D) capability and (H8e). Communication capability.

The Chi-Square test conducted with regards to *Hypothesis Category 8* above is demonstrated in *Table H8* below; the result revealed that there exist a significant relationship between absorptive capability and employee capability ($X^2 = 71.745^d$, $X^2\alpha = 9.488$, df = 4, $p < 0.05$); knowledge sharing ($X^2 = 19.489^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$); working culture ($X^2 = 51.957^a$, $X^2\alpha = 7.815$, df = 3, $p < 0.05$); research and development (R&D) capability ($X^2 = 9.574^a$, $X^2\alpha = 7.815$, df = 3, $p > 0.05$); and communication capability ($X^2 = 28.745^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$). Since, $X^2_{cal} > X^2\alpha$ (5.991; 7.815; 9.488) at $p < 0.05$ in the cases of all the group independent variables (*employee capability; knowledge sharing; working culture; research and development (R&D) capability; and communication capability)*, we reject the null hypothesis $H_0$8 at a significance level of 0.05. Therefore, there exist a significance relationship between absorptive capability and employee capability; knowledge sharing; working culture; and communication capability.

Drawing on from the above, the results confirm there exist a significance relationship between absorptive capability and employee capability; knowledge sharing; working culture; research and

development (R&D) capability; and communication capability. Ashekele & Matengu (2008) on an SME found that relatively high levels of skill among employees provided impetus for a desire to be more competent. They also found that the willingness of employees to learn and adopt new technologies is an asset to firm's success. As articulated by Lall (2002), "developing countries obtain industrial technologies mainly from the industrialized world, and their main technology problem is to master, adapt, and improve on the imported knowledge and equipment. In conclusion, knowledge sharing is a learning process where organization units continually interact with others in order to enhance the process of firm's technology development.

Table H8: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Employee Capability	71.745[d]	4	0.000	Reject
2. Knowledge Sharing	19.489[b]	2	0.000	Reject
3. Working Culture	51.957[a]	3	0.000	Reject
4. Research and Development (R&D) Capability	9.574[a]	3	0.023	Reject
5. Communication Capability	28.745[b]	2	0.000	Reject

Source: Researcher's Survey (2015)

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 23.5.
b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 31.3.
d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.8.

5.5.1.9 Hypothesis Category 9

H_o9: There exist no significant key relationship between knowledge transfer and: (H9a). Knowledge strategy, (H9b). Organizational culture, (H9c). Information technology and (H9d). Knowledge leadership.

$H_1$9: There exist a significant key relationship between knowledge transfer and: (H9a). Knowledge strategy, (H9b). Organizational culture, (H9c). Information technology and (H9d).

Knowledge leadership.

The Chi-Square test conducted with regards to *Hypothesis Category 9* above is demonstrated in *Table H9* below; the result revealed that there exist a significant relationship between knowledge transfer and knowledge strategy ($X^2 = 11.766^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$); organizational culture ($X^2 = 54.660^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$); information technology ($X^2 = 33.787^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$); and knowledge leadership ($X^2 = 13.298^b$, $X^2\alpha = 5.991$, df = 2, $p < 0.05$). Since, $X^2_{cal} > X^2\alpha$ (5.991) at $p < 0.05$ in the cases of all the group independent variables (*knowledge strategy; organizational culture; information technology; and knowledge leadership)*, we reject the null hypothesis $H_0 9$ at a significance level of 0.05. Therefore, there exist a significance relationship between knowledge transfer and knowledge strategy; organizational culture; information technology; and knowledge leadership.

Drawing on from the above, the results confirm that there exist a significance relationship between knowledge transfer and knowledge strategy; organizational culture; information technology; and knowledge leadership. Strategies such as knowledge transfer strategy, knowledge creation strategy and customer focus strategy are some of the strategies which organizations consider as knowledge management (KM) adopting strategies (Wiig, 1997; Manasco, 1996). According to Wen-bao (2007) organizational culture is the common belief, conduct rules and values shared by all organizational members. Previous study as (Lu *et al.,* 2006; Kim & Lee, 2006; Lee & Choi, 2003; Goh, 2002) found that teamwork and collaboration are important culture to support knowledge sharing in an organization which considers knowledge transfer as a part from knowledge sharing. Furthermore, the information technology is also an important enabler that supports knowledge transfer. The results of data analysis indicate that information technology facilitate process of

knowledge transfer. According to Hein (2004), Brink (2003), technology support refers to knowledge sharing by enabling the communication, collaboration provision of knowledge storing the accumulated knowledge and retrieve knowledge. Ahmad *et al.* (2009), found that information technology may serve as a cost effective and fast medium to acquire, store, share and transfer knowledge but it needs human's motive and willingness to engage in KM. Lastly, according to Nonaka & Toyama (2005) leadership is a vital knowledge creating which requires active commitment from all the members of the organization, not just from a few elites.

Table H9: Test Statistics

Independent Variables	Chi-Square (X^2)	df	Asymp. Sig.	Decision
1. Knowledge Strategy	11.766[b]	2	0.003	Reject
2. Organizational Culture	54.660[b]	2	0.000	Reject
3. Information Technology	33.787[b]	2	0.000	Reject
4. Knowledge Leadership	13.298[b]	2	0.001	Reject

Source: Researcher's Survey (2015)

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 31.3.

5.6 FACTOR ANALYSIS

For such relatively large number of the independent variables (25) involved in this study, it is possible that some of the variables are measuring the same underlying effect. It was therefore deemed plausible to use factor analysis for data reduction to establish which of the variables could be measuring aspects of the same underlying dimensions. Factor analysis is a statistical approach involving finding a way of condensing the information contained in a number of original variables into a smaller set of dimensions (factors) with a minimum loss of information (Hatcher, 1994; Hair *et al.,* 1998), *cited in* (DeCoster, 1998). Factor analysis attempts to bring inter-correlated variables together under more general, underlying variables. More specifically, the goal of factor analysis is

to reduce "the dimensionality of the original space and to give an interpretation to the new space, spanned by a reduced number of new dimensions which are supposed to underlie the old ones" (Rietveld & Van Hout 1993), and to explain the variance in the observed variables in terms of underlying latent factors" (Habing, 2003) Thus, factor analysis offers not only the possibility of gaining a clear view of the data, but also the possibility of using the output in subsequent analyses (Field, 2000; Rietveld & Van Hout, 1993).

5.6.1 Evaluating the Enablers of Technology Transfer

5.6.1.1 Initial Consideration

Factor analysis is based on the correlation matrix of the variables involved, and correlations usually need a large sample size before they stabilize. Therefore the reliability of factor analysis is also dependent on sample size. As a rule of thumb, a bare minimum of 10 observations per variable is necessary to avoid computational difficulties (DeCoster, 1998). According to Field (2005) Ahadzie (2007) and Owusu & Badu (2009), factor analysis is useful for finding clusters of related variables and thus ideal for reducing a large number of variables into a more easily understood framework. The first attempt to the use of factor analysis was to address some pertinent issues relating to the appropriate sample size for undertaking and establishing the reliability of factors analysis (Field, 2005). The reliability of factor analysis is determined by the sample size as correlation coefficients changes from one set of sample to another. The data sample was deemed adequate for factor analysis, exceeding the observation to variable ratio (i.e. 3.8:1) recommended by Hair *et al*., (1998). Furthermore, the data was subjected to the Kaiser-

Meyer-Olkin (KMO) and Bartlett's test of Sphericity which are used to measure sampling adequacy in the use of factor analysis (Field, 2005). The KMO statistic varies between 0 and 1 with a value of zero indicates that the sum of partial correlations is large relative to the sum of

correlations, indicating diffusion of pattern of the correlations and hence factor analysis is likely to be inappropriate (Field, 2005; Gorsuch, 1983).

A value close to 1.00 indicates that patterns of correlation are relatively compact and so factor analysis should yield distinct and reliable factors (Field, 2005). However, literature recommends that the KMO value should be greater than 0.50 if the sample size is adequate (Coakes, 2005; Field, 2005; Child, 1990). Subsequently, drawing on From Table F1 below using the KMO measure of sampling adequacy which is approximately 0.638 signifies the adequacy of the sample size of the data for the factor analysis to be conducted. This implies that factor analysis has been given a clean sheet to proceed. Similarly, the data has 94 observations per variable and the communalities in Table F2 after extraction were above 0.6 (Cheng & Chen, 2004), and this further strengthen the adequacy of the sample size; hence the communalities in the Table F2 are significant. The Bartlett's Test of Sphericity is also significant since the KMO is above 0.5. These phenomena of the data as demonstrated by the KMO and the Bartlett's Test of Sphericity clearly indicate that there is a strong relation among the enablers of TT variables. The significance of the Bartlett's test of Sphericity also suggested that the population was not an identity matrix; therefore, there are some relationships between the variables (Field, 2005a).

Bartlett's Test for this study was highly significant ($p<0.001$), and therefore factor analysis is appropriate (Field, 2005a).

After ascertaining the suitability of the data on evaluating the enablers of TT in the TT process, the data was analyzed using the Principal Component Analysis (PCA) and Varimax with Kaiser Normalization. The communalities involved were ascertained as indicated in Table F2 below to account for the number of variables to be extracted finally. A critical examination of the extraction

column of Table F2 indicated that the average of communalities extracted were above 0.60 indicating how well the extracted components represent the variables hence the extracted components are very good representation of the factors of enablers of TT.

