Learning in Engineering Consultancy Practice

A Rapprochement between Cognitive Learning and Knowing in practice in International Consultancy Alliances at NESPAK Pakistan

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2019

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Submission

This thesis is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy (Ph.D.)

Doctoral Thesis
2013-2019

Declaration

I declare that this Ph.D. thesis, entitled ***"Learning in Engineering Consultancy Practice: A Rapprochement between Cognitive Learning and Knowing in practice in International Consultancy Alliances at NESPAK Pakistan"***, is my own work and has not been submitted in the same form elsewhere. This thesis has been developed within the agreed limits, for the award of Doctor of Philosophy (Ph.D.) in Management Learning and Leadership under the guidance and supervision of Dr. Dermot O'Reilly and Dr. Uzair Shah at the Department of Organization, Work and Technology, Lancaster University Management School, UK.

Muhammad Shakeel Aslam

To my beloved parents, my lovely wife and my adorable children.

Acknowledgements

I would like to express my deep gratitude to my learned supervisors, Dr David Simm, Dr Uzair Shah and Dr Dermot O'Reilly, for their invaluable involvement, guidance, advice, constructive criticism and support during different phases of this thesis. I could not have imagined having a better advisor and mentor for my PhD study. I am most grateful to Dr David Simm for having faith in my ability and accepting me as a doctoral student. His support, encouragement and intellectual guidance since the start of this journey have been invaluable. Special thanks to Dr Uzair and Dr Dermot for taking on a supervisory role in the middle of this journey, which must have been challenging for both of them. It was their intellectual feedback and long insightful discussions that made this journey a learning experience and helped me reach the destination. I am immensely thankful to Dr. Imran Haider Naqvi for providing me with ample resources and an environment conducive for focused excellent research output. His administrative help in managing my official workload ensured the efficient progress and timely completion of my research study. It was fantastic to have the opportunity to work with these supervisors, who accepted nothing less than excellence from me. I will be truly indebted to them throughout my life for steering the course of this research.

I am thankful to COMSATS University, Islamabad (Lahore Campus), for the award of a scholarship for PhD study. I would also like to express my gratitude to my panel reviewers for their insightful suggestions. Thanks are due also to all my friends at Lancaster University and COMSATS University, for their wonderful company and unwavering friendship. I express special thanks to my intellectual friends: Aniqa and Ahmad Qammar for long discussions of theories and philosophies and zealous support whenever needed. Sincere thanks go to the departmental administrative staff, Shirley, Helen, Catherine and Benjamin, for providing comprehensive administrative support and facilities.

I am pleased to recognise NESPAK, as the research organization, for hosting this research and the individual hospitality of the research participants. I appreciate their passion and input, without which the fieldwork could not have been successfully completed. Special thanks go to Mr Abdul Qayyum for arranging access to the research organization and to the participants of this research.

I owe special thanks to my parents, Bashiran Begum and Muhammad Aslam Azhar, whose prayers have been answered. They always believed in me and showed me unconditional love, care and support at every stage of my life. Words could never express my gratitude to them for shaping my life. I owe them everything. My earnest thanks to my siblings, Shabana, Aqeel and Saif, for always giving me true support and backing me throughout my studies.

Last but by no means least, a big thanks to the special person, my wife, Sadia, for her unfailing and continued love, care, companionship and patience during my pursuit of a PhD. The way she cared for our children while doing her job and managing the household, is gratefully recognized. I appreciate her believing in me and standing by me during this tough journey: thank you Sadia for being true support. To my adorable children, Zoha, Aizzah and Wali, I express my deepest love for tolerating my having to ignore them and sacrificing their time to allow me to write this thesis. Their hugs were a source of great happiness and comfort in times of distress and instilled a new sense of determination: I love you all.

Muhammad Shakeel Aslam

Abstract

The current research examines engineers' learning in the practice of engineering consultancy in the context of international consultancy alliances. Though practice-based approaches to learning have been well established since the early 1990s, the area is still relatively under-studied as only relatively few notable empirical studies have been conducted so far. And there is no empirical study that has used this concept to examine learning across the boundaries of an organization, such as in the context of international alliances wherein the practice is constituent of local and foreign practices, activities and ways of working. Further, practice-based approaches to learning are especially dismissive of cognitive learning and do not give much importance to explicit knowledge. On the other hand, there are research calls for using a knowing in practice perspective in different organizational contexts, as well as for developing the rapprochement between cognitive learning and knowing in practice and acknowledging the role of explicit knowledge in knowing in practice. To address these research calls, the current research examines learning in doing the practice of engineering consultancy, which is a rapprochement between cognitive learning and knowing in practice. This rapprochement is informed by the concepts of distributed cognition and the collective mind. Thus, engineers' learning is studied in this research, which takes place through cognitive learning and learning in the practice of engineering consultancy in an integrated manner. Further, this research also studies the role of explicit knowledge, in addition to tacit knowledge, in learning in doing consultancy practice.

Further, the practice of engineering consultancy emerges through the integration of local and foreign working practices shared by the partners in an international consultancy alliance. Thus, in addition to engineers' learning, I also study cross-border sharing of working practices and knowledge in consultancy alliances to complete Pakistan-based infrastructure projects. In the domain of cross-border sharing of practices, the existing literature is extremely deficient as I could find only one study exploring the cross-border transfer of Japanese practices to China-based foreign subsidiaries. On the other hand, there is voluminous literature available on the factors influencing cross-border sharing of knowledge in strategic alliances. However, most of these studies are quantitative in nature and measure the effects of different factors on knowledge-sharing in strategic alliances. There is a deficiency of qualitative research on this phenomenon that explores how different factors influence such cross-border sharing of knowledge. The current research addresses these literature gaps and contributes to the existing body of knowledge by empirically studying cross-border sharing of consultancy practices and related knowledge in international consultancy alliances.

The research is conducted at NESPAK, Pakistan, an engineering consultancy company following a critical realist philosophy of social science, a qualitative research approach and a single case study design based on systematic combining. Participants of the research are NESPAK's engineers who have been involved in developing and performing engineering consultancy practices for local projects through collective working with foreign consultants. I assembled a sample of 30 engineers through purposive and snowball sampling and collected data using semi-structured interviews, observation, field notes and documentary analysis. The data is analyzed using grounded theory. Following systematic combining, data collection and analysis were done simultaneously in order to consider emerging themes relevant to the phenomenon being studied.

The findings of the research are presented in the form of two core categories. The first core category is labelled as Learning in Engineering Consultancy Practice, which offers three accounts of engineers' learning (categories): Self-directed Learning, Managerially Influenced Learning and Partner-influenced Learning. The second core category is labelled 'Symbiotic Learning Alliance' and identifies different factors (categories) influencing the cross-border sharing of consultancy practices and knowledge and their ways to have influence. These factors are: Symbiotic Alliance Relationship, Developing Cultural Harmony, Intention to Learn and Willingness to Share Knowledge, and Constructive Disagreements. Each category of both core categories is presented and analyzed. Findings are further discussed theoretically in relation to relevant existing literature, theories and models.

This research makes a substantial contribution to the existing body of knowledge by empirically substantiating the rapprochement between two perspectives of learning which were previously seen as being in contrast to each other. Rapprochement is developed through theories of distributed cognition and the collective mind. Further, this research also identifies new aspects, such as disagreements and cultural differences, that influence the cross-border sharing of working practices and knowledge and how these aspects influence this sharing process, and how impeding aspects are variously addressed. A

learning model in place at NESPAK that reflects a comprehensive learning process is presented, which is another significant contribution to the existing body of knowledge. The findings of the study also present significant insights not only for NESPAK, but for other organizations as well, where employees are learning in practice in the context of international alliances.

Keywords: Engineers' Learning, Practice-Based Studies, Knowing in practice, Cognitive Learning, Distributed Cognition, Collective Mind, Rapprochement, Cross-Border Sharing of Knowledge and Practices, International Consultancy Alliance, Learning in Engineering Consultancy Practice, Symbiotic Learning Alliance, NESPAK Pakistan

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List of Abbreviation

PBS	Practice-Based-Studies
NESPAK	National Engineering Services of Pakistan
RBV	Resource-Based-View
SLT	Situated Learning Theory
CoP	Community of Practice
PoC	Practices of a Community
ICTs	Information and Communication Technologies
FEWS	Flood Early Warning Systems
NJHPP	Neelum Jhelum Hydro Power Project
MWH	Montgomery Consulting Engineers (JMM), Watson Hawksley, Ltd., and Harza Engineering Company, USA
NORPLAN	Norwegian-based engineering consultancy, Asplan Viak AS
NDC	National Development Consultant
ACE	Associate Engineering of Pakistan
WAPDA	Water and Power Development Authority
KMS	Knowledge Management System
ToRs	Terms of References
IJVs	International Joint-Ventures
SET	Social Exchange Theory
CR	Critical Realism
GT	Grounded Theory
US	United States
SoPs	Standard Operating Procedures
ISO	International Standards Organization
TAMS	Tippetts, Abbett, McCarthy and Sharton
COMSATS	The Commission on Science and Technology for Sustainable Development in the South
VP	Vice President
HR	Human Resource
PEC	Pakistan Engineering Council

CAQDAS	Computer Aided Qualitative Data Analysis Software
HVDC	High Voltage Direct Current
NGO	Non-Governmental Organization
SCADA	Supervisory Control and Data Acquisition
CCT	Combined Cycle Technology
SNC	Surveyer, Nenniger & Chenevert Consulting Engineers, Canada
DHI	Delph Hydraulics Holland
MD	Managing Director
JV	Joint Venture
ADB	Asian Development Bank
LOLMPT	Lahore Orange Line Metro Train Project
DMS	Documents Management System
T&D	Training and Development
CPEC	China Pakistan Economic Corridor
OBOR	One Belt One Road
FDI	Foreign Direct Investment
IAS	Integration Acculturation Strategy
BID	Building Infrastructure Division
CR	China Railway

CHAPTER 1: INTRODUCTION

1.1 Personal Context and Motivation

I have spent over a decade in the academic environment as part of an administration and teaching faculty. During my professional life, I have been curious as to how people learn by doing. My own experience of learning was the backdrop for my thoughts. I reflected on the way I learned. My learning was from reading, listening, watching and performing, and such learning is long-lasting. I quote a specific example from my professional life.

I have been involved in the process of accreditation of the undergraduate engineering programmes of a local public-sector university from Pakistan Engineering Council (PEC), which is the highest governance body in Pakistan that approves engineering programmes at local universities. The accreditation process is a complex one based upon detailed information including academic curricula, student-teacher ratios, student-computer ratios, laboratories (number of work stations and details of equipment, software and staff), libraries (number of available academic resources), admissions and registration process, examination and grading process, etc. Though I was new to the accreditation process, I learnt it through studying relevant information, such as by-laws and other requirements, analysing it and discussing it with peers, as well as through preparing practical documents.

Later, in 2012, I was assigned a somewhat similar activity of getting accreditation for business undergraduate programmes from the National Business Education Accreditation Council (NBEAC). NBEAC is the highest governing body in Pakistan for the accreditation of business degree programmes. I found myself already geared up for the task, based on my initial learning of the accreditation process. The process involves similar basic activities to those I had been performing for PEC accreditation' however, there were differences in the practice of accreditation between the two bodies. This experience drew my attention to different perspectives and sources of learning, such as studying and analysis, preparing applications and repeating the same activities in another context.

Reflecting further, my thoughts drifted towards large infrastructure projects such as irrigation and rail networks, developed for the first time in the subcontinent during the British Raj, which had a marked impact on the lives of common people. These networks are classic examples of creating and sharing knowledge in large infrastructure projects. Sharing knowledge in those projects seemed to be across borders, as these projects were undertaken for the first time in the subcontinent. Consequently, it is assumed that people working on those projects had learnt knowledge specific to the local context because such projects were developed and relevant technologies were used according to specific local environmental conditions.