Table F1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.638
Bartlett's Test of Sphericity	Approx. Chi-Square	2126.103
	Df	300
	Sig.	.000

Source: Researcher's Survey (2015)

Table F2: Communalities

Variables	Initial	Extraction
1. Complexity of Construction Technology	1.000	.898
2. Construction Mode of Transfer	1.000	.751
3. Government Policy	1.000	.838
4. Government Enforcement	1.000	.853
5. Cultural Differences	1.000	.899
6. Trust	1.000	.695
7. Communication	1.000	.645
8. Training Programs	1.000	.798
9. Teamwork	1.000	.725
10. Willingness to transfer	1.000	.617

11. Level of Experience	1.000	.790
12. Cultural traits	1.000	.884
13. Knowledge base	1.000	.636
14. Intent to learn Technology	1.000	.872
15. Level of Experience	1.000	.927
16. Cultural traits	1.000	.776
17. Knowledge base	1.000	.877
18. Competitiveness	1.000	.646
19. Performance improvement	1.000	.693
20. Improved Knowledge	1.000	.845
21. Improved working practices	1.000	.764
22. Long-term adoption of transferred skills	1.000	.755
23. Financial Performance	1.000	.795
24. Schedule Performance	1.000	.686
25. Quality Performance	1.000	.846

Extracted Method: Principal Component Analysis

Source: Researcher's Survey (2015)

From Table F3, both the Guttman-Kaiser rule and the Cattell scree test were used in determining the number of factors to be extracted. Guttman-Kaiser rule suggests that only those factors with an eigenvalue larger than 1 should be retained, whilst the Cattell scree test suggests that all further components after the one starting the elbow should not be included. Applying these criteria on the number of principal components to be extracted, eight (8) components have been extracted to represent the enablers of TT factors or variables. The total variance explained by each component extracted include, the first principal component (component 1) version is 16.990% of the total variance; second principal component (component 2) version is 15.283% of the remaining variance unaccounted for by the first component while the third principal component (component 3) version is 10.622% of the remaining variance unaccounted for by the first and

second component; the fourth principal component (component 4) accounted for 10.251% of the remaining variance not explained by the previous three components; the fifth principal component (component 5) version is 8.048% of the remaining variance unaccounted for by the previous four components while the sixth principal component variance (component 6) version is 6.956% of the remaining variance unaccounted for by the previous five components; the seventh principal component (component 7) version is 5.317% of the remaining variance unaccounted for by the previous six component; and finally the eighth principal component (component 8) version is 4.567% of the remaining variance unaccounted for by the previous seven components. In all, the 8 components extracted cumulatively accounted for 78.035% of the variation inherent in the data. This therefore implies that 8 principal components have been extracted to represent key enablers of TT whose eigenvalues are greater than 1. These factors with high eigenvalues explained about 78% of the variables, therefore the factor (variables) can be reduced to these set of variables with a loss of 22% information.

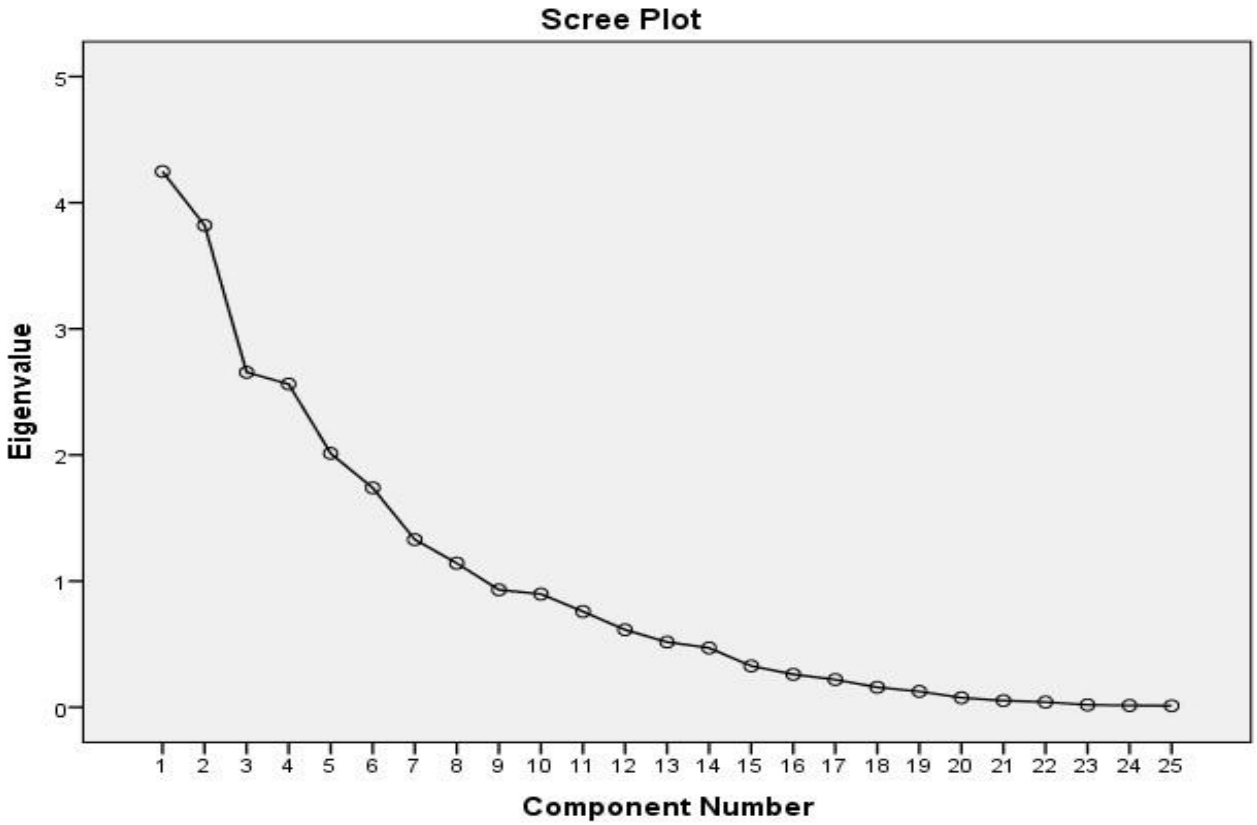


Figure 5.1: Scree Plot of the Enablers Variable

Source: Researcher's Survey (2015)

Table F3: Total Variance Explained

Component	Initial Eigenvalues	Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings

	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %
1	**4.248**	**16.990**	**16.990**	4.248	16.990	16.990	3.044	**12.178**	**12.178**
2	**3.821**	**15.283**	**32.273**	3.821	15.283	32.273	2.983	**11.933**	**24.111**
3	**2.656**	**10.622**	**42.896**	2.656	10.622	42.896	2.875	**11.502**	**35.612**
4	**2.563**	**10.251**	**53.147**	2.563	10.251	53.147	2.798	**11.192**	**46.804**
5	**2.012**	**8.048**	**61.195**	2.012	8.048	61.195	2.396	**9.584**	**8.584** **56.387**
6	**1.739**	**6.956**	**68.151**	1.739	6.956	68.151	2.146	**6.594**	**64.971**
7	**1.329**	**5.317**	**73.468**	1.329	5.317	73.468	1.648	**6.470**	**71.565**
8	**1.142**	**4.567**	**78.035**	1.142	4.567	78.035	1.617		**78.035**
9	0.931	3.724	81.759						
10	0.898	3.590	85.349						
11	0.759	3.035	88.384						
12	0.614	2.458	90.842						
13	0.517	2.067	92.908						
14	0.470	1.879	94.788						
15	0.327	1.309	96.097						
16	0.261	1.044	97.141						
17	0.219	0.876	98.017						
18	0.158	0.633	98.650						
19	0.125	0.500	99.150						
20	0.075	0.301	99.451						
21	0.053	0.210	99.661						
22	0.041	0.163	99.824						
23	0.019	0.075	99.900						
24	0.014	0.055	99.955						
25	0.011	0.045	100.000						

Extraction Method: Principal Component Analysis.

Source: Researcher's Survey (2015)

The interpretability of results can be improved through rotation (Norusis, 2005). The rotated factor solution is displayed by default and is essential for interpreting the final rotated analysis. Rotation suggests the behaviour of the variables under extreme conditions and maximizes the loading of each variable on one of the extracted factors whilst minimizing the loading on all other factors and it is best factor output solutions for interpreting factor analysis (Child, 1990). ***Table F4 and F5*** presents the results of the component matrix and the rotated component matrix of the

principal component analysis respectively. The interpretations of the results are provided in the next section of the dissertation.

Table F4: Component Matrix[a]

Variables	Component							
	1	2	3	4	5	6	7	8
					-.139	.369	-.248	-.012
Complexity of Construction Technology	.278	-.677	.319	-.210				
Construction Mode of Transfer	.652	-.390	.237	-.189	.117	.083	-.233	.087
Government Policy	-.206	.579	.502	.349	.179	.009	.176	.154
Government Enforcement	-.467	.434	.604	.118	.136	-.100	.121	.157
Cultural Differences	-.554	.265	.547	-.019	-.091	.440	.105	.094
Trust	-.088	-.311	.458	.075	.413	.033	.204	-.403
Communication	.226	.038	.114	-.136	.251	-.527	-.337	.326
Training Programs	.480	.068	.300	-.137	-.249	-.578	.204	.129
Teamwork	.029	.600	.426	-.009	-.080	-.160	-.320	.218
Willingness to transfer	.262	-.608	.053	-.077	.232	.170	-.065	.288
Level of Experience	.421	.518	-.001	-.395	.272	-.043	-.299	-.153
Cultural traits	.594	.101	.217	-.479	.180	-.170	.277	-.325
Knowledge base	.095	.555	-.413	-.210	.153	.036	-.214	.185
Intent to learn Technology	.425	-.273	-.204	-.076	-.276	.242	.367	.549
Level of Experience	.316	.556	-.110	-.291	.211	.601	.012	-.123
Cultural traits	.459	.037	.179	-.522	-.181	-.213	.415	-.089
Knowledge base	.348	.732	-.175	-.326	-.006	.270	.100	.033
Competitiveness	.535	-.048	.413	.270	.075	.082	.286	.142
Performance improvement	.608	.185	.324	.236	.013	.318	-.150	.069
Improved Knowledge	.672	.238	-.025	.513	-.256	.067	-.018	-.053
Improved working practices	.438	.161	-.123	.581	-.287	-.082	-.039	-.321
Long-term adoption of transferred skills	.483	-.010	.263	.534	-.251	.012	-.294	-.131
Financial Performance	.110	-.342	.199	.079	.775	-.035	-.130	.002
Schedule Performance	.253	-.012	-.255	.415	.516	.085	.296	.152
Quality Performance	.244	.202	-.534	.455	.445	-.166	.162	.040

Extraction Method: Principal Component Analysis[a] a. 8 Components Extracted

Source: Researcher's Survey (2015)

Table F5: Rotated Component Matrix[a]

Variables	Component							
	1	2	3	4	5	6	7	8

Complexity of Construction Technology	-.156	.088	**.794**	-.230	.021	-.395	-.153	.051
Construction Mode of Transfer	.086	.228	**.722**	-.232	.256	-.057	.213	.057
Government Policy	.071	.143	-.212	**.855**	-.021	.164	.039	.094
Government Enforcement	-.079	-.142	-.211	**.861**	-.016	-.075	.101	.159
Cultural Differences	.032	-.198	.005	**.757**	-.206	-.342	-.354	.023
Trust	-.260	-.073	.256	.187	.175	.108	-.242	**.649**
Communication	.011	-.041	.127	.008	.128	.070	**.777**	.032
Training Programs	-.154	.239	-.031	.056	**.718**	-.072	.402	-.176
Teamwork	.286	.210	-.143	.541	.009	-.264	.464	-.034
Willingness to transfer	-.174	-.104	**.712**	-.203	-.016	.146	.051	-.063
Level of Experience	**.745**	.074	-.013	-.049	.224	-.045	.353	.225
Cultural traits	.340	.035	.150	-.121	**.808**	.021	.037	.272
Knowledge base	**.639**	-.103	-.242	-.071	-.147	.138	.272	-.199
Intent to learn Technology	-.041	.033	.400	-.163	.234	.187	-.174	**-.750**
Level of Experience	**.908**	.049	.086	.085	.041	.069	-.281	.007
Cultural traits	.137	-.045	.062	-.092	**.843**	-.139	-.014	-.111
Knowledge base	**.844**	.069	-.184	.103	.231	.043	-.057	-.240
Competitiveness	-.065	.430	.396	.290	.371	.269	-.056	-.056
Performance improvement	.319	**.610**	.402	.218	.078	.054	.018	-.030
Improved Knowledge	.147	**.856**	-.005	-.043	.113	.194	-.013	-.194
Improved working practices	-.034	**.802**	-.251	-.176	.028	.138	-.070	.013
Long-term adoption of transferred skills	-.101	**.836**	.159	.022	-.042	-.073	.099	.060
Financial Performance	-.073	-.146	.509	.033	-.071	.420	.225	.525
Schedule Performance	.039	.106	.126	.005	-.054	**.806**	-.071	.001
Quality Performance	.127	.181	-.241	-.186	-.107	**.824**	.118	.002

Extracted Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization[a] a. Rotation converged in 16 iterations
Source: Researcher's Survey (2015)

The next stage involves examining the presence of any complex structure among the variables. A complex structure is said to be present when a variable has a factor or component loading greater than 0.50 on more than one component. Loadings express the influence of each original variable within the component. After checking for complex structure in the variables, the factor loadings

are again examined, but this time to check for components that have only one variable loading on them. A check on Table F5 shows that all 8 components had more than one variable loading on them, thus resulting in the keeping of all the 8 components. What remains is the interpretation of the 8 principal components extracted. It is instructive to note that the original 25 variables have been summarized into 8 new inter-correlated variables that explain 78.035% of the total variance in the variables included on the components.

5.6.1.2 Component Extracted

The results of the factor analysis above are promising. The data was summarized to 78% of the variance in the 25 factors with 8 components. Each component has at least 1 factor and at most 4 factors which can be represented as factors which are significant in enabler of TT with regards to the Ghanaian construction industry. Factors are interestingly grouped according to the themes.

Table F6: Component Profile of the Enablers of TT

Description of Components and Variables	Factor Loading	Variance Explained
Component 1:Transferor and Transferee Characteristics		
1. Level of Experience	.745	**16.990%**
2. Knowledge Base	.639	

3. Level of Experience	.908	
4. Knowledge Base	.844	
Component 2: Knowledge Advancement		
1. Performance Improvement	.610	**15.283%**
2. Improved Knowledge	.856	
3. Improved Working Practices	.802	
4. Long-term Adoption of Transferred Skills	.836	
Component 3: Transfer Environment		
1. Complexity of Construction Technology	.794	**10.622%**
2. Construction Mode of Transfer	.722	
3. Willingness to Transfer	.712	
Component 4: Government Influence		
1. Government Policy	.855	**10.251%**
2. Government Enforcement	.861	
3. Cultural Differences	.757	
Component 5: Learning Environment		
1. Training Programs	.718	**8.048%**
2. Cultural Traits	.808	
3. Cultural Traits	.843	
Component 6: Project Performance		**6.956%**
1. Schedule Performance	.806	
2. Quality Performance	.824	
Component 7: Communication		
1. Communication	.777	**5.317%**
Component 8: Relationship Building and Absorptive Capability	.649	**4.567%**
1. Trust		
2. Intent to Learn Technology	-.750	

Source: Researcher's Construct (2015)

5.6.2 Discussion and Interpretation of Results

This section focuses on the discussion and interpretation of the results. It combined the inferential analysis using chi square test for hypotheses; and factor analysis meant to classify and reduce variables for development of the conceptual framework. This section would adopt the procedure of Leedy & Ormrod (2005) for the discussion and interpretation of results by relating the findings of the research to the hypotheses advanced; relating the findings to extant literature, concepts, theories and research studies; determining if the findings have practical and statistical significance; and identifying the limitations of the research. Based on critical examination of the inherent relationships among the variables under each component, the following underlying dimensions were deduced. For instance, component 1 was labelled Transferor and Transferee Characteristics; component 2 was labelled Knowledge Advancement; component 3 was themed Transfer Environment; component 4 was themed Government Influence; component 5 was termed Learning Environment; component 6 was titled Project Performance; component 7 was themed Communication; and finally component 8 was referred as Relationship Building. These names were derived based on their interrelated characteristics and combination of variables with high factor loadings.

5.6.2.1 Component 1: Transferor and Transferee Characteristics

The first principal component (PC1) in Table F6 reported high factors loadings for the variables on *level of experience* (0.745), *knowledge base* (0.639), level of experience (0.908), and *knowledge base* (0.844). The numbers in brackets indicate the respective factor loadings, which assume the relative importance of the variable in the data set of the component. The component (cluster of the variables) accounted for 16.990% of the variance explained as shown in Table F3.

The statistical significance of these transferor and transferee characteristics in this study was been ascertained by the chi square test of significance. It was revealed from the chi square test that there exist a significant key relationship between level of experience; knowledge base; level of experience; and knowledge base, hence, the acceptance of the hypothesis that level of experience; knowledge base; level of experience; and knowledge base are fundamentals of transferor and transferee characteristics as enablers of TT. ***Drawing on from the above***, developing a realistic framework for TTPs in the Ghanaian construction industry will be appropriate and novel as demonstrated in ***figure 5.6.2.1*** below.