Building on this background, I found NESPAK was the ideal choice for the current research because it provides engineering consultancy for mega infrastructure projects, such as power-generation dams, irrigation and transportation, collectively with foreign partners.

1.2 Aim and Focus of the Research

The purpose of this study is to explore how engineers view their learning in the practice of engineering consultancy involving cross-border sharing of knowledge and practices in the context of an international consultancy alliance. This research is informed by the knowing in practice perspective (Gherardi 2000, 2009a, Orlikowski 2002), one of the themes of practice-based studies (PBS) of learning (Corradi, Gherardi & Verzelloni 2010, Gherardi 2011). In addition, a cognitive learning and information-transfer perspective of learning (Ausubel 1961, Burgyone 2002) is used to understand the engineers' learning in the practice of engineering consultancy. Hence, this research is informed by a rapprochement between cognitive learning and knowing in practice that also involves the interaction of explicit and tacit knowledge in performing the consultancy practice.

The current research is thus informed by a rapprochement between cognitive learning (Ausubel 1961) and knowing in practice (Gherardi 2000, 2006, 2009a, 2013, Nicolini, Gherardi & Yanow 2003, Orlikowski 2002, Strati 2007), as proposed by Marshall (2008). This rapprochement is, in turn, informed by the notions of 'distributed cognition' (Hutchins 1995) and 'collective mind' (Weick & Roberts 1993). Knowing in practice is one of the themes of PBS, which is particularly relevant to the current research due to its characteristics of recursiveness of practice and knowledgeable doing (Gherardi 2000, 2006, 2009a); situated, socially organized/ distributed and communicative practice (Gherardi 2013); the employment of bodies and their senses in activities for the practice and construction of aesthetic knowledge (Strati 2007); and the constitutive entanglement of social and material agents (Orlikowski 2002). Meanwhile cognitive learning includes rote and meaningful reception learning and discovery learning (Ausubel 1961), informed by an information-transfer perspective of learning (Burgoyne 2002).

This research is thus informed by a rapprochement and amalgamation between cognitive learning and knowing in practice, as argued by Marshall (2008). This rapprochement is developed through 'distributed cognition' (Hutchins 1995) and the 'collective mind' (Weick & Roberts 1993). Distribution cognition argues that people working in a network share a common cognition that is distributed through different technological artefacts. Further, a member of the network can also externalize his/her cognition to other members of the network, and the cognitions of different members work together either in parallel or in coordination with each other (Hutchins 1995), while the notion of the collective mind argues for *"a pattern of heedful interrelations of actions in a social system"* (Weick & Roberts 1993, p.357). Heedful interrelation links the cognitive learning of an individual with the collective and communicative learning of a team, because team members process information cognitively to perform collective teamwork. Thus, through the notions of distributed cognition and the collective mind, this research acknowledges the place of cognition and the utilization of cognitive knowledge in practice-based learning in performing a socially organized distributed practice. The research also moves beyond the traditional reliance of practice-based learning on tacit knowledge (Orlikowski

2010) and acknowledges the equal role of explicit knowledge and its interaction with tacit knowledge in learning in consultancy practice.

In the current research, engineers' learning in consultancy practice takes places in doing, in the context of NESPAK's international consultancy alliances. The core purpose of consultancy alliances is to access and learn state-of-the-art engineering knowledge, technologies and working practices from foreign partners. As both local and foreign practices and knowledge are shared and integrated into a context-specific consultancy practice for a project, this research also explores the ways in which individual learning is facilitated by the sharing of existing knowledge and practices by both partners in collective doing.

As the study involves digging deep into the understudy phenomenon, a qualitative approach is followed to pursue this research. Aligning with a qualitative approach, this research is based upon critical realism and its aspects of causation and a retroduction mode of inference (Bhaskar 1975, 1978, Danermark 2002, Easton 2010, Sayer 2000, Simm 2009). Critical realism seems to better serve the purpose of this research, which is to explore underlying causes and factors behind engineers' learning and inter-organizational sharing of existing knowledge and consultancy practices. In other words, critical realism helps to explore the ways in which engineers' learning is enacted by underlying entities, processes and activities.

Summing up, the current research follows a qualitative approach, utilising critical realism philosophy from the social sciences and qualitative data-collection and analysis methods.

The next section discusses research gaps in this field of study and how this research addresses those gaps and contributes to current literature debates.

1.3 Research Organization – National Engineering Services, Pakistan

The research organization for this study is National Engineering Services, Pakistan (NESPAK). The company has worked extensively with various foreign partners on different engineering projects, not only in Pakistan but also in 36 other countries across the world. As the engineering field is assumed to comprise both theoretical and practical knowledge, engineers learn through: 1) studying academic texts, theories, engineering methods and project-related texts; 2) surveying and analyzing project sites; and 3) developing feasibility reports, concept designs and drawings using engineering theories, methods and models. This is routine engineers' work that they do to provide engineering consultancy for projects.

Every NESPAK project has its unique requirements in terms of using/ installing modern technologies and applying complex engineering methods. The company is often unable to complete such projects independently. This leads NESPAK to form consultancy alliances with foreign consultancy companies that have already worked on similar projects. NESPAK still completes a significant proportion of consultancy work independently, particularly in the area of civil engineering. However, civil work must be in line with electro-mechanical (E&M) engineering methods and technologies, which are often worked on by foreign partners. Given this, NESPAK has to include many activities, processes or methods shared by foreign consultants to make civil work compatible with E&M work. Further, civil work is often done using new engineering methods, technologies and software shared by foreign partners. However, they adapt foreign activities and engineering methods according to existing engineering practices and projects' technological requirements.

For instance, NESPAK is presently working on the Lahore Orange Line Metro Train Project (LOLMTP). LOLMTP is a complex engineering project that involves developing both overhead and underground train routes within congested areas of the Lahore metropolis. This is the first project of its kind in Pakistan and NESPAK did not have sufficient expertise to execute this project independently, hence a need to form a consultancy alliance with an experienced foreign partner. In the project, preliminary civil work is done by NESPAK, which is then reviewed by CR-Norinko (Chinese consultant partner) to ensure its compatibility with E&M work. The civil work is done using Chinese construction codes, as proposed by CR-Norinko. These construction codes were new to NESPAK's engineers, as they had previously worked with American and British construction codes. Further, NESPAK's engineers found that Chinese software shared by CR-Norinko was significantly different from that already used by them. So, the overall practice of engineering consultancy for LOLMTP is a mix of both existing local and foreign practices emerging according to the unique context of the project.

The Neelum Jhelum Hydropower Project (NJHP) is another Pakistan-based project involving unique tunnelling work, which is being done for the first time in the country. A dam is being built in an area considered to be an earthquake zone 4,[1] requiring additional precautionary measures when developing a concept design for it. To do consultancy work for NJHP, NESPAK formed a consultancy alliance with two foreign consultancy companies (MWH International Inc., USA and NORPLAN, A.S., Norway) and two local companies (National Development Consultants (NDC) and Associated Consulting Engineers (ACE)). In addition, NESPAK's engineers availed themselves of the services of two Swiss professors for most of the complex work involved in developing designs for the tunnels and dam reservoir.

In the joint consultancy work, the main design work is done by NESPAK's engineers who have done basic work and calculations independently and prepared some basics for the concept design, since they have experience of working on different dams. However, given the aforesaid complexity of NJHP, highly complex work is done with the assistance of the Swiss professors, who proposed new formulas and calculation methods using software such as SAP[2], ETAB[3] and Abacus[4]. NESPAK engineers were already using this software but on a limited scale, and they were unfamiliar with some advanced level features of these programs. So, during this joint work with the Swiss professors,

[1] Muzaffarabad lies in the region of earthquake zone 4, indicating that most damaging earthquakes can occur in this area.
[2] SAP is finite-element software that can analyse stresses in the body of a dam and its foundations (Mughieda, Hazirbaba, Bani-Hani & Daoud 2017).
[3] ETAB is an integrated software package used for structural analysis (Computer & Structures Inc. 2017).
[4] Abacus software is used for thermal analysis of dams (Gao, Cheng & Brebbia 2013).

NESPAK engineers learnt and utilized advanced features of specialised software while developing the concept design. They also learnt entirely new techniques, such as pseudo static[5] and response spectrum,[6] which was helpful for estimating the effects of earthquake shocks on the dam. Then they tested the design in a simulation to ensure that the actual dam would absorb the maximum earthquake shocks likely in the next 100 years. Since, NESPAK has expertise to develop concept design for a normal dam, a local project team did initial consultancy work independently. However, the complete concept design was the outcome of integration of existing and new, local and foreign activities, and engineering methods in the unique context of the project.

In this way, NESPAK forms international consultancy alliances whenever it lacks any modern technologies and is unable to complete consultancy work independently. This has been NESPAK's practice since its establishment, enabling the company to undertake complex projects. The formation of international consultancy alliances is thus an ongoing need for NESPAK as technologies are constantly evolving and most of the latest ones originate from technologically advanced countries (Cantwell 2009), while developing countries like Pakistan are users of such technologies.

Although the practice of forming international alliances is long-standing at NESPAK, no attempt has been made to study learning while practising engineering consultancy, which is developed through cross-border integration of existing practices, activities and

[5] Pseudo static analysis is used to measure the response of a soil in response to potential earthquake (Melo & Sharma 2004).
[6] Response Spectrum analysis is performed to compute the contribution of natural vibration and potential maximum response of an essentially elastic structure (Gupta 2017).

knowledge. Further, aspects that facilitate or impede cross-border sharing of practices and knowledge have not been studied either.

1.4 Research Gaps and Joining the Research Debate

Given the aims and focus of the current research, i.e. studying engineers' learning involving cross-border sharing of knowledge and consultancy practices in the context of international consultancy alliances, this section is divided into two sub-sections. **Sub-section 1.4.1,** below, identifies literature gaps in the field of learning in practice, while sub-**section 1.4.2** explores the factors influencing cross-border sharing of knowledge and consultancy practices. These sections also discuss how the current research joins the current literature debate.

1.4.1 Engineers' Learning in Practice of Engineering Consultancy

Though various scholars have theorized the concept of learning in practice and presented various aspects of it since its origin, there is a serious deficiency of empirical evidence regarding a practice-based-studies (PBS) perspective of learning. I could find only five empirical studies using a learning-in-practice perspective. These studies explore learning in doing: in a large software firm, 'Kappa', headquartered in the Netherlands (Orlikowski 2002); cooking practices in a kitchen in a Parisian restaurant (Gomez, Bouty & Drucker-Godard 2003); telemedicine practice in the healthcare sector of Northern Italy (Nicolini 2011); a telecardiological healthcare consultancy practice in Northern Italy (Gherardi

2010); practice in engineering work on a project site of an Australian construction company (Rooney, Reich, Willey, Gardner & Boud 2012).

These empirical studies are informed by the core conception of PBS and knowing in practice (Gherardi 2000, 2006, 2009a, Nicolini et al. 2003, Strati 2003). The PBS perspective is especially dismissive of cognitive learning (Marshall 2008) and does not give primacy to the human mind for learning and knowledge creation (Gherardi 2006). Further, PBS does not see knowledge as a transferable object/ objective commodity, as it is seen by cognitive learning (Ausubel 1961, Burgoyne 2002). Instead, PBS sees knowledge as a situated, embedded, relational and emergent act of knowing (Blackler 1995, Gherardi 2009a). Thus, being informed by the core conception of PBS, the aforementioned empirical studies do not consider cognitive learning.