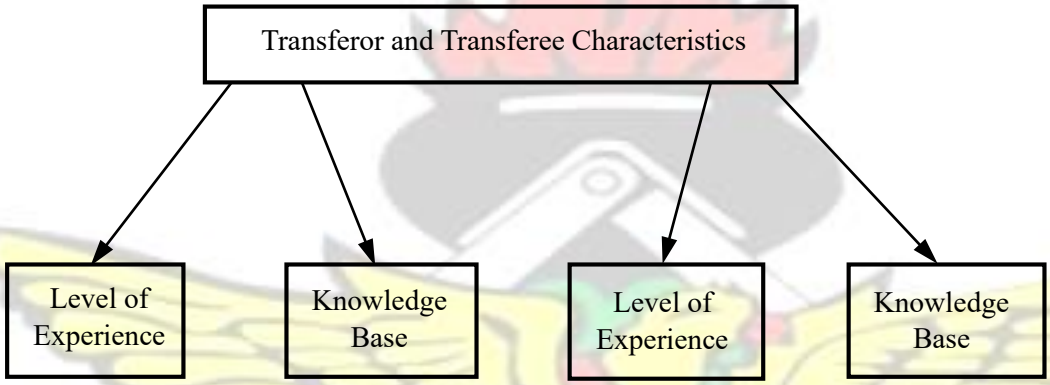


Figure 5.6.2.1: Transferor and Transferee characteristic sub TTP Framework
Source: Researcher's Survey (2015)

5.6.2.2 Component 2: Knowledge Advancement

The second principal component (PC2) in Table F6 reported factor loadings for the variables performance improvement (0.610), improved knowledge (0.856), improved working practices (0.802), and long-term adoption of transferred skills (0.836); and accounted for 15.283% of the variance explained as shown in Table F3. The statistical significance of these knowledge advancement in this study was been ascertained by the chi square test for significance. It was revealed that there exist a significance key relationship between performance improvement, improved knowledge, improved working practices and long-term adoption of transferred skills and hence, acceptance of the hypothesis as an enabler of TT. ***From the above discussion***, the sub

conceptual framework for TTPs in the Ghanaian construction industry is demonstrated below in ***figure 5.6.2.2.***

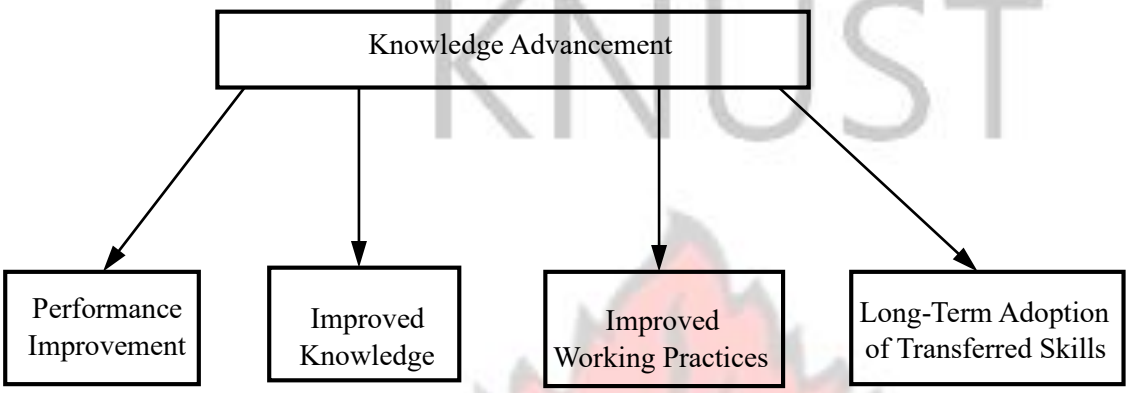


Figure 5.6.2.2: Knowledge Advancement Sub TTP Framework
Source: Researcher's Survey (2015)

5.6.2.3 Component 3: Transfer Environment

The variables extracted under *component 3* include complexity of construction technology; construction mode of transfer; and willingness to transfer with eigenvalues of 0.794, 0.722 and 0.712 respectively. The component (cluster of the variables) accounted for 10.622% of the variance explained as shown in Table F3. The chi square test of significance adopted for testing hypothesis accepted the null hypothesis relation to construction mode of transfer, hence, it is not dependent on the transfer environment as an enabler of TT. However, per the chi square test of hypothesis, there is statistical evidence to advocate the dependency of complexity of construction technology and willing to transfer of the transfer environment as an enabler of TT. ***Figure 5.6.2.3*** demonstrates the sub TTPs framework in terms of achieving realistic TTPs framework in the Ghanaian construction industry.

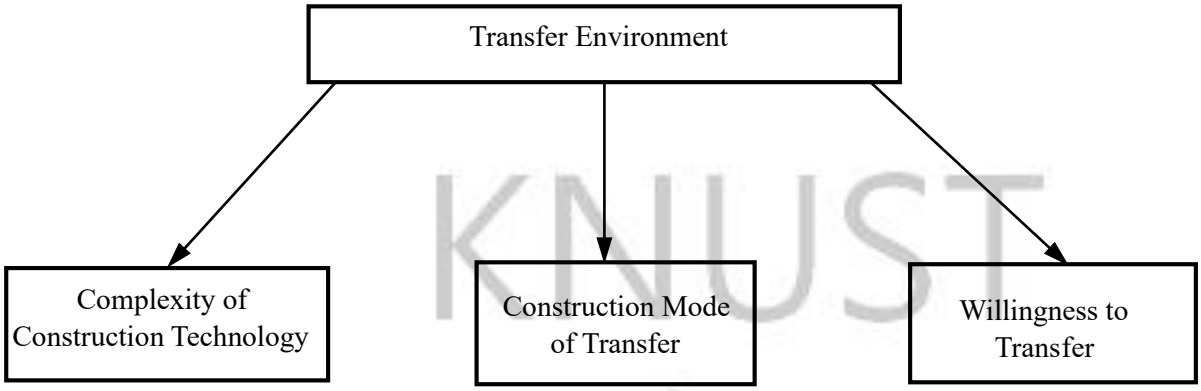


Figure 5.6.2.3: Transfer Environment Sub TTP Framework
Source: Researcher's Survey (2015)

5.6.2.4 Component 4: Government Influence

The variables extracted under *component 4* include government policy; government enforcement; and cultural differences with eigenvalues of 0.855, 0.861 and 0.757 respectively. The component (cluster of the variables) accounted for 10.251% of the variance explained as shown in Table F3. The chi square test of significance adopted for testing hypothesis rejected the null hypothesis relation to all extracted variables, hence, there is a statistical evidence to opine that there exist a significant dependent on the government influence as an enabler of TT. ***From the above discussion***, the sub conceptual framework for TTPs in the Ghanaian construction industry is demonstrated below in ***figure 5.6.2.4.***

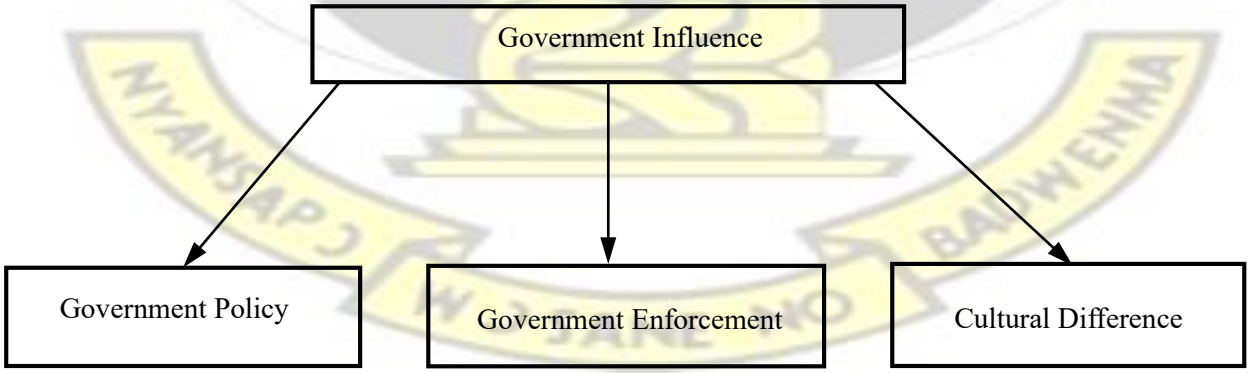


Figure 5.6.2.4: Government Influence Sub TTP Framework
Source: Researcher's Survey (2015)

5.6.2.5 Component 5: Learning Environment

The variables extracted under *component 5* include training programs; cultural traits; and cultural traits with eigenvalues of 0.718, 0.808 and 0.843 respectively. The component (cluster of the variables) accounted for 8.048% of the variance explained as shown in Table F3. The chi square test of significance adopted for testing hypothesis rejected the null hypothesis relation to all extracted variables, hence, there is a statistical evidence to opine that there exist a significant dependent on the learning environment as an enabler of TT. ***From the above discussion***, the sub conceptual framework for TTPs in the Ghanaian construction industry is demonstrated below in ***figure 5.6.2.5.***

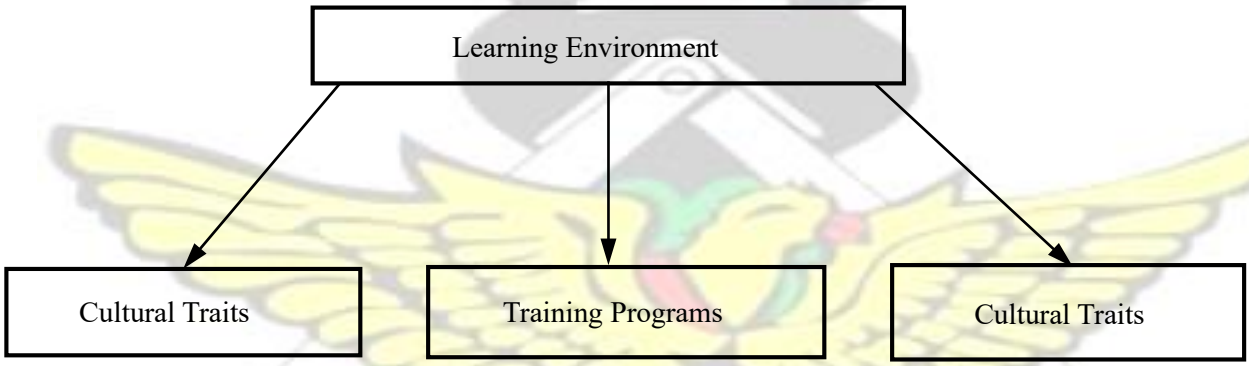


Figure 5.6.2.5: Learning Environment Sub TTP Framework
Source: Researcher's Survey (2015)

5.6.2.6 Component 6: Project Performance

The variables extracted under *component 6* include schedule performance; and quality performance with eigenvalues of 0.806 and 0.824 respectively. The component (cluster of the variables) accounted for 6.956% of the variance explained as shown in Table F3. The chi square test of significance adopted for testing hypothesis rejected the null hypothesis relation to all extracted variables, hence, there is a statistical evidence to opine that there exist a significant dependent on the project performance as an enabler of TT.

Project outcomes are usually measured by comparing the project with certain predefined goals expressed in terms of time, cost and quality. ***From the above discussion***, the sub conceptual framework for TTPs in the Ghanaian construction industry is demonstrated below in ***figure 5.6.2.6.***

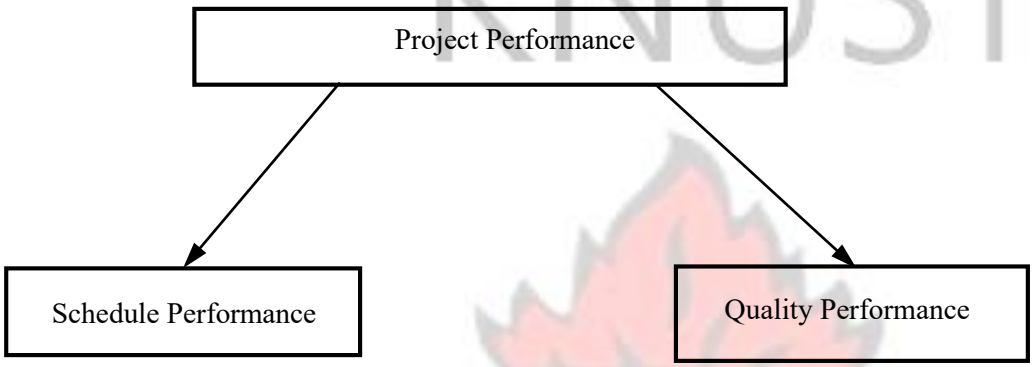


Figure 5.6.2.6: Project Performance Sub TTP Framework
Source: Researcher's Survey (2015)

5.6.2.7 Component 7: Communication

The variables extracted under *component 7* include communication with eigenvalues of 0.777. The extracted component accounted for 5.317% of the variance explained as shown in Table F3. The chi square test of significance adopted for testing hypothesis rejected the null hypothesis relation to the extracted variable, hence, there is a statistical evidence to opine that there exist a significant dependent on the communication as an enabler of TT. The effectiveness of communication between transferor and transferee and its impact on the TT process should always be considered as one of the key factors for successful TT processes (Black et al., 2000;

Devapriya & Ganesan, 2002; Ganesan & Kelsey, 2006; Malik, 2002; Nguyen et al., 2004). ***Drawing on from the above discussion***, the sub conceptual framework for TTPs in the Ghanaian construction industry is demonstrated below in ***figure 5.6.2.7.***

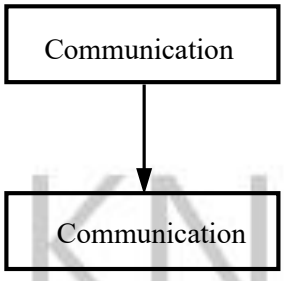


Figure 5.6.2.7: Communication Sub TTP Framework
Source: Researcher's Survey (2015)

5.6.2.8 Component 8: Relationship Building and Absorptive Capability

The variables extracted under *component 8* include trust; and intent to learn technology with eigenvalues of 0.649 and -0.750 respectively. The component (cluster of the variables) accounted for 4.567% of the variance explained as shown in Table F3. The chi square test of significance adopted for testing hypothesis rejected the null hypothesis relation to all extracted variables, hence, there is a statistical evidence to opine that there exist a significant dependent on the relationship building and absorptive capability as an enabler of TT.

For TT to function properly the organizations involved in the TT process should try to build a culture of mutual trust through effective communication between transferor and transferee (Black *et al.,* 2000; Malik, 2002). Cohen & Levinthal (1990) adjusted this macroeconomic concept and viewed absorptive capacity as a firm-level construct. Cohen & Levinthal (1989) introduced the absorptive capacity construct as the firm's ability to identify, assimilate and exploit knowledge from the environment. They argue that absorptive capacity depends greatly on prior related knowledge and diversity of background. They assume that a firm's absorptive capacity tend to develop cumulatively and is depend on the absorptive capacity of its individual members. ***Drawing***

on from the above discussion, the sub conceptual framework for TTPs in the Ghanaian construction industry is demonstrated below in ***figure 5.6.2.8.***

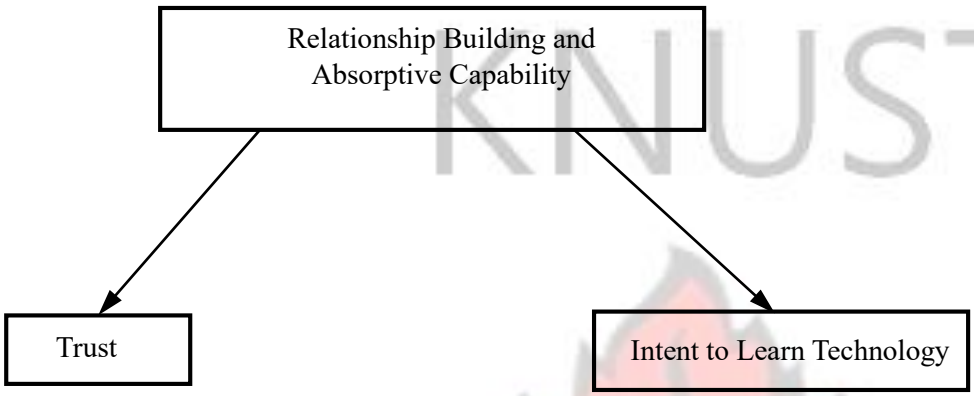
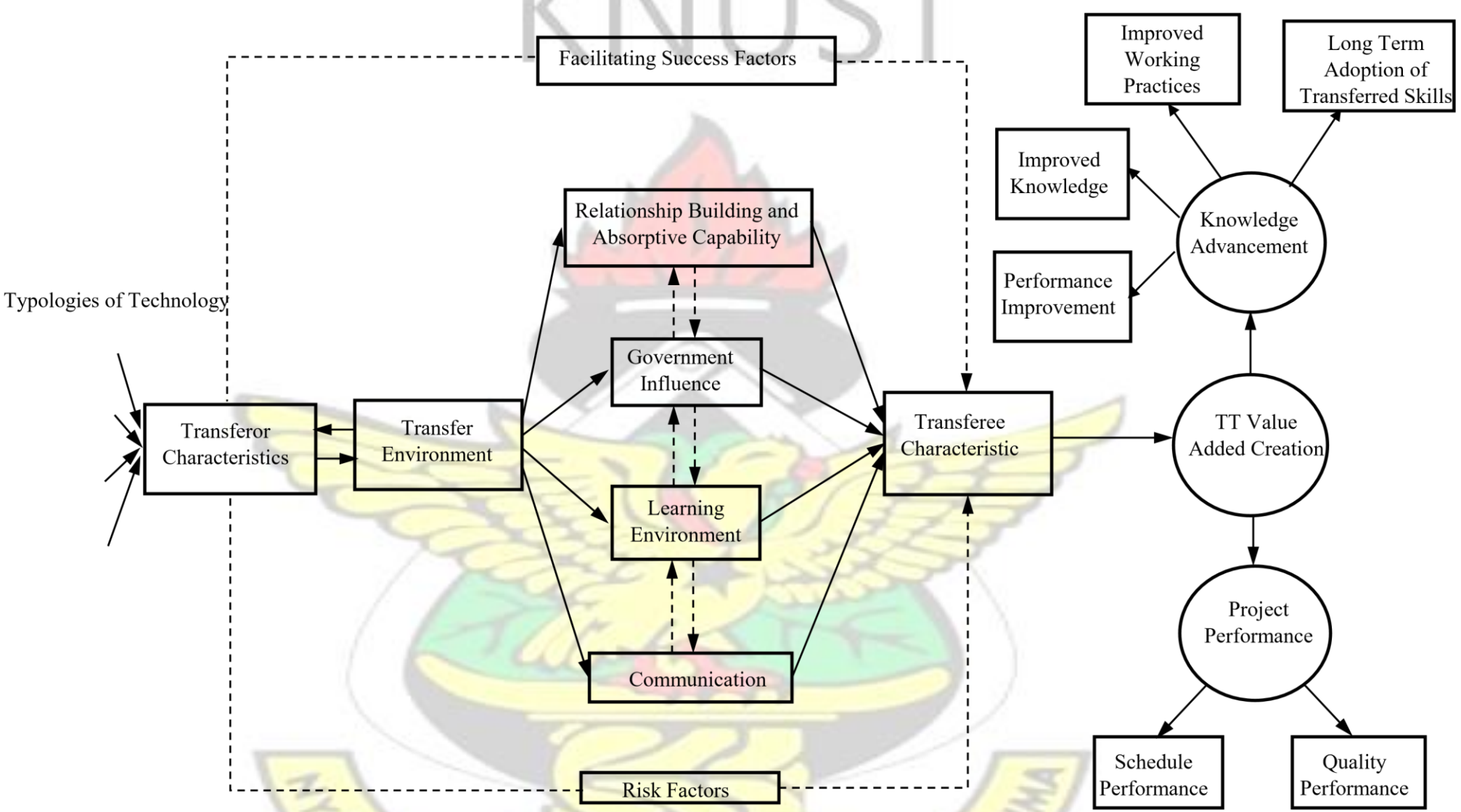


Figure 5.6.2.8: Relationship Building of Absorptive Capability Sub TTP Framework
Source: Researcher's Survey (2015)

5.6.3 Conceptual Framework for TTPs

Having examined the TT enablers pertinent in the Ghanaian construction industry empirically through the development of sub frameworks above, it is now plausible to develop the conceptual framework that will reflect the realities of TTPs in the construction sector. This conceptual framework metamorphosed from all figure in this sections above and is demonstrated in ***figure 5.6.3*** below.