The current research urges moving forward to look at the role of cognitive learning in practice. Marshall (2008) argues for a rapprochement between cognitive learning and PBS, stating that PBS unnecessarily limits itself by considering cognitive learning to be incompatible with a socially situated, constructionist and processual view of knowing. Similar to Marshall, Fenwick (2008, p.232) also recognizes the role of cognitive learning in practice-based learning, stating that *"much workplace learning research also employs the assumption that individuals acquire knowledge cognitively, for example, by listening to information presentation, then apply it to practice, in a sort of 'transfer' process from mind to hands"*.

Being informed by these arguments from Marshall and Fenwick, the current research extends this line of research by innovating methods for rapprochement between cognitive learning and practice-based learning through the concepts of 'distributed cognition' (Hutchins 1995) and the 'collective mind' (Weick & Roberts 1993). It indicates that individuals acquire knowledge, such as rules, formulas, methods etc., cognitively, in performing different activities of practice and operate technological artefacts. Apart from this, existing theoretical texts on learning in practice (Gherardi 2000, 2006, 2009a, Nicolini et al. 2003, Strati 2007) do not give much space to explicit knowledge compared to tacit knowledge. However, some practice-based authors, such as Sole and Edmondson (2002), are of the view that both explicit and tacit knowledge are equally involved in practice.

The current research studies engineers' learning occurring in the workplace, where engineers are likely to learn through mental processing in addition to learning in performing the overall practice of engineering consultancy. They are assumed to consult academic texts and project related information, in addition to having tacit knowledge. The current research thus takes forward the traditional conception of PBS and knowing in practice by studying engineers' learning informed by: 1) distributed cognition and collective for a rapprochement between cognitive learning and practice-based learning, and 2) interaction between explicit and tacit knowledge in practice.

Second, previous empirical studies have explored learning in indigenous practices that are already well situated and embedded and have emerged historically and been relationally arranged in a single organizational context. Considering the key characteristics of practice, i.e. situatedness, embeddedness, relational and emergent (Kemmis 2009), foreign practices are difficult to share and apply in a local context. Despite an extensive search of various databases, I could not find any empirical study that explores learning in doing a foreign practice in the local context. The current research attempts to address this research gap by studying learning while doing the practice of engineering consultancy, involving local and foreign practices and activities.

1.4.2 Cross-border Sharing of Existing Practices and Knowledge

As the practice of engineering consultancy emerges and is performed by sharing and integrating existing practices and knowledge of local and foreign partners, cross-border sharing of such practices and relevant knowledge also comes within the purview of this research. However, I found only one relevant empirical study exploring the cross-border transfer of the learning practices of five Japanese parent companies to their respective subsidiaries operating in China (Hong, Easterby-Smith & Snell 2006). Though practices are difficult to transfer because of their characteristics (discussed in the last paragraph), (Hong et al. 2006) argue that learning practices can be transferred across borders in the form of knowledge repositories (from Japanese headquarters to China based subsidiaries) through collective routines while this transfer process is mediated by the enterprise context.

The current research, having theoretical and methodological differences with the study of Hong et al. (2006), extends this line of enquiry from many perspectives. Hong et al.

(2006) argue for the complete transfer of practice from a foreign to a local context. The current research intends to examine the sharing of foreign practices in a local context, those practices being integrated with local practices and transformed according to specific contextual dimensions. People are more likely to learn in doing a newly emerged practice in which their existing local practices are also merged. Thus, the current research assigns equal importance to existing local practices of engineering consultancy.

Second, Hong et al. (2006) studied the cross-border transfer of practices in the context of a foreign subsidiary alliance which is a tightly coupled form of strategic alliance (Steiner 2006). In foreign subsidiary alliances, organizational and knowledge management systems are shared and a significant portion of staff from the parent company are deputed to the subsidiary, as reported by Hong et al. (2006). These personnel are assumed to have already developed practices in their original context. So, they are better able to perform practices and impart knowledge in a new context because, in such alliances, the *"parent corporation continues to serve as the most active creator and diffuser of knowledge within the corporation"* (Boussebaa, Sturdy & Morgan 2014, p.1228).

On the other hand, sharing working practices and knowledge in an international consultancy alliance is a different scenario. In contrast to a tightly-coupled foreign subsidiary, consultancy firms are *"network-like organizations"* (Boussebaa et al., 2014, p.4) that do not require the involvement of complete organizational systems, particularly a knowledge management system (KMS), in the alliance. Instead, some highly specialized members of the partner firms work together to provide consultancy to a third party (the client). Sharing practices and knowledge in such network-like consultancy alliances is quite different to that in a foreign subsidiary.

In light of these arguments, the current research contributes to this field by studying the cross-border sharing of practices in a loosely-coupled consultancy alliance, their emergence in a new context and subsequent learning by local engineers.

In addition, factors influencing the cross-border sharing of practices and knowledge are also of great value in this research, because consultancy work is done collectively by local and foreign partners in consultancy alliances. There is voluminous literature on the factors influencing knowledge creation, transfer and application in strategic alliances. Argote, Mcevily & Reagans (2003) and Meier (2010) have presented meta-reviews in this area of research. The studies reported by these meta-reviews explore the influence of knowledge characteristics, partner characteristics, partner interaction and active knowledge management on knowledge creation, transfer and application in strategic alliances. Besides, Easterby-Smith, Lyles and Tsang (2008) and Salk and Simonin (2011) also highlight some factors that resemble the aforementioned factors. I have further studied 19 empirical studies conducted after 2010 (after Meier's meta-review). The empirical evidence relevant to this research is discussed in section 2.7.2, under respective sub-sections.

This field of research is dominated by quantitative research, though a few studies are qualitative in nature. Quantitative research has the advantages of statistically computing the effects of one variable on others and can claim more generalizable findings through larger samples of data (Easterby-Smith, Thorpe & Jackson 2012). But it is unable to answer ‘how’ and ‘why’ research questions and to provide detailed insights into how a phenomenon occurs, its underlying reasons and ways to address problems and issues (Guba & Lincoln 1994). The current research, being critical realist and qualitative in nature, advances this knowledge base by adding qualitative empirical evidence regarding the ways in which cross-border knowledge sharing takes place, identifying the underlying reasons and factors influencing such a sharing process, and the problems faced and likely solutions.

Apart from that, no previous study has explored cross-border knowledge sharing in an international consultancy alliance that is a relatively loosely-coupled alliance (Steiner 2006). The involvement of a partner in joint working, and its willingness to share knowledge, is supposedly less in a loosely-coupled consultancy alliance than that in a tightly-coupled form of strategic alliance. Lastly, given the social nature of the studied phenomenon, which is not static, existing theories, models and empirical findings are difficult to generalize across time and contexts. These research gaps thus call for fresh and context-specific knowledge on the topic.

Despite these limitations, the existing literature provides a strong platform to explore the phenomenon under study in the given context. Thus, being informed by the current literature, I will develop a preliminary framework comprising possible influential aspects for sharing working practices and knowledge. However, as I am expecting fuzzy and blurred boundaries of the case, surprises, shocks and emerging phenomena, I conduct this research following Dubois and Gadde's (2002) systematic combining, moving back and forth to create a fit between theory and data. Following this, the empirical field is approached on a preliminary basis and with initial questions while being open to emergent phenomena and different boundaries of the case. Existing aspects that are substantiated in this research are retained, while others are removed from the literature review during the data analysis phase. Meanwhile, new aspects influencing the phenomenon under study, which emerged during fieldwork, are made part of the current research.

Following this, the current research qualitatively explores the phenomena under study in the specific context of NESPAK, Pakistan. In this way, this research addresses the aforementioned literature gaps and takes forward the existing literature debates and empirical work by exploring engineers' learning in an international consultancy. This will make a significant contribution to the existing body of literature.

1.5 Research Questions

In order to address the aforementioned research and contextual gaps, the main research question developed in this research is: **How do engineers' view their learning of engineering consultancy in the context of an international consultancy alliance?** In addition, as discussed above, existing knowledge and working practices are shared across borders in consultancy alliances, transformed according to a given context and integrated with each other to perform project-specific engineering consultancy practice. I ask the following sub-question as well:

- Which factors influence cross-border sharing of knowledge and consultancy practices between local and foreign engineers, and in what ways?

1.6 Key Terminology and Concepts used in the Research

In order to help the reader understand some of the core concepts used in this research, brief explanations are given below. The definitions are conceptualized on the basis of pertinent literature used to ground the current research, as well as from empirical insights. Detailed explanations and discussions of these concepts are provided throughout the thesis. In addition, these concepts also define the boundaries of the current research.

Cognitive Learning

Cognitive learning involves mental processing for receiving and processing information, it is based upon the dualities of mind and body, mind and matter (Ausubel 1961, Fox 1997). The current research follows Ausubel's (1961) types of cognitive learning in which: 1) external information is received and stored in cognitive memory as an isolated piece of information (cognitive rote learning); 2) a learner relates external information to existing cognitive structures and draws some meaningful insights (cognitive meaningful learning); and 3) the principal content of external information is presented to the learner who arranges and analyses a given array of information, integrates it with existing cognitive structures and discovers a solution to a problem (cognitive discovery learning). Cognitive learning involves knowledge as an objective commodity that is received, analyzed and stored in cognitive memory and retrieved as and when required (Burgoyne 2002).

Knowing in Practice

Being informed by one of the themes of practice-based studies (PBS) of learning (Corradi et al. 2010) i.e. knowing in practice, the current research considers learning in doing, which takes place in performing situated, embedded, relational, emergent and recursive work practices. Blackler argues that *"social learning is a creative achievement, therefore, which involves a degree of personal investment; it can only be achieved through active participation"* (Blackler 1993, p.870). Active participation implies that an individual performs a practice with a union of mind and body and deploys his/her body and senses in the activities of a practice for learning and the construction of tacit and explicit knowledge (Gherardi 2000, 2006, 2009a, Nicolini et al. 2003, Orlikowski 2002, Strati 2003).

According to the renewed conceptualization of knowledge, knowledge is a situated act of knowing (Blackler 1995, Gherardi 2009a). This indicates that knowledge, similar to knowing, is a socially organized and collective activity situated in a time and a place and occurs in doing a practice. Thus, it is a 'verb' instead of a 'noun', which is similar to the concept of learning and in contrast to the cognitive learning perspective, which treats knowledge like an objective commodity (Burgyone 2002).

Consultancy Practice

Engineering consultancy is considered to be a learning practice in this research. A practice is recursively performed by knowledge actors as routine day-to-day activities and socially organized and distributed among people, social and material artefacts through a rich fabric of connectivity (Gherardi 2009a, 2013). Participants of the practice learn, construct their aesthetic and sensible knowing[7] and tacit knowledge by employing their bodies and senses in the activities of a practice (Strati 2003, 2007). Such knowledge is embodied in the participants, who in turn become knowledgeable bodies. A practice is situated, embedded, relational, emergent, recursive, culture-specific and embodied (Gherardi 2009a, Hong et al. 2006, Kemmis 2010, Rooney et al. 2012). In the current research, engineering consultancy is seen as a practice because it is a recursive socially and relationally organized practice performed in every project, and engineers learn new engineering knowledge in performing its routine activities recursively, but it emerges differently in different contexts.

Rapprochement between Cognitive Learning and Knowing in Practice

The PBS perspective is especially dismissive of cognitive learning and sees it as incompatible with knowing in practice. However, the current research is informed by the rapprochement between cognitive learning and knowing in practice, as argued by Marshall (2008), which is developed through the concepts of distributed cognition

[7] Strati (2003, p.62) states that *"aesthetic or sensible knowledge comprises 'what is perceived through the senses, judged through the senses, and produced through the senses. It resides in the visual, the auditory, the olfactory, the gustatory, the touchable and the sensitive-aesthetic judgment."*

(Hutchins 1995) and the collective mind (Weick & Roberts 1993). In this way, the current research argues that performing a practice equally involves cognitive learning. The cognition of one participant can be externalized to other participants of the networked practice through technological artefacts, as well as different cognitions of participants working in parallel or in coordination in performing a practice (Hutchins 1995). Meanwhile, the collective mind is heedful of the interrelation between members of a team performing collective teamwork (Weick & Roberts 1993).