Info ware

Organ ware

Figure 5.6.3: A Conceptual Framework for Technology Transfer Partnerships
Source: Researcher's Survey (2015)

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

This dissertation focused on the development of TTP framework in the Ghanaian construction industry is divided into six (6) independent but interrelated chapters. The general introduction to the research was covered in Chapter One. Chapter Two and Three discusses the literature review which delved into the phenomenon of TT and critical review of related models on TT respectively. In chapter Four, the methodology adopted for the study including the philosophical positions, research design, research strategy, and method of data collection were discussed. The research process was in two main phases: in-depth exploratory interviews and survey questionnaires. Chapter five presented the empirical analysis and provided detailed discussions on the survey results. The analysis and discussion of results led to the development of a conceptual framework for TTPs in Ghana. This chapter of the research is brought to a close by summarizing the issues addressed throughout the study. It begins with a summary on how the research objectives were achieved, followed the findings of the study and the contributions of this research to knowledge. The chapter concludes with recommendations for further research that can be conducted based on the conclusions and limitations of the study.

6.2 REVIEW OF RESEARCH OBJECTIVES

The aim of this research was to explore technology transfer partnerships in Ghana, and to develop a conceptual framework for facilitating the flow of technology from transferor to transferee construction firms in Ghana. To achieve this novel aim of the research, five key specific research objectives were set to commendably drive the schema as follows:

6.2.1 Objective 1:

To conduct literature survey to establish critical technology typologies pertinent to the construction industry;

Consequently, critical issues concerning the phenomenon and related models TT were reviewed to identify the trends in practice. The review began with discussions on working definitions of technology and TT and covered such topics as typologies, channels, success factors and risk factors of TT. The review was also necessitated by the need be abreast with the current TT and research environment to take sound decisions concerning what should be investigated. The review observed that, there have been many studies on TT aiming at identifying determinant factors for developing of a model manufacturing and other sectors but none was directed to explore TTPs specific to the Ghanaian constructions industry. The review aided in the identification of the knowledge gap and research gap as far as this research is at stake. In relation to the critical technology typologies, the review identified four (4) main typologies/component of technology namely: human ware; techno ware; info ware; and organ ware. Again, the review of extant literature concentrated on key issues conspicuously phenomenon of TT; and critical related models on TT and its allied concepts which are needed in the development of a conceptual TTPs framework. The conceptual framework climaxed in to the postulation of key hypotheses in which the dependent variable was enablers of TT process and several independent variables (**see *chapter 3***). The lacuna in knowledge and research is not related to TTPs in the construction industry alone but in other sectors as well.

6.2.2 Objective 2:

To establish the channels of transfer of technology from transferor to transferee construction firms in Ghana;

With the background knowledge on the conceptual maps of TT process gained from the literature review, an in-depth exploratory interviews were conducted to identify the channels/modes of transfer of technology from transferor to transferee firms in the Ghanaian context. Consequently, the channels were categorized into two (2) main methods namely: direct and indirect transfer methods. Conversely, eight (8) variables were identified were identified under the direct transfer method and three (3) variables relating to the indirect transfer method, emanating eleven (11) variables of channel of transfer of technology; and further tested on a larger number of respondents including the Ghanaian construction sector and its professional participating in TT programs.

The study explored the channels of transfer of technology and found licensing agreement; technical service agreement; machinery supply agreement; engineering and construction agreements; management contracts; turnkey contracts; franchising; and international subcontracting (outsourcing) as the direct transfer methods. On the indirect transfer methods, the study revealed joint venture; foreign direct investment; and partnerships. However, using the mean score analysis as well as the relative important index (RII), the indirect transfer methods are perceived to be most often used channels of transfer of technology. This therefore implies that the direct transfer methods are the less often channels of transfer of technology in the Ghanaian construction context.

6.2.3 Objective 3:

To explore the underlying risk factor confronting technology transfer partnerships applicable to the construction industry;

In the case of the third objective, an in-depth interviews were conducted to identify the risk factors (challenges) confronting the partnerships of transferor and transferee firms applicable in the Ghanaian context with the background knowledge on the conceptual maps of TT process gain from the literature review. Consequently, eleven (11) variables were identified as the risk factors confronting TTPs; and further tested on a large number of respondent including the Ghanaian construction industry and its professionals participating in TT programs.

The study unfolded infrastructure; current weak capacity; choice of technology; absorptive capability; industrial experience; marketing capabilities; technology transplantation; socioeconomic structure; government regulation; conflict of interest; and incompatibility as the general risk factors confronting TTPs in the Ghanaian construction context. Again, the mean score rankings as well as the RII were used to rate the level of severity of these risk factors confronting TTPs within the transferor and transferee firms in the TT process.

6.2.4 Objective 4:

To establish the underpinning success factors inherent in technology transfer partnerships;

Likewise the second and third objective, with the background knowledge on the conceptual maps of TT process gain from the literature review, an in-depth exploratory were conducted to identify the underpinning success factors facilitating TTPs within transferor (developed) and transferee (developing) firms in the Ghanaian construction industry. Consequently, eleven (11) variables were identified as the critical success factors facilitating TTPs; and further tested on a large number of

respondent including the Ghanaian construction industry and its professionals participating in TT programs.

The study unfolded long-term orientation/relationship; top management support; clear definition of roles; mutual decision-making; effective coordination among partners; trust; effective communication; shared corporate culture; commitment among partners; management innovations; and joint actions as the critical success factors inherent in TTPs in the Ghanaian construction sector. Again, the mean score rankings as well as the RII were used to rate the significant levels of these success factors inherent in TTPs within the transferor and transferee firms in the TT process.

6.2.5 Objective 5:

To develop a conceptual framework for facilitating technology transfer partnerships from foreign to local construction firms in Ghana.

In achieving the above objective which is the grand itinerary of this dissertation, the researcher combined the results and discussion conducted using statistical tools: mean score rankings, chisquare test of hypotheses to ascertain the relationship between the dependent variables and independent variables; and the factor analysis to measure the relatively large number of the independent variables (i.e. 25 enablers and outcome factors of TT process) could be measuring the same underlying effect. Factor analysis (Principal Component Analysis) was applied for data reduction to establish which of the variables could be measuring aspects of the same underlying dimensions. This also resulted in eight (8) components which were subsequently discussed and aided to the development of the conceptual framework (***see figure 5.6.3***).

6.3 FINDINGS OF THE RESEARCH

The findings of the research were reviewed under each of the research objectives. The data analysis and discussion of the results involved the use of mean score rankings, chi-square test of hypothesis and factor analysis. Other findings identified by in this research study which led to the development of a conceptual framework TTPs in the Ghanaian construction industry includes:

- The four elements/typologies of technology transfer namely: human ware; techno ware; info ware; and organ ware are very helpful in identifying and selecting what components of technology can be transferred and successfully implemented in developing countries;

- The channel/mode of transfer of technological capabilities are vital. The taxonomy of technology that is easily communicated and understood by the transferee (recipient) firms tend to diffuse faster and be viably transferred through indirect transfer method such as joint venture, foreign direct investment and partnerships;

- TT can be expensive if critical success factors are not properly considered during the TT decision-making process. Thus, overlooking these critical factors may create opportunity for impeding the development of transferee firm and economy.

6.4 CONTRIBUTION TO KNOWLEDGE

The relevance of a research is measured in terms of its contribution. However, there are parameters set all over the world form higher education institutions for contribution to knowledge of a research. There are commonalities among these parameters for determining contribution to knowledge by a research work which differ slightly from institution to institution.

According to Gray (2011), identified five criteria for determination of contribution to knowledge as:

- Literature review to demonstrate what counts as knowledge and research gap in the area of discourse and establishing what is currently known in the areas of the research study;
- Development of frameworks(models);
- Publications;
- Contribution to methodology; and
- Formulas.

Theoretically, as demonstrated in chapter two and three of this dissertation, numerous researchers have attempted to examine and/or model TT process. There are increasing number of research findings conduction on technology transfer partnerships specific to a peculiar context in developed countries. A large portion of these studies were predominately focused on the business and manufacturing sectors. Some of these empirical and qualitative studies resulted in the development of a framework or model of the TT process. Unfortunately, none of these existing frameworks attempt to explore technology transfer partnerships in Ghana, and to develop a conceptual framework to facilitate the flow of technology from transferor to transferee firms in the context of the Ghanaian construction industry. Thus, in an attempt to fill this gap in knowledge, this research developed a framework for TTPs in construction projects, which captured all of the relevant factors that influence the effectiveness and efficiency of the TT process as well as those which pertain to the value added. The developed framework provide evidence that the technology and knowledge of level of Ghanaian engineering and construction professional as well as the economy has improved after implementing TT operations involving TT initiatives.