International Consultancy alliance

A consultancy alliance is not a well-defined concept and interorganizational learning in an international consultancy alliance has not previously studied. What little conceptualization of consultancy alliances that is available in the existing literature states that they are *"network-like organizations"* (Boussebaa et al. 2014, p.4). With this cue, the concept is further defined through studying the research organization of this thesis. It is thus defined as a form of strategic alliance in which a few but highly specialized members of partnering organizations work in either geographic proximity or through a network to provide consultancy for a project. The partnering organizations with their complete systems, structures, technology and processes are not involved in the consultancy alliance. However, specialists from both partners share highly complex explicit and tacit knowledge, working practices and technology with each other in joint working and collectively perform the practice of engineering consultancy.

Existing Knowledge and Working Practices

Cook and Brown (1999) are of the view that existing knowledge is used as an aid to construct new knowledge. Drawing on these concepts, it is conceptualized in this research that the sharing of existing knowledge and working practices are necessary to develop and perform a context-specific practice of engineering consultancy in an alliance.

The existing knowledge and working practices of local partners are related to similar consultancy work which has already been done on similar projects in the past. The local partner is assumed to have already established working practices and to better know the local technical, geological and environmental conditions, which can influence the concept design and overall consultancy work for a project. On the other hand, the foreign partner is assumed to have already established working practices and relevant knowledge and to use modern engineering methods and use/ install modern technologies. The core purpose of a consultancy alliance is not only to complete a project with the support of foreign partners but also to learn such modern knowledge and practices to gain self-reliance in the future.

1.7 Thesis Structure

The thesis is structured as follows:

- Chapter 1, Introduction: The chapter starts with my personal background and motivation for the current research. This is followed by the aims and foci of the research and research organization which, respectively, are presented. Further, existing literature gaps are identified and how these gaps are addressed in the current research is discussed. This leads to developing two research questions to be answered in this thesis. Finally, I give a brief overview of the key terminology and concepts used in this research.

- Chapter 2, Theoretical Framework: The chapter critically evaluates cognitive learning and PBS perspectives of learning. Given that this research is not completely informed by either of the learning perspectives, the chapter argues for the role of cognitive learning in knowing in practice. Interaction between explicit and tacit knowledge in performing practice is also discussed. Being informed by both perspectives of learning, individual learning in practice is seen as a unit of analysis. Finally, the chapter critically reviews existing relevant literature and identifies research gaps and how these gaps are addressed by this research.

- Chapter 3, Methodology: The chapter argues for the different components of the research methodology followed in this research. These include research philosophy, qualitative research approach, single-case study design, research organization, i.e. NESPAK, Pakistan, purposive and snowball sampling tools, qualitative data collection, grounded theory for data analysis. Further, the quality of the research and consideration of research ethics are also discussed in the chapter.

- Chapter 4, Presentation and Discussion of Finding I: The chapter presents and discusses the first finding/ core category of the current research, i.e. Learning in Practice of Engineering Consultancy through its categories, i.e. Self-directed Learning, Managerially Influenced Learning and Partner-Influenced Learning

- Chapter 5, Presentation and Discussion of Finding II: The chapter presents and discusses the second finding/ core category, i.e. ‘Symbiotic Learning Alliance’ through its categories of Symbiotic Alliance Relationship, Developing Cultural Harmony, Intention to Learning and Share Knowledge, and Constructive Disagreement.

- Chapter 6 presents the comprehensive learning model being in place at NESPAK, with complete details and a discussion. Further, the findings of the current research are discussed in relation to critical realism, the philosophical position of the research. Finally, it discusses the research findings in relation to the literature theories and models reviewed in Chapter 2.
- Chapter 7 concludes the research. At the start of the chapter, a recap of all the previous chapters is given. Following that, the theoretical and methodological contributions of the thesis and its practical implications are presented. Limitations and future areas of research are also highlighted.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter serves two purposes. First it reviews relevant literature to develop an understanding of *engineers' learning in practice in the context of international consultancy alliances*: engineers' learning being informed by cognitive learning (Ausubel 1961, Burgyone 2002, Fox 1997) and knowing in practice (Gherardi 2000, 2006, 2008, 2009a, Orlikowski 2002, Strati 2003, 2007). Second, the chapter reviews empirical research done on practice-based learning and cross-border sharing of practices and knowledge with respective methodologies to identify research gaps and inform the research questions and research methodology. For better management, the chapter is divided into eight main sections.

Before critically reviewing learning perspectives, it is important to mention that sections 2.2 to 2.6 inform the main research question posed in Chapter 1, that is:

> *How do engineers view their learning in engineering consultancy in the context of an international consultancy alliance?*

The current research urges moving beyond the core conception of knowing in practice and argues for the role and recognition of cognitive learning and explicit knowledge in it. **Section 2.2** thus denotes cognitive learning and its two main forms: reception learning and discovery learning. The process and outcomes of learning and knowledge storage of these forms of cognitive learning are critically reviewed in this section. Concluding the section are the key stances of cognitive learning, including the mental processing of information and its storage in the human mind, the duality of mind and body, the human mind as a locus of learning, knowledge being a public, objective and transferrable object.

Section 2.3 reviews ‘knowing in practice’, one of the conceptual labels of Practice-Based-Studies (PBS) (Corradi et al. 2010, Gherardi 2008, 2009b, 2011). To provide a basic understanding, first, the theoretical origins of practice with its implications for learning, as well as a definition of practice, are given. This is followed by the progression in the field of practice-based learning from Situated Learning Theory (SLT) and Communities of Practice (CoP) (Brown & Duguid 1991, Lave & Wenger 1991) to the broad PBS debate, as well as overturning the notion of CoP to ‘practices of the community’ (POC), which are reviewed in detail (Corradi et al. 2010, Gherardi 2009b, Gherardi, Nicolini & Odella 1998). This provides an understanding of the preference for PBS to study engineers’ learning. PBS is a broad debate with many themes in it; however, while the current research is specifically informed by learning in practice, it generally acknowledges various aspects of different practice-based theories. Thus, the last section comprehensively reviews key aspects of learning and the ways it takes place, following the theme of learning in practice.

Since neither cognitive learning nor knowing in practice is alone sufficient to study engineers’ learning in this research, the next **section 2.4** argues for the role of cognition and cognitive learning in knowing in practice and a rapprochement between them. The section is thus mainly articulated by considering distributed cognition (Marshall 2008), the collective mind (Weick & Roberts 1993), cognition in practice (Hutchins 1995) and the utilization of cognitive knowledge in performing a practice (Fenwick 2008).

Similar to cognitive learning, explicit codified knowledge cannot have much acknowledgement from the concept of knowing in practice as is evident in the main texts (Gherardi 2006, 2009a, Orlikowski 2002, Strati 2003, 2007). Some practice-based theorists (e.g. Cook & Brown 1999, Sole & Edmondson 2002) do though acknowledge the role of explicit knowledge in practice. On that point, in **section 2.5**, the current research moves away from a traditional position and identifies the role of explicit knowledge, in addition to tacit knowledge, in knowing in practice. The section discusses the interaction of explicit and tacit knowledge in practice through a knowledge spiral (Nonaka & Takeuchi 1995) and the interplay relationship between explicit and tacit knowledge for the generation of new knowledge while doing practice (Cook & Brown 1999).

Section 2.6 argues for 'individual learning in practice as a unit of analysis'. Cognitive learning considers the individual as a unit of analysis, whereas the concept of knowing in practice argues for practice as a more obvious unit of analysis (Corradi et al. 2010, Gherardi 2011). Since this research is informed by a rapprochement between cognitive learning and knowing in practice, the unit of analysis for this research is also an amalgamation of units of analysis from both learning perspectives. Thus, individual learning in performing socially organized practice is considered as a unit of analysis in this research.

Section 2.7 reviews relevant empirical studies, their respective conceptualizations of the phenomenon under study and the methodological framework through which they are studied in order to inform the research questions and methodology of the current research. In the first sub-section, empirical studies exploring knowing in practice are reviewed, these are limited to the core concept of knowing in practice and do not acknowledge the role of cognitive learning and explicit knowledge. These studies also explore knowing in an already situated, contextually and historically developed indigenous practice, instead of studying it in the context of an international alliance.

The second and third sub-sections inform the sub-question of this research, that is:

Which factors influence cross-border sharing of knowledge and consultancy practices between local and foreign engineers, and in what ways?

These sub-sections critically review theoretical and empirical work related to the factors affecting cross-border sharing of knowledge and practices. The second sub-section points out that there is a single study exploring cross-border sharing of practices in a tightly-coupled foreign subsidiary form of strategic alliance, though it overlooks the local context where foreign practices are to be resituated. The third sub-section reviews theoretical and empirical literature on cross-border sharing of knowledge and identifies that most of the studies are quantitative in nature, which provide little detailed understanding of the processes of knowledge sharing and scarcely answer ‘how’ and ‘why’ questions.

Overall, section 2.7 identifies gaps in the existing literature, the ways in which these gaps are addressed, how the current research joins the existing debates, how the literature review informs the research questions and the research methodology.

Section 2.8 concludes the chapter with a summary of the key arguments I have made in the chapter. This includes a summary of the theoretical and empirical underpinnings of the research questions (which are restated here), research gaps and the theoretical and methodological position of the current research to address those gaps.

2.2 Cognitive Learning

The concept of learning has been extensively researched and contested for several decades. It has evolved and transformed with passing time, which has resulted in a wide range of perspectives, as is evident in the academic literature. The phenomenon of engineers’ learning under study also seems to be informed by cognitive learning, in addition to learning in practice. The current research thus urges moving beyond a single perspective of learning and argues for the amalgamation of both perspectives of learning to foreground this research, as argued by Marshall (2008). This section critically evaluates different aspects of cognitive learning, followed by Practice-Based-Studies (PBS) of learning in the next section.

Cognitive learning theories consider learning which occurs inside the mind or the head (Fox 1997). For these theories, learning is a mentalistic process consistent with the dualities of mind and body, mind and matter (Fox 1997). Cognitive theory mainly involves interaction between mental components and external information (Neisser 1967). McEntire (1992) explains that individuals learn through actively creating cognitive structures which define their concept of self and the environment. The fundamental concept of cognitive learning is that it takes place when information is integrated into an active storage system comprising organizing structures termed ‘schemata’ (Baron & Byrne 1987). Therefore, cognitive learning theories mainly involve receiving information and its storage, and mental processing while the locus of learning is the human mind. Such reception, storage and processing of information are thoroughly discussed by Ausubel (1961), who presents two principal kinds of cognitive learning, i.e. reception and discovery learning.

In reception learning, the learner receives the entire content of learning material in its final form, so that the learning process does not involve any discovery at this stage. The learner *“is only required to internalize the material (e.g. a list of nonsense syllables or paired associates; a poem or geometrical theorem) that is presented to him, i.e., make it available and functionally reproducible for future use”* (Ausubel 1961, p.16).

In the first kind of reception learning i.e. rote learning, new information is not related to or integrated with what a learner already knows, so s/he memorizes and stores such information in his/her memory as an isolated piece of information and reproduces it when it is called for. Such an information-transfer perspective of learning is also used by Burgoyne (2002), knowledge is seen as an informational commodity, an object/ entity which is transferred from someone who knows (e.g. trainers, instructors, teachers etc.) to learners (who do not know). He states that:

> *"This way of thinking implies that the product of learning is knowledge as an objective commodity, publicly owned and acknowledged, and, at least in its simpler forms, having straightforward truth value. The primary orientation to learning as a process is learning as memory, and the theoretical and practical problems that are seen or acknowledged by this perspective are to do with how the learner takes in information, how it can be presented to be internalized, how the learner organizes their knowledge – like a filing system or library so that it is stored and can be accessed (remembered) when it is called for."* (Burgoyne 2002, p.7–8)

Thus, reception learning views knowledge as a transferable object that can be transferred to the learner. The process of learning mainly revolves around the receiving and storage of information, like the cataloguing of books in a library, and its retrieval when it is needed.