The methodology adopted uniquely brings to bear the relevance of the TT process. The chisquare test of hypothesis establishes the key relationship between the various enablers and its outcome

factors. The factor analysis employed brings new thoughts of the underlying dimensions of the various factors identified. This research offered significant contribution to the existing body of knowledge in the research field of TT in construction industry in the area of TT performance evaluation. Such contribution is in the form of developing a conceptual TT framework which included TT process enablers and outcome factor. This framework developed aid researchers to better understand the TT process and the pertinent relationships to achieving value from TT operations and implementation. Again, the conceptual TT framework developed provides researcher with the tools to undertake further TT studies in the construction context of other developing countries. The findings of this study contributes towards a better understanding of TTPs in Ghanaian construction context. This research contributes to the body of knowledge which are presented through the submission of this dissertation and the publication of refereed conference proceedings. ***Drawing on from the above***, the contribution to knowledge of this research could be viewed in respect of its immediate contribution and what potential it may have in the future if further work is carried out.

6.5 RECOMMENDATIONS AND POLICY IMPLICATIONS

Governmental agencies and industries, such as construction, mining, manufacturing and businesses are gaining benefits and competitive advantages from the successful operation and implementation of TT initiatives. Coaxing such TT initiatives is the first step to effectively and efficiently transforming or re-engineering traditional construction business processes, and ultimately improving the productivity of the domestic construction industry. However, it is not enough to just expect that TT will naturally occur. The processes which underpin TT should be continuously evaluated to ensure that knowledge, experience and skills are being seamlessly absorbed by

transferee firms. This research study has implication for the construction sector of developing countries attempting to develop and promote an effective TT process in construction projects.

The developed TT framework could be utilized to assist government and construction professionals in developing countries to better evaluate TT performance. Specifically, TT stakeholder will be interested in the significant pathways and relationships to achieving value from the TT process. Understanding the dynamics of such relationships will assist them to better structure TT arrangements and operations on the most empowering enablers and its outcome value added creation.

This research study provides evidence that when construction projects incorporating TT initiatives are established, there must be careful selection of both transferor and transferee firm(s). Firms with appropriate technology and characteristics for TT process will form solid bonds that are based on trust, commitment, understanding and communication. Thus, it is essential that a substantial investment is provided for workshops and other relationship construction activities to create these bonds as early as possible in the construction program. In essence, speeding up the TT value creation process is the key to rapidly enhancing industry capacity and competitiveness.

Again, the developed conceptual framework is especially important for publicly funded infrastructure projects where the government is concerned that advanced technologies are being willingly and effectively transferred to transferee workers and professionals. Moreover, the conceptual framework developed could assist multilateral funding agencies, such as the World

Bank, which would want to have tools to better monitor the performance and evaluation of the TT process when they provide loans for the procurement of necessary infrastructure for developing countries. One of the primary objectives of these funding agencies is to actively encourage domestic firms in developing countries to improve the knowledge levels of their workers and professional as well as industry capacity; ultimately leading to improved standards of living for all local people.

TT cannot be simply transferred without strong institutional support. The necessary institutional framework should be set-up to support the process of: identification; communication; acquiring; evaluation; absorption; development; utilization; assessment; promotion and forecasting of technology. The institutional support for construction industry will boost their absorptive capacity on facilitating the availability of information, reliable infrastructure, and legal aid and training opportunities. The government and other stakeholder can play a pivotal role in this respect.

Finally, this research study found that the Ghanaian construction industry has gained advanced knowledge from transferor TT ventures. The author suggest that government and construction industries in developing countries should seriously start to invest funds into further developing acquired construction technology and management knowledge.

6.6 LIMITATIONS OF THE RESEARCH

The main limitations of this research were emphasized in its conduct and scope of the study. These limitations provided the basis for future research suggestions. It is envisaged that the limitations of this research are as follows:

- The effect of sampling and measurement error which might affect the collection of data and the kind of analysis to be carried out and the conclusions drawn;

- The developed framework did not utilized to refine and validate the case study design in the TT process for the construction industry. This phase of the research process should involve statistical analysis giving the means of each individual factor of the conceptualized framework in this study and their validation of the causal paths together with its application;

- In this research, structural equations and method of benchmarking TT performance had not been applied. In reality, the strength of relationship and path ways in the developed conceptual framework may vary depending on the maturity of the transferee country and tis respective construction industry;

- The analysis and conclusion of this research were based on data collected from respondent by using the data collection instruments.

6.7 DIRECTIONS FOR FUTURE RESEARCH

This research has its own shortcomings and a number of areas were identified and therefore opens opportunities for further investigations, which could provide prolific results if investigated further. The following directions for future studies are therefore suggested to enhance the empirical research in Ghana and other developing countries:

- Future studies should provide the springboard for research is determining the relationship between perceptions of culture, physical environment, geographical location and the success of TT;

- Similarly, further research study to refine and validate a model in the TT process using structural equations and method of benchmarking to strengthen the evaluation of baseline performance of construction TT process in Ghana and other developing countries. Future researchers and practitioners should adopt the path equations and method for benchmarking TT performance to assist them when identifying deficient facets of the TT process and the most appropriate paths to achieving higher value form TT process;
- Moreover, future research should take many enablers towards project management and knowledge management process as knowledge creation, knowledge sharing, knowledge acquisition and knowledge application;
- Another potential direction of research can concentrate on the dual TT and economic dimension of developing countries that seek an optimal approach of TT. This can be accomplished by investigation all the possible opportunities to establish long-term commercial cooperative practice between developed and developing countries to enhance TT process;

- Finally, an interesting area of research could investigate how diaspora (human expert such as bilingual, bicultural and technology expert) can be beneficial for their countries given the merits and demerits of involving them in TT projects. This can be approached by conducting comparisons of how diaspora involvement in TT projects can provide viable and faster implication than educating and training local staff.

6.8 SUMMARY OF CHAPTER

This chapter summarizes the empirical findings which form the contributions to the body of knowledge and fills the research and knowledge gap in terms of theoretical and practical

underpinnings. The main conclusions have been presented and the limitations of the research have been acknowledged. Recommendations for further research and policy implications for stakeholder and practitioners involvement in the area of construction professionals and technology have been prescribed by the study.

6.9 CONCLUSION OF THE RESEARCH

The fundamental problem addressed by this study is inserted with five independent but interlinked issues in an attempt to fill identified research gaps (see section 1.3.1). This led to the overall aim to explore TTPs in Ghana, and to develop a conceptual framework to facilitate the flow of technology from transferor to transferee construction firms in Ghana. Recognizing that the construction industry plays a vital role towards achieving the millennium goal of attaining middle-level income status and strong economic stability is key to understand the contribution of this research study to bring the innovations, creativity, knowledge and philosophy behind its commencement.

Developing a conceptual framework for TT process was the primary facet of this dissertation. The conceptual framework was developed after reviewing numerous TT studies conducted in a wide variety of industry sectors. Following the extant literature reviewed, an in-depth exploratory interview was conducted and subsequently a survey questionnaire was aimed to test the validity and reliability of data collected. The interest of this study has been multi-faceted and committed to fulfilling above arguments in real life context. The findings and conclusions from this study, however, are considered in the light of the limitations of the study, methodology used and the analysis adopted. In conclusion, the theoretical and empirical literature on the phenomenon of TT and its related works is fragmented and has so far paid relative responsiveness to developing countries. It has added significantly an important portion of knowledge to the construction

technology and knowledge literature. The research objectives of this study outlined at the beginning of this study have been fully achieved under consideration of the stated scope and boundary. The methodology and findings of this study can be easily be applicable in other sectors of the economy such as manufacturing, mining, business, agricultural

etc.

The innovations the study brings are evident in its contribution to the body of knowledge; theoretically and practically as discussed earlier. The recommendations and policy implications suggested by this study is hoped to contribute to the economic and project success of construction firms operating in developing countries, particularly in Ghana if they are implemented. The finding suggested in this study provided a conceptual framework to facilitate the flow of technology from developed (transferor) to developing (transferee) construction firms in Ghana. Finally, this study will inspire other researcher to better understand the dynamics of the TT process and practitioner to more proactively manage TT ventures and operations.

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APPENDIX 1A: SURVEY QUESTIONNAIRES

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF ART AND BUILT ENVIRONMENT

DEPARTMENT OF BUILDING TECHNOLOGY

Dear Sir/Madame,

SURVEY QUESTIONNAIRE- DEVELOPMENT OF A FRAMEWORK FOR TECHNOLOGY TRANSFER PARTNERSHIPS (TTPs) IN THE GHANAIAN CONSTRUCTION INDUSTRY.

I am currently conducting a study into the developing a framework for technology transfer partnership in the Ghanaian construction industry regarding the concepts of knowledge transfer, absorptive capacity and technological innovation.

As part of the research, I am conducting a questionnaire survey to seek input from construction participants within the industry in Ghana. Since only a limited number of qualified professionals are sampled, your experiences and perceptions on the subject are very important to this research. The research will provide information on the attributes of TT that are most important to construction participants and ultimately offer recommendations on how to accelerate the TT process in the Ghanaian construction industry.

Your response will be treated as STRICTLY CONFIDENTIAL. The information will be used for academic purposes only, as one part to a university research project. Only a consolidated summary of the results may be published, i.e. no names of participating individuals will be referred to and only the aggregate groups will be reported. A summary of the findings will be made available to you upon request.