In the second form of reception learning, termed meaningful learning, involves the acquisition of information that is related to what an individual already knows and it can be subsumed into existing cognitive structures. In this case, the learner mentally processes new information from the perspective of what s/he already knows and forms some meaning. Knowledge is still seen as a transferable object, because the learner receives information as s/he does in in rote learning; however, meaningful learning goes beyond a simple information-transfer approach because it also involves the mental processing of new information from the perspective of already stored knowledge, in addition to information acquisition.

The second kind of cognitive learning is discovery learning, in which the principal content of what is to be learned is not presented straightforwardly but must be independently discovered by the learner before its internalization (Ausubel 1961). Discovery learning is related to concept formation and problem-solving through the discovery of solutions. In this learning, *"the learner must arrange a given array of information, integrate it with existing cognitive structure, and reorganize or transform the integrated combination in such a way as to create a desired end product or discover a missing mean-ends relationship"* (Ausubel 1961, p.16). Upon completion of this process, the discovered content is internalized just as it is in reception learning.

The aforementioned rote reception learning involves little or no discovery. Meaningful reception learning, though, often involves some amount of discovery because it goes beyond the acquisition of ready-made information and often involves the reconciliation of information with existing cognitive structures and its translation into a personal frame of reference, which varies across learners due to their different backgrounds. This results in the discovery of new things, finding solutions to problems, concepts and understanding. However, since information or learning material is presented straightforwardly in both kinds of reception learning (e.g. rote and meaningful learning), the amount of discovery is likely to be less than that in the case of purely discovery learning, in which discovery starts from arranging a given array of information and continues while subsuming it into existing cognitive structures and coming up with final solutions to problems.

It can thus be argued that the key stances of cognitive learning are: 1) the human mind as a locus of learning; b) knowledge is a transferable object (which can be acquired as an informational commodity); 3) it is processed purely through mentalistic processing; 4) it is stored in the mind as either an isolated piece of information or through integration with existing knowledge; 5) and such knowledge is public and objective and readily available to others. Learning takes place in both cases, whether a learner simply stores information or draws meaningful concepts and solutions through the mental processing of information. The mind is thus a locus of learning and knowledge resides in one's head. This is what Gherardi (2006, p.xv), though being a practice-based theorist, writes about cognitive learning:

> *"Knowledge resides in the heads of humans, and it is appropriated, transmitted and stored by means of mentalistic processes. This figure works through the dichotomies of mind/body, thought/action, individual/organization."*

The cognitive learning approach and the individual mind as a locus of learning faced much criticism when the social perspective of knowledge joined the debate (Berger &

Luckmann 1966, Bredo 1997, Larochelle, Bednarz & Garrison 1998). The key question posed to the cognitive learning approach by Cook and Yanow (1993) is: if learning takes place in cognitive structures, how do individuals learn in practice and doing/ practising, such as from emotions, the body and from unspoken and taken-for-granted culture and history? Cognitive learning prevails in workplaces because people acquire knowledge cognitively through reading texts, watching videos, attending off-the-job training lectures/ seminars, taking instruction from peers and so on, and store and process such information to draw meaningful concepts. Yet, much learning in the workplace is argued to take place in performing working practices and activities in routine jobs. Such learning has different characteristics, as well as different processes and outcomes, than those in cognitive learning.

Given this, it is argued that cognitive learning cannot solely foreground engineers' learning in this research, which is expected to mainly take place in performing working practices, so I move on to practice-based learning to offer a relevant theoretical lens for the current research.

2.3 Practice-based-studies Perspective of Learning

Engineers do not only seem to learn through cognitive learning, they also learn in performing the practice of engineering consultancy, which is a socially organized communicative practice. This section thus foregrounds engineers' learning in practice

Practice-based studies (PBS) (Gherardi 2000, 2001, 2006, 2009a, Orlikowski 2002, Strati 2003, 2007) has significant potential to foreground the engineers' learning being studied in the current research. Within PBS, the theme of knowing in practice (Corradi et al. 2010, Gherardi 2008, 2011), amongst many others, seems to have key significance for the current research. Knowing in practice argues that learning takes place in performing socially organized communicative practices in which the loci of learning are social interaction, conversation and participation (Gherardi 2006, 2009a, 2013). Knowledge is not mentally but socially constructed through knowledgeable doing of recursive and socially organized practice (Gherardi 2006, 2009a); it is not a transferable object but an act of knowing (Blackler 1995), and such knowledge is situated, embedded and emergent in a specific context (Gherardi 2009a).

In addition, from this perspective, individuals do not only produce but are also the product of a situation. This situated view moves learning away from cognition and the individual mind to the social sphere of practice, activity and interaction, assuming that learning takes place through interaction and conversations among people (Easterby-Smith, Crossan & Nicolini 2000). In other words, learning occurs through interaction among people and artefacts as a relational activity, instead of as the result of an individual's mental processing. From this perspective, learning is not viewed as an epistemic accomplishment but is seen as a practical activity.

Knowledge is thus studied in situ – individuals are situated, connected and responsive to changes in the external world. The previous cognitive view of knowledge as an acquirable and transferable object (noun) has been supplemented with knowledge as a situated act of knowing (verb) (Blackler 1995, Gherardi 2009a). So, knowledge is knowing, a process that takes places through participation in practice; Blackler (1995, p.870) argues that *"social learning … can be achieved through active participation"*. Such knowledge cannot be stored in brains, books and information systems (Gherardi 2006, 2009, Gherardi et al., 1998). Contrary to the information-processing perspective (Burgoyne 2002), knowledge is not only stored in human memory but it also a distributed activity located among individuals and artefacts (Brown & Duguid 1991, Orlikowski 2002, Richter 1998). Learners have to participate in social practices, make sense of their participation and perform socially organized practices to construct knowledge. In sum, practice-based learning speaks for interaction, discourse, expression and vocabulary, and it stresses that delving into a situation instead of seeing it from a distance, and connectedness instead of separation are powerful tools to learn and create knowledge. It is context-specific and emphasizes forming and transforming knowledge within a particular environment.

In order to provide a holistic understanding, I explain the theoretical foundation of practice in section 2.3.1, give a definition of practice in section 2.3.2, describe the progression of practice-based learning from situated learning theory (SLT) and communities of practice (COP) to PBS and practices of a community (POC) in section 2.3.2. These understandings helped me to review the process of knowing and learning in performing a practice, being informed by the theme of knowing in practice in next section 2.3.4.

2.3.1 Theoretical Foundation of Practice

Gherardi (2000) is of the view that the theoretical origins of practice are wide-ranging and have long roots in sociology and philosophy. Practice-based theorists (e.g. Gherardi 2006, 2009a, Nicolini et al. 2003, Orlikowski 2002, Strati 2003, 2007) have drawn their conceptions of practice from the work of different social scientists. For instance, their conception of practice is taken from the view of practice as *'customary rules'* in the publication 'Outline of a Theory of Practice' (Bourdieu 1977, p.16). Bourdieu is of the view that practices are performed according to the social customs and traditions that reside in local sociocultural settings. Such practices involve people's intentions and goal-seeking participation in shared activities in accordance with socially shared principles, customs, habits and overall context, which results in the construction of situated knowledge.

Second, they draw their concept of practice on structuration theory (Giddens 1984), which focuses on the production and reproduction of social systems through analyses of structure and agency. Guala (2005, p.3) defines structure as a *"set of entities and the relations holding between them"*. Agency is referred to as humans' capacity to act independently and make their own decisions (Barker 2011). Although human agency is the individual's ability to *"choose to do otherwise"*, because of their power and knowledgeability (Giddens 1984, p.4), it is influenced and informed by structures and sociocultural factors that lie in their surroundings, thus it is difficult for an individual's decisions to be detached from the context.

There is considerable sociological and historical work arguing that subjects are produced by social forces/ structures existing outside the individual (Rorty 1999). Due to such socially produced agency, humans *"go on with the routines of social life"* in recurrent activities (Giddens 1984, p.4). However, *"structures must not be conceptualized as simply placing constraints upon human agency but as enabling"* agents to perform differently in different situations, using their power and knowledgeability (Giddens 1976, p.161). Social systems and structures are produced and reproduced by human agency and they formulate rules for social systems due to their power and knowledgeability. Further, structures do not comprise barriers to action but facilitate agency for the reproduction and transformation of social systems.

Besides, the routines of social life evolve in constantly changing contexts so that humans' activities also change accordingly. Individuals negotiate meanings of practice in their routine work, while these practices themselves are not stable, thus there is no simple reproduction of practices. Instead, practices emerge differently in different social situations according to the specific context. This implies that working practices are recursive – they are performed repetitively every day (e.g. doing real work/ jobs/ tasks/ activities every day), but these practices emerge through 'sustained adjustment' (Orlikowski 1996), i.e. they remain attached with a primary focus but make adjustments according to the changing context. Summing up, it can be argued that according to Giddens' structuration theory, practice is knowledgeable recursive doing with agents having 'freedom to act otherwise'.

Third, Gherardi (2006) is of the view that the conception of practice is informed by the concept of 'science as practice' (Latour 1987) by stating that *"people interact not only with each other but also with the non-human that makes up the remainder of the natural world"* (Gherardi 2006, p.41). Thus, a practice takes place in a coordination centre and participants in the practice, having a common orientation, communicate with each other as well as with the artefacts involved in a practice through a precise division of labour in order to perform it. Gherardi (2013, p.36) calls it *"socially organized communicative practice"*. In addition, Orlikowski (2007) argues that the social and the material have constitutive entanglement characteristics of practice, so that practices are sociomaterial practices according to which both social and material elements constitute each other. Fourth, Gherardi (2006) draws the conception of practice on phenomenology and Heidegger's (2005) term 'Dasein', which refers to 'there-being'. Informed by this, learning in practice works against the dualisms of mind/body, thought and action, knowing and doing (Gherardi 2009a), as argued by cognitive learning and the employment of body and senses into different activities of a practice (Strati 2007).

2.3.2 Defining Practice

The above theoretical foundations collectively define practice as the collective/ socially organized doing of daily routine work (recursive) by knowledgeable agents (agents' knowledgeability) informed by the historical and emergent social context (structures), and such practices are sociomaterial (constitutive entanglement of the social and the material). These practices are embedded and situated in a specific social, historical and material context, materially mediated, relationally arranged and embodied but continuously improvised (emerged) to respond to changing environmental conditions (Gherardi 2009a, Hong et al. 2006, Kemmis 2009, Rooney et al. 2012).

2.3.3 Practice-based-studies – from CoP to PoC

To identify the departure of practice-based-studies (PBS), Corradi et al. (2010) state that organization studies started taking an interest in the concept of practice many years before the so-called label of the ‘practice turn’ (Schatzki 2001). For instance, studies on communities of practice (CoP) (Lave & Wenger 1991) marked the passage from cognitive learning theory to socially situated learning theory, as its concepts of situated learning theory (SLT) acted as ‘pathfinders’ and presented a plurality of concepts, such as situatedness and sociality of practice, participation, practical know-how and learning within a practitioners’ community. SLT proposes that social aspects are a central and integral part of learning, where employees learn from experienced peers and seniors by sharing and socializing the issues they face in the workplace. Lave and Wenger (1991) call this course of action ‘legitimate peripheral participation’. Becoming a member of the community and progressive engagement in practice are necessary conditions for learning and knowledge construction and mastery of the role (Lave & Wenger 1991). Brown and Duguid (1991) also use the thesis of CoP to understand the concept of learning as an activity situated in a particular context. They are of the view that CoP explicates the ways in which informal groups constitute and extemporize solutions to problems when canonical accounts of work stop working.

The notion of CoP has been the subject of much debate and criticism. The main reason for this criticism is its greater focus on ‘community’ for the governance of knowledge and management of the community itself for learning (Amin & Cohendet 2004). The focus on ‘community’ as a blanket has also faded from the original conceptualization of the relationship between CoP and learning that is situated in every social practice, which results in obscuring the importance of practice (Brown & Duguid 2001). This criticism has led learning theorists (e.g. Corradi et al. 2010, Gherardi et al. 1998, Gherardi 2009a, b) to change the notion of CoP into practices of communities (PoC).

This reversal of the concept made practice, instead of the community, the locus of learning. It is argued that there is a strong interrelationship between knowledge, activity and social relationships within a practice instead of an interrelationship between knowledge and the community. Knowledge construction does not only happen through becoming part of a community; rather, people learn through engaging physically with performing a practice as part of their routine work (Giddens 1984, Orlikowski 2002). Further, it is argued that the focus on community for learning stresses that the community constitutes the context and community exists even before its activities take place. The latter view, however, implies that practice itself develops a community in such a way that it forms *“a glue which holds configuration of people, artefacts and social relations”* (Gherardi 2009b, p.523). Practice, not community, keeps all human and non-human actors intact in a synchronized manner with their distributed agency (Gherardi 2009a), which performs an integrated role in performing a practice.

Finally, with the move to seeing practice as a locus of learning, the focus is on practical knowledge that is generated contextually in performing situated recursive practices (Gherardi 2013). Hence, *"knowledge is not an asset of the community, but rather an activity ('a knowing'), and an activity that itself constitutes the practice ('knowing in practice')"* (Gherardi 2013, p.35). This is in line with the focus on knowledge as a process and an act of knowing that is constructed in doing and active participation in a practice, and this is a key phenomenon within the theme of knowing in practice (Blacker 1995, Gherardi 2009a).

This overturning of COP to POC initiated the broad PBS debate (Corradi et al. 2010, Gherardi 2009b). It is a broad approach, with many themes within it, which also acknowledges the concepts of COP and SLT, such as the situatedness and sociality of practice, participation and practical know-how (Brown & Duguid 1991, Lave & Wenger 1991). The themes within PBS include: practice-based standpoint (Brown & Duguid 1991), work-based learning and practice-based learning (Raelin 1997, 2007), practice 'as what people do' (Pickering 1990, 1992, Whittington 1996, 2004), the practice lens and practice-oriented research (Orlikowski 2000), knowing in practice (Gherardi 2000, Orlikowski 2002), a practice-based perspective (Sole and Edmondson 2002) and practice-based approaches (Carlile 2002).

The current research is specifically informed by one of the themes of PBS, i.e. 'knowing in practice' (Gherardi 2000, 2009a, Orlikowski 2002, Strati 2003, 2007), but it also acknowledges the general characteristics of practice-based learning, such as the situatedness of learning (Brown & Duguid 1991, Lave & Wenger 1991); the generative dance between the epistemology of possession and the epistemology of knowing (Cook & Brown 1991); and application of both the explicit and tacit elements of knowing (Sole & Edmondson 2002).

The next section discusses the ways in which learning takes places, being informed by the theme of knowing in practice.

2.3.4 Knowing in Practice

Aligning with the theoretical foundations of practice, this section presents various aspects of knowing in practice through which participants learn and create knowledge in performing practices.

One of the key aspects of knowing in practice is individuals' participation in a practice. Being part of a practice, they perform it in their routine work, in which learning takes places socially through interaction among participants and between participants and physical artefacts. Gherardi (2013, p.30) states that:

> *"learning in practice and learning a practice enables us to focus on the fact that, in everyday practices, learning takes place in the flow of experience, with or without our awareness of it. In everyday organizational life, work, learning, innovation, communication, negotiation, conflict over goals, their interpretation, and history, are co-present in practice."*

So, for learning to take place, we have to become participants and engage mentally and physically in the activities of a socially organized practice, wherein learning and doing are co-constituents. Practices comprise 'topos' connecting knowing and doing (Gherardi 2008). Participation in a practice is not only a way to create knowledge in action but also a *"way to change or perpetuate such knowledge and to produce and reproduce society"* (Gherardi 2000, p.215). In other words, knowing in practice takes place through participation, with a union between mind and body, thoughts and actions, both consciously and unconsciously (Gherardi 2009a).

Instead of seeing a practice from a distance, as argued by cognitive learning and a Cartesian view, which believes in a dichotomy of mind and body, thought and action (Easterby-Smith, Snell & Gherardi 1998), knowing in practice is informed by Heidegger's (2005) phenomenology, which uses the term 'Dasein' to refer to 'there-being', wherein a subject (knower) and an object (known) are inextricably inseparable. Gherardi (2009a, p.355) states that:

> *"PBS works against dualism of mind/body, knowing/doing, micro/macro, nature/culture, and in this they refer to a phenomenological set-up in which practices are the place of the Dasein that is, of the union between thought and action, of dwelling in the world."*

PBS thus argues for a union between mind and body, thought and action, knowing and doing for learning and knowledge creation. This is one of the predominant features of knowing in practice. Strati (2007, p.65) argues that:

> *"…individuals in organizations use their bodies to feel and judge, to sense and to act, and that they exhibit their difference and personal knowledge in organizational and working practice. The knowledge that they display is, as said, the knowledge acquired through the senses of sight, hearing, smell, taste and touch."*

Knowledge constructed via the five senses is aesthetic, not mental (Gherardi 2006), it is perceived, judged and produced through the senses (Strati 2007). Thus, knowledge is not only constructed through thoughts but also through the body and senses. This reflects that individuals engage in the activities of a practice both mentally and physically.

Seen in this way, participants in a practice mainly construct tacit knowing. Gherardi (2009a, p.355) argues that *"the tacit knowledge embedded in practices, and which is therefore learned through participation in them, is a knowledge that comprises numerous elements of habits, habitus and habitualization".* Viewing this aspect of knowing in practice brings to the fore the aspect that a practice is in-between actions and habits. It is not a habit but it has many elements of habits, it is not an action but it has many elements of actions (Gherardi 2009a). Participants in a practice learn such tacit knowledge through being part of the practice (being-there) and employing their bodies and senses in the activities of a practice (Strati 2007). Such bodily and aesthetic knowledge can only be imparted to a certain extent, because it is difficult to codify and share with others, just like explicit knowledge. This is similar to what Polanyi (1967, p.4) argues, i.e. that *"we can know more than they can tell".*

Besides, knowing in practice is a practical shared activity; Gherardi (2013, p.36) refers to it as *"socially organized communicative practices".* Practices are conducted in coordination centres, which are defined by Gherardi (2013, p.35) as being like:

> *"…airport control towers, the control rooms for railway or subway traffic, the call centres which handle emergency calls and deploy ambulances, as well as all those work situations characterized by information and communication technologies used to support cooperation at a distance. Coordination centres are representative of a set of situations which have to do with, working together, where 'together' refers to the world of humans interacting with the world of non-humans and, mainly, with the information and communication technologies which support distance work."*

Thus, a practice is conducted in coordinated and collective ways, in which activities are distributed among participants who work together and share a common orientation through technological artefacts to perform its activities, its socially organized communicative practice (Gherardi 2013). In alignment with this, practices are viewed as materially and economically mediated. Kemmis (2009, p.23) states that:

> *"…[a] practice is always materially and economically formed and structured – it is shaped by physical and material circumstances, by "set ups" of physical objects including tools, resources, "raw material", and in more or less regular patterns of activity ("activity system")".*

These material entities, ICTs tools and techniques, raw materials and physical artefacts shape and structure working practices (Rooney et al. 2012). This implies that practices are relationally arranged among all social and material actors or, in other words, the human and non-human actors involved in practices. Maintaining a common orientation is another worth-relevant feature of practices that allow participants to understand how ways of participation and the ability to maintain a common orientation are entangled. Individual competence in knowing, regarding how to get things done, is thus both distributed and collective, and grounded in routine practices.

A practice is thus a constitutive entanglement of the social and material agents involved in it – shaped by connection-in-action between the social and the material – sociomaterial practices (Orlikowski 2002). So, agents and their connection-in-action are shaped by being interconnected. No agent is superior in the course of practice, as Orlikowski (2002, p.1437) argues that the *"position of constitutive entanglement does not privilege either humans or technology (in one-way interactions). Inste*ad*, the social and the material are considered to be inextricably related – there is no social that is not also material, and no material that is not also social."* Hence, they constitute each other. So, practice does not allow a human (social) agent to hold a privileged position in this interconnection; instead, it is relational materialism (Law 1993) that provides the basis to construe the interconnections between humans and non-humans and their sociomaterial relations. Contrary to the cognitivism that gives primacy to mental processing for knowledge creation, in practice-based approaches, the constitutive entanglement of the social and the material and the interaction of human with material artefacts with unions between mind/

body, thoughts/ actions are sources of learning and the creation of tacit knowledge – how practice is performed by both human and non-human actors.

Practices are situated because they are performed while being situated in a time and a place. The context includes participants, place, material artefacts (e.g. technologies, tools and objects), less material artefacts (e.g. rules and norms) and non-material artefacts (e.g. values, habits and customs) (Gherardi 2009a). Participants in the practice learn situated knowledge because their doing is situated in a specific context of practice (Blackler 1995, Gherardi 2009a).

However, variability is acknowledged in performing a practice in a specific context. It reflects a contextual rationality, which is a type of action and practical reasoning informing the work at hand, settings, resources and interactions. Gherardi (2012) exemplifies this aspect of practice through the jobs of a lawyer, a nurse and a motorcycle courier comprising a defined set of practices, which are constantly repeated and changed according to the changing circumstances where they are performed. This aspect highlights the recursiveness of practices that are performed repeatedly as routine work following already set sociocultural customs, norms, habits, values and ways of working (Bourdieu 1977). However, practices are modified and emerge according to the changing context. Thus, practices are viewed as partially already given and partially emergent. Through such sustained adjustment (Orlikowski 1996), practices give rise to social change. Their internal variability is not difference but repetition. Gherardi (2012, p.203) argues that "*a practice is such precisely because it is practiced, habitual, taught and* *learned as an activity that constitutes the job and requires expertise".* It is different from an emergency, wherein certain operational parameters and procedures are altered. If a building we work in is on fire, our evacuation is an action, but it is a practice for the fire brigade. This reflects the knowledgeable doing of agents and their power to do otherwise (Giddens 1984), as fire brigade staff are knowledgeable to control the fire, and they have power to do otherwise, e.g. altering operational parameters according to the situation in place.

The recursive characteristics of practice are a central theme in structuration theory (Giddens 1984). The theory contends that like many natural self-reproducing phenomena, the social activities of humans, as well as those performed in the workplace, are also recursive. The aforementioned example of the fire brigade reflects the recursiveness of practices, as it is a routine activity for the fire brigade to evacuate a building and control a fire. Similarly, participants in any practice perform it in their routine work and produce and re-produce knowledge. This feature of practice does not only develop the skills of its participants but also leads to learning new skills through re-specifying and re-situating the practice to address contingencies and changing circumstances. These two features are connected insofar as the constant reproduction of a practice or its activities in a continually changing context causes constant improvement in participants' existing skills and the learning of new skills through adapting and altering practice to complete a task. This is similar to what Gherardi (2012, p.203) states, i.e. *"knowing-how is refined by being practiced, just as excellence in knowing-how is a symbolic element which motivates, rewards, and celebrates the doing and the community of practitioners".*

So, a practice is not only a recurring pattern of actions (production) but a recurring pattern of socially sustained actions (production and reproduction). People do not only produce work in their situated activities, they also reproduce society (Gherardi 2012). A practice can only be recognized in its inter-subjectively created meanings (Gherardi 2009a). The competent reproduction of a practice and its refinement are enabled by the constant negotiation of what are ethically and aesthetically correct/ incorrect ways to perform the practice within the community. This constant negotiation among participants enables them to address constant changes, tensions and contradictions and subsequently causes the situated learning of the participants (Elkjaer & Huysman 2008). It would be difficult to say that all practitioners of practices are in complete agreement over the ways a practice is performed and continues to be performed; instead, a minimum agreement by practitioners normally exists to sustain the practice.