I appreciate that the survey is going to take some of your valuable time, however, we urge you to try and participate, as your contribution is very important towards the success of this research. On this note, I wish to take this opportunity to thank you in advance for your cooperation. Yours Sincerely,

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SURVEY QUESTIONNAIRE ON TECHNOLOGY TRANSFER PARTNERSHIPS IN THE CONSTRUCTION INDUSTRY

This survey aims to develop a framework for technology transfer partnerships in the Ghanaian construction industry. The information will be used for academic purposes only, for MPhil in Building Technology at Department of Building Technology, KNUST-Kumasi under the supervision of Dr. DeGraft Owusu-Manu. The area of this research is on developing a framework for Technology Transfer Partnerships between

foreign and local construction companies in Ghana. Individual responses will be kept confidential. Only a consolidated summary of the result may be published.

Please, kindly respond to the questions by ticking (√) the appropriate box for each item.

PART A: BACKGROUND INFORMATION

Firm Status

1. What is the status of your firm?
   - A. Enterprise / sole proprietorship [ ]
   - B. Private Limited company [ ]
   - C. Partnership / Joint venture [ ]
   - D. Other (Please specify) …… [ ]

Firm Existence

2. How long has the firm been in existence?

[ ] under 10 years [ ] 11 – 20 years [ ] 21 – 30 years [ ] over 30 years

Experience of Professional

3. How many years of experience do you have in the construction area?

[ ] Less than 5 [ ] 5-10 [ ] 11-15 [ ] 16-20 [ ] More than 20

PART B: EVALUATING TECHNOLOGY TRANSFER PARTNERSHIPS (TTPS)

This part studies the factors that influence TT approach in terms of positive and negative experiences. This depends naturally on your case project. Please tick your selected rating, using the scale below, for following variables based on your experience on the projects you have been involved. **Typologies of Technology**

4. How significant does the following components of technology are being embodied in the production process? Please rank by using the key: **1= Not Significant; 2=Less Significant; 3=Moderate Significant; 4=Significant; 5=Very Significant**

Typologies Of Technology	**1**	**2**	**3**	**4**	**5**
A. Human ware					
Skills					
Experience					
Insight					
Learning					
B. Techno ware					
Tools					
Machines					
Equipment					
C. Info ware					
Design Parameters					
Specification					
Procedure					
Knowledge based systems					
Manuals					

Theories					
D. Organ ware					
Organizational structure					
Policies					
Contracts					
Techniques					
Organizational networks					
Management practices					

Channels/Modes of Transfer of Technology

5. How often does the following transfer channel effectively used between technology transfer agreements? Please rank using the key: **1=Not Often; 2=Less Often; 3=Moderately Often; 4=Often; 5=Very Often**

Channels/Modes of Transfer of Technology	**1**	**2**	**3**	**4**	**5**
A. Direct Transfer Method					
Licensing Agreement					
Technical Service Agreement					
Machinery Supply Agreement					
Engineering and Construction Agreements					
Management Contracts					
Turnkey Contracts					
Franchising					
International Subcontracting(Outsourcing)					
Other please specify……					
B. Indirect Transfer Method					
Joint Venture					
Foreign Direct Investment(FDI)					
Partnership					
Other please specify……					

Risk factors confronting Technology Transfer

6. How would you rate the severity levels of the following challenges confronting Technology Transfer partnerships within transferor firm and transferee firms? Please rank on a scale of 1-5 where: **1=Not Severe; 2=Less Severe; 3=Moderately Severe; 4=Severe; 5=Very Severe**

Risk Factors	**1**	**2**	**3**	**4**	**5**

Infrastructure					
Current weak Capacity					
Choice of technology					
Absorptive Capacity					
Industrial Experience					
Marketing Capabilities					
Technology Transplantation					
Socio-economic structure					
Government regulation					
Conflict of Interest					
Incompatibility					

Others please specify ……

Critical Success Factors Facilitating Technology Transfer

7. Below are the critical success factors facilitating technology transfer partnerships among developed (transferor) firms and developing (transferee) firms. Please rank on a scale of 1-5 indicating their significant levels in the construction industry. Use the key: **1=Not Significant; 2=Less Significant; 3=Moderately Significant; 4=Significant; 5=Very Significant**

Critical Success Factors	**1**	**2**	**3**	**4**	**5**
Long-term Orientation/Relationship					
Top Management Support					
Clear Definition of Roles					
Mutual decision-making					
Effective Coordination among partners					
Trust					
Effective Communication					
Shared Corporate Culture					
Commitment among partners					
Management Innovation					
Joint Action					

Others please specify ……

PART C: EVALUATING THE CONCEPTUAL FRAMEWORK

This part evaluates the new proposed conceptual framework in the construction industry. The conceptual framework will be developed based on the literature review (retrospective TT research and models) and empirical of construction firms engage in transferring Technology and Knowledge to local firms in Ghana.

8. Please indicate by ticking your selected rating, using the scale below, for following factors based on your experience on the projects you have been involved. Use the key: **1=Not Significant; 2=Less Significant; 3=Moderately Significant; 4=Significant; 5=Very Significant**

Enablers of Technology Transfer

A. Transfer Environment	**1**	**2**	**3**	**4**	**5**
Complexity of Construction Technology					
Construction Mode of Transfer					
Government Policy					
Government Enforcement					
B. Learning Environment					
Cultural Differences					
Trust					
Communication					
Training Programs					
Teamwork					
C. Transferor Characteristics					
Willingness to transfer					
Level of Experience					
Cultural traits					
Knowledge base					
D. Transferee Characteristics					
Intent to learn Technology					
Level of Experience					
Cultural traits					
Knowledge base					
E. Economic Advancement					
Competitiveness					
Performance improvement					
F. Knowledge Advancement					
Improved Knowledge					
Improved working practices					

Long-term adoption of transferred skills					
G. Project Performance					
Financial Performance					
Schedule Performance					
Quality Performance					
H. Absorptive Capability					
Employee Capability					
Knowledge Sharing					
Working Culture					
Research and Development(R&D) Capability					
Communication Capability					
I. Knowledge Transfer					
Knowledge Strategy					
Organizational Culture					
Information Technology					
Knowledge Leadership					

END OF QUESTIONNAIRE
THANK YOU FOR YOUR PARTICIPATION

APPENDIX 1B: PRELIMINARY INTERVIEW GUIDE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI
COLLEGE OF ART AND BUILT ENVIRONMENT DEPARTMENT OF BUILDING TECHNOLOGY

Dear Sir/Madame,

CASE STUDY INTERVIEW- DEVELOPMENT OF A FRAMEWORK FOR TECHNOLOGY TRANSFER PARTNERSHIPS (TTPs) IN THE GHANAIAN CONSTRUCTION INDUSTRY.

My name is Antwi-Afari Maxwell Fordjour an MPhil student at Kwame Nkrumah University of Science and Technology, Department of Building Technology. I write to kindly reserve an appointment with you for an interview on the above research topic. The concept of TTP continues to emanate; however, there is few studies and theories among practitioners and researchers on its application in Ghana.

This research intents to elicit the views of key stakeholders on the subject, based on their experience and high profile work undertaken in their capacity with local contractors in establishing a common mechanism in understanding the concept of technology transfer. The implication of the

findings is for the future development of the Technology Transfer Partnerships in Ghana and developing countries as a whole, which basically faces similar challenges.

I appreciate that the interview is going to take some of your valuable time, however, we urge you to try and participate, as your contribution is very important towards the success of this research. On this note, I wish to take this opportunity to thank you in advance for your cooperation. Yours Sincerely,

Antwi-Afari Maxwell Fordjour
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Project Supervisor
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Senior Lecturer
Department of Building Technology
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INTERVIEW GUIDE

INTERVIEW DURATION: 30 mins

This semi-structured interview guide consists of detailed but not restricted to the following questions that will be discussed during the interviews with targeted respondents aimed at developing a framework for technology transfer in the Ghanaian construction industry.

CASE STUDY INTERVIEW ON TECHNOLOGY TRANSFER PARTNERSHIPS IN THE GHANAIAN CONSTRUCTION INDUSTRY

Part A: Background Information

Name of Interviewee:…….
Organization:……..
Position in the organization:…….....
Date of the interview:…….....
E-mail/ Contact No:……...

Part B: Interview Guide on Technology Transfer

1. What are the principal factors that drives your firm in participating in technology transfer (TT)?
2. What form of technology and knowledge do you acquire from developed (transferor) firm?
3. What are the various specific components of technology that your firm received from transferor firm?
4. What is the mode of transfer of the technologies received from developed (transferor) organization?
5. Under which particular transfer method was the contractual agreement based?
6. What are the main barriers faced by transferor firm in transferring technology to transferee firm in the construction industry?

7. What are the critical success factors that facilitate the transfer of technology among partners in the construction industry?
8. Did your firm faces significant problems in performing the project due to political and government interference?
9. What the main transfer programmes put in place to facilitate project performance among partners?
10. How does human resource dimensions such as language and culture skills impact on TT process?
11. How does your firm absorb and acquire new technology and skills to improve project management and performance?
12. How the attributes of absorptive capability does improves TT performance in the construction industry?
13. How does the attributes of knowledge transfer contributes significantly on the TT process?
14. How does the impact of technological innovation influence the TT process?
15. How the enablers of TT does contributes significantly to the degree of value added to the transferee construction industry?

END OF INTERVIEW

THANK YOU FOR YOUR PARTICIPATION

Please take a minute to ensure you have answered each question Thank you very much for your time and effort