Kemmis (2009, p.23) argues that a practice is *"always embodied (and situated)"*, summarizing *"what particular people do, in a particular place and time, and it contributes to the formulation of their identities as people of a particular kind"*. The embodiment characteristics of practice originated from the phenomenological school, which argues for a distinction between the phenomenal and the objective (physiological) body (Bermudez 2005). The concept is related to the phenomenal body, which is experienced tacitly by the individual as a capacity for doing something. The term 'Dasein' (there-being) used in Heidegger's phenomenology implies that knowing and doing (with and through the phenomenal body) are inseparable (Gherardi 2006), and this is the key feature of PBS. Such learning that takes place while doing a social practice is embodied among participants. As a result, their bodies and senses become skilled and their identities to perform certain activities are formed over time (Kemmis 2009).

Participation, apart from a necessity to engage in practice, is itself an *"act of presence"* (Gherardi 2013, p.35) – an activity situated in the specific context of a practice and a community. Unlike a 'community of practice' in which participation only involves becoming part of the community, knowing in practice implies that participation *"is inherent to working and organizing and not separable from knowing how to perform presence and competence"* (Gherardi 2013, p.41). Participation in a practice is not only a knowledge-construction method, it is also a way to change and upgrade such knowledge and constitute and reconstitute the organization (Gherardi 2000). Knowledge and knowing are embedded in every activity of a practice, even in the activity of participation, as individuals construct knowledge about how to become part of the practice.

Importantly, knowing in practice brings into consideration the value of the context and role of networks and various human and non-human actors in the learning process. In this light, instead of adopting a linear approach to organizational learning and dealing with learning as something ready to be acquired, enhanced and transferred, studying knowing in practice suggests a need for rich descriptions of the practices and role of actors that constitute and shape the context and learning. According to Nicolini et al. (2003, pp. 26), the:

> *"…practice-based approach is a promising way to address the issues of knowing and learning in organizations in such a way that the richness and depth of the phenomenon is given full consideration."*

Such rich description in the current study can be achieved through having a rich understanding of the context where a practice is performed.

Summing up, it is argued that a practice involves collective, knowledge and recursive doing. Participants of a practice perform it by employing their bodies and senses in the activities of the practice. Practices are performed in coordination centres, through relational arrangements among humans and physical, less physical and non-physical artefacts. Humans do not hold privileged positions in the course of practice; rather, all agents (human and non-human actors) have equal status and there is a constitutive entanglement of social and material, sociomaterial practices. Further, because of knowledgeability, agents do not always follow structures as they may also do otherwise. Practices are repeatedly performed as routine job activities of participants, so it is routine work. However, these practices and ways to perform them change in response to unforeseen situations and environmental changes. Participants learn new knowledge and innovate in such dynamic situations through constant negotiation with each other.

The theme of knowing in practice from a specific and practice-based perspective of learning in general provides a holistic understanding to foreground engineers' learning in performing a practice. However, a practice-based perspective of learning alone seems unable to foreground a complete account of engineers' learning. Thus, the current study also explores the role of the cognitive learning of participants of a practice and their mental processes in performing routine work, and there is a certain amount of knowledge which is a transferable object/ entity. This form of knowledge seems to play a role in practice-based learning. So, cognitive learning theories seem to play a considerable role in practice-based learning as well as in foregrounding engineers' learning in this research. The next section thus presents the role of cognitive learning in knowing in practice and the rapprochement between the two.

2.4 Combination of Cognitive Learning and Knowing in Practice

As engineers' learning in this research is foregrounded by the learning perspectives discussed above, i.e. cognitive learning and knowing in practice, this section informs the rapprochement and amalgamation of these perspectives of learning in order to inform the first research question.

Practice-based studies (PBS) have been especially dismissive of cognitive approaches (Gherardi 2006, 2009a, Gherardi & Nicolini 2002, Orlikowski 2000, 2002). Marshall (2008) mentions that PBS actually places an unnecessary limitation on itself and holds that the cognitive dimension of learning is incompatible with a socially situated, constructionist and processual view of learning. In alignment with Marshall's (2008) suggestion, the current research develops the rapprochement between cognitive learning and a practice-based perspective of learning through the notions of ‘distributed cognition’ (Hutchins 1995) and the ‘collective mind’ (Weick & Roberts 1993).

Distributed cognition is of the view that cognitive processing is not just done by an individual person and remains only within his/her mind but is also distributed among many individuals (Hutchins 1995). In other words, distributed cognition argues that the cognitive processing going on in one’s head is coordinated and inter-linked to the cognitive processing going on in another individual’s head, often through technological artefacts. In this respect, cognitive processing is argued to be performed beyond the boundaries of an individual’s head. This can be seen in the division of labour in which the mental processing of different individuals working on a task is coordinated through shared representations and in a coordinated manner.

In his book ‘Cognition in the Wild’, Hutchins gives a dramatic account of what happened when the crew of the USS Palau realised that its steering gear had failed as it was approaching San Diego harbour and how the ship was guided to a safe anchorage:

> *“...no single individual on the bridge [was] acting alone – neither the captain nor the navigator nor the quartermaster chief supervising the navigation team could have kept control of the ship and brought it safely to anchor. Many kinds of thinking were required to perform this task. Some of them were happening in parallel, some in co-ordination with*

> *others, some inside the heads of an individual, and some quite clearly both inside and outside the heads of the participants."* (Hutchins 1995, pp. 5–6)

In this account, Hutchins explains the social activities of Palau's staff in cognitive terms as a result of coordinated and inter-linked mental processing going on in the heads of different crew members. Their handling of the ship was guided by individuals and shared cognitive processing. Viewing it from the perspective of PBS, their doing was itself knowledgeable, as they were skilled to do so; situated in the situation of the failure of the steering gear and attempting to take the ship to a safe anchorage; and relationally organized among different crew members as well as artefacts. Technology, which is considered as material artefacts in PBS (Gherardi 2009a), is used to externalize cognitive processing from an individual mind to a network of different individuals. These technological artefacts are not only part of individual personal cognitive processing (because individuals learn through interaction with them), but also used as a means of communication as they help to share cognitive knowledge in performing socially organized communicative practices (Gherardi 2013).

Such sharing of the cognitive processing of mental models helps to develop a 'collective mind', that is, *"a pattern of heedful interrelations of actions in a social system"* (Weick & Roberts 1993, p.357). It links the cognitive learning of an individual with the collective and communicative learning of a team, as members of the team process information cognitively with great heed, while being collectively interrelated with other team members in order to contribute to the team's performance. Though individual team members contribute to the collective mind, it differs from individual to individual (Weick & Roberts 1993). In performing a socially organized communicative practice, participants heedfully interrelate with each other based on a precise division of labour and responsibilities as they contribute their cognitive knowledge as a collective mind to performing the practice while being networked with other participants of a collective, distributed and communicative practice.

Further, Hutchins (1995) views charts as memory (as displayed on the ship reflecting certain information), similar to the cognitive memory/ storage of an individual, because *"within cognitive sciences, memory is described in computational terms as 'a store' of information awaiting retrieval"* (Button 2008, p.90). Given that, these charts were viewed as distributed memory providing information to be used in navigation. However, this could only be similar to the information storage in human memory in the case of rote reception learning, because information in such learning is stored as isolated pieces (Ausubel 1961) and retrieved as and when it is needed. Such charts cannot process information as it happens in meaningful reception learning or discovery learning, wherein individuals process information to draw some meanings and solutions to problems (Ausubel 1961).

However, an already stored isolated piece of information can be used in the course of meaningful learning, discovery learning or knowing in practice. Such information, when externalized, is distributed among the participants of a practice and becomes social rules and norms for doing things, which are followed to perform socially organized working practices. This is consistent with what Marshall (2008) argues, that *"[mental] schemas are [the] cognitive equivalent of social rules and norms, and that they are central in underpinning the interpretative competence necessary to constitute, but also potentially transform, situationally appropriate actions"* (p.620). Given this, such rules are not only used in the simple repetition of a practice but also facilitate transforming a practice according to the changing context.

Hence, cognitive knowledge could contribute significantly to performing a practice. Fenwick (2008 p.232) also recognizes the role of cognitive learning in practice-based learning, stating that *"much workplace learning research also employs the assumption that individuals acquire knowledge cognitively, for example, by listening to information presentation, then apply it to practice, in a sort of 'transfer' process from mind to hands".* It indicates that individuals acquire knowledge, such as rules, formulas, methods etc., cognitively in order to operate different technological artefacts in performing a practice. In this way, such knowledge is transferred from mind to hands to perform a working practice. In a social practice, knowledge, as the outcome of either individual cognitive learning or practice-based learning, is externalized and shared by the participants in a practice. Individual cognition and mental modes thus become shared and distributed cognition in the course of performing a practice collectively, which is inseparable from Weick and Roberts's (1993) notion of collective minds and heedful interrelating.

Marshall (2008) also brings to the fore a similar phenomenon, saying that in performing a practice, participants' understanding of the situation is informed by framing rules and interactional competence. Knowledge of both rules (a form of cognitive learning) and practice sense (tacit knowing) is required and used in an interrelationship for the production and reproduction of a practice. Hence there is a key cognitive dimension to the ability to perform situated actions, in that interpretive schemata guide both normative expectations and understanding of a situation (Marshall 2008). This is also in line with the knowledgeability of actors, one of the key characteristics of structuration theory (Giddens 1984) and knowing in practice (Gherardi 2006, 2009a), indicating that participants of a practice need to have knowledge of the rules and processes of performing the practice. In this way, PBS acknowledges pre-existing individual cognition and memory traces, which allow the production and reproduction of a practice (Marshall 2008).

Marshall (2008) further argues that cognitive schemas should not only be viewed from a purely computational perspective and as *"rule-based processing of information"*; rather, they can also be viewed from a less mechanistic and broader perspective, which is often unarticulated and implicit (Marshall 2008, p.602). Such interpretive schemas guide social realities through enactive sense-making (Weick 1995). They argue for a relationship between the past, present and future of a practice, allowing its transformation and emergence according to an emerging situation, while being aligned to its history. Illustrating this, it is argued that practices are not simple repetition but 'pattern-in-variety' (Cohen 2007). Thus, there is still an element of patterned continuation which maintains its embeddedness in socio-culture and history; however, at the same time, it acknowledges variety/ differences due to the emerging situation. Orlikowski (1996) calls this the ‘sustained adjustment’ of a practice. Here, I argue that the simple repetition of a practice can be determined by explicit rules, guidelines and information – simple rule-based mechanistic processing of information. However, the sustained adjustment, transformation and emergence of a practice is only likely to be possible via the participants’ implicit interpretation of existing cognitive knowledge and the situation to hand.

Similar to the above arguments for the role of cognitive learning in knowing in practice, the next section argues for the role of explicit knowledge, in addition to tacit knowledge, in knowing in practice. The section first reviews knowledge types and argues for the role of different knowledge types in knowing in practice, followed by the ways explicit and tacit knowledge interact in performing a practice for learning and knowledge construction.

2.5 Knowledge Types

It is assumed that engineers’ learning involves not only tacit knowledge but also explicit knowledge, which have equal roles in learning in the practice of engineering consultancy. This section thus argues for interaction between explicit and tacit knowledge in performing engineering consultancy work.

Knowledge is mainly classified into tacit and explicit knowledge (Polanyi 1967). Collins (2010) classifies tacit knowledge into three types. The first is weak or relational tacit knowledge, which is tacit without any philosophical reason. It is tacit simply because of privacy or because no effort has been made to codify it and make it public. Collins (2010) explains this with an example of an old man who is very familiar with his warehouse and can search for things with his own personal way but may be unable to describe that way or list its steps. However, any piece of relational tacit knowledge can be written down, with enough effort, to be shared with others. Second is medium or somatic tacit knowledge, which is tied to the human body and brains (Collins 2010). The famous example from Polyani (1967) of riding a bicycle falls under this type, because when we ride a bicycle, we do not consciously use any model of physics to maintain our balance. We cannot learn to ride a bicycle just by reading rules, watching other people riding bicycles or being told what to do by instructors. Instead, training and practice establish our capacity to maintain balance and such expertise is embedded into our neural and muscular systems in ways that we are unable to speak about. This is what Polanyi (1967, p.4) means when he states that *"we know more than we can tell"*, as we are unable to fully tell somebody how we maintain balance on a bicycle. Such knowledge is embedded in our body and inexplicable in words; however, human scientists can make it explicable through their research (Collins 2010).

Third is strong or collective tacit knowledge, which is the *"irreducible heartland of the concept"* (Collins 2010, p.119). This type views tacit knowledge as social. Considering the example of riding a bicycle in a social context (on a road), Collins (2010) argues that a cyclist has not only to maintain his/her balance but also negotiate with the social context, including traffic and pedestrians on the roads, obey traffic signs and the social convention of traffic management in a particular city. Such tacit knowledge can only be learnt by participating in the social world and interacting with other human and non-human actors. It is very difficult to share because it is about one's interaction with the social world. Where somatic tacit knowledge can be termed bodily knowledge as it is embodied in the human physique, social tacit knowledge is embedded in human interaction with the society. Individuals can learn such knowledge while being in and interacting with the society; in the aforementioned example, the cyclist has to interact with the society to learn such social tacit knowledge. Seen in this way, tacit knowledge ranges from an individual's personal hunches, insights and subjective insights to his/her bodily knowledge, and to collective social knowledge.

Unlike tacit knowledge, explicit knowledge is viewed as codified and more formalized and is thus easier to share and communicate to others (Nonaka & Takeuchi 1995). Explicit knowledge can be transferred because it is stored in symbolic form (Collins 1993), such as codified procedures and hard data (Bollinger & Smith 2001, Inkpen 1996). It has the potential to be stored in objective form at a single location (Lam 2000) and such knowledge can be learned through studying and formal instruction (Roth 2003, Smith 2001). The information storage perspective of cognitive learning (Burgoyne 2002) mainly deals with explicit knowledge, because such knowledge can not only be stored as an isolated piece of information but also related to existing knowledge and retrieved and transferred to others as and when required. The aforementioned charts (mentioned on page 31) displayed in Palau (Hutchins 1995) are a form of explicit knowledge reflecting codified information for Palau's staff.

2.5.2 Knowledge Types in Knowing in Practice

Tacit knowledge has long been associated with practice-based studies (PBS); Gherardi (2009a, p.354) argues that working practices are *"loci in which tacit knowledge is constructed, harbored and transmitted to newcomers"*. Particularly, somatic tacit knowledge relates [but is not limited] to 'sensible knowledge' in the context of knowing in practice, which is viewed by Strati (2007, p.62) as *"knowable through a person's gaze, gestures, looking, that is through his/her body"*, including the senses. Similarly, as regards tacit knowledge, Gherardi (2009a, p.355) refers to *"the tacit knowledge embedded in [social] practices, and which is therefore learned through participation in them".* Although all three of the aforementioned forms of tacit knowledge are constructed through a union between mind/body and thoughts/actions, which is one of the key characteristics of PBS, collective tacit knowledge also satisfies the criterion of sociality of practices as it can only be learnt in performing 'socially organized communicative practices' (Gherardi 2013) in a sociomaterial entanglement (Orlikowski 2002).

On the other hand, existing literature on knowing in practice does not explicitly acknowledge explicit/codified knowledge. For instance, Orlikowski argues that studies informed by the practice perspective of learning are *"relying less on explicit knowledge, specific prescriptions and canonical procedures, and more on tacit knowing, situated* *experiences and reflective improvisations"* (Orlikowski 2010, p.24). In the same vein, Gherardi (2012, p.53) states that:

> *"…in everyday practice we are often aware of being able to do something but unable to describe analytically how we do it, to explain it scientifically, and thereby turn it into [something] explicit. Sensible knowledge has precisely this characteristic: it evades logical-analytical description and scientific formalization and is better expressed evocatively and metaphorically."*

These notions indicate that knowing in practice is of a more tacit form, which is scientifically inexplicable and less explicit. Such knowing seems difficult to express and describe.

Further, the concept of knowing in practice views knowledge as anti-cognitivist (Gherardi 2009a), while the information-processing perspective of cognitive learning mainly deals with explicit knowledge, which is a transferable object (Burgoyne 2002). Hence, the concept of knowing in practice indirectly dismisses explicit knowledge. This might be the reason why existing literature on knowing in practice (Gherardi 2000, 2006, 2009a, Orlikowski 2002, Strati 2003, 2007) does not reflect any clear interaction or relationship between explicit and tacit knowledge in performing a practice.

But it also does not mean that explicit knowledge has no role in knowing in practice as there are practice-based theorists who acknowledge explicit rules and processes of performing practices. For instance, Cook and Brown (1999), amongst the main authors of practice-based approaches, recognize the present interplay between epistemology of possession (explicit knowledge) and epistemology of practice (tacit knowing). They argue that *"we must see knowledge as a tool at the service of knowing"* (Cook & Brown 1999, p.388), implying that existing knowledge, either explicit or tacit, can be used as an aid in performing a practice to construct further knowledge. The application of explicit knowledge in a practice in addition to tacit knowledge has also been argued by Sole and Edmondson, (2002, p.18) saying that:

> *"Practice connotes doing and involves awareness and application of both explicit (language, tools, concepts, roles, procedures) and tacit (rules of thumb, embodied capabilities, shared worldviews) elements"*

Seen in this way, existing knowledge, whether explicit or tacit, cannot be ignored in knowing in practice; instead, it is used in learning new knowledge in performing working practices. Hence, in the current research, both explicit and tacit knowledge are viewed as playing a considerable role when studying knowing in practice. Acknowledging the role of both explicit and tacit knowledge, the next section illustrates how both forms interact and play their roles in knowing in practice.

2.5.3 Interaction of Explicit and Tacit Knowledge in Knowing in Practice

To foreground the interaction between explicit and tacit knowledge in knowing in practice, I first present Nonaka and Takeuchi's (1995) knowledge spiral (as reflected in Figure 2.1) followed by the interplay relation between explicit knowledge and tacit knowing (Cook & Brown 1999).

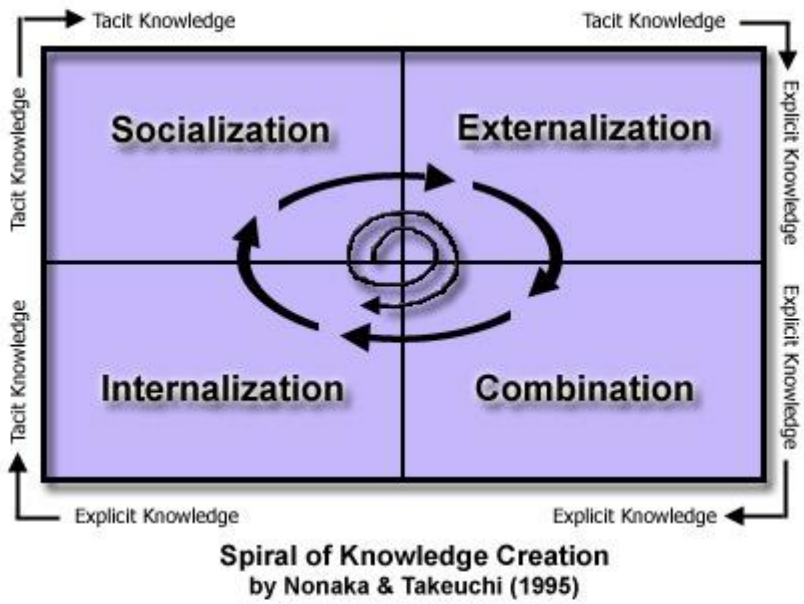
Nonaka and Takeuchi (1995, p.61) argue that explicit and tacit knowledge *"are not totally separate but mutually complementary activities … knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge"*. In stating this, they argue for interaction between explicit and tacit knowledge in such a way that one type of knowledge can be turned into the same or other types of knowledge through the knowledge spiral.

The knowledge spiral argues that participants of a practice may share tacitly held opinions, experiences, mental models and technical skills through socialization (observation, on-the-job training, participation in collective doing). As working practices are socially organized communicative practices (Gherardi 2013), the tacit knowledge of one participant in the practice can be turned into the tacit knowledge of other participants by sharing it through the aforementioned methods in collectively performing the practice.

Second is the externalization mode for the articulation of hidden tacit knowledge as explicit knowledge. This is initiated by collective reflection and meaningful dialogue and it uses appropriate analogies or metaphors to help participants in the practice articulate their tacit knowledge, which would otherwise be difficult to articulate and communicate. Conceptual knowledge is produced as a result of externalization. Such a tacit-explicit connection is critical for knowing in practice, because expert practitioners can codify their tacit knowledge into explicit knowledge with the help of language, analogies and metaphors to help learning of new learners.

The third mode, combination, serves the purpose of turning explicit knowledge into explicit knowledge through collecting information from all the participants of the practice and combining it so that all of them perform the practice collectively. Systematic knowledge of new components, technologies and prototypes is the result of combination. As a practice is anchored in the materiality of different technological/ material artefacts (Gherardi 2009a), having explicit knowledge of technological artefacts (e.g. operating rules, user-manuals etc.), and how to operate them, is a pre-requisite of using/ applying them in performing a practice. So, creating explicit knowledge through combinations of existing explicit knowledge has significant value in knowing in practice. Finally, knowing in practice acknowledges internalization, through which explicit knowledge is converted into tacit knowledge, in that participants of a practice already use explicit knowledge in performing the practice and so develop their tacit expertise.

Figure 2.1: Knowledge Spiral



In contrast to the knowledge spiral, Cook and Brown (1999, p.385) argue that *"tacit knowledge cannot be turned into explicit, nor can explicit be turned into tacit"*. They suggest an alternative process of 'generative dance' for the creation of knowledge in which *"the source of new knowledge and knowing lies in the use of knowledge as a tool of knowing within situated interaction with the social and physical world"* (Cook & Brown 1999, p.384). Through the interplay relationship between epistemology of possession (explicit knowledge) and epistemology of knowing (tacit knowing), they negate the conversion of knowledge and instead argue that each form of knowledge can be used as an aid and tool in performing situated and social practices to create the same or another form of knowledge.

Thus, two contrasting viewpoints exist in the literature presenting the interaction between explicit and tacit knowledge. The differences between them are significant. Nonaka and Takeuchi (1995) suggest that the conversion of one type of knowledge into the same or another type of knowledge in a more mechanistic and cyclical approach to knowledge creation. While Cook and Brown (1999) are against such mechanistic conversion and argues that knowledge is used as a tool in practice to create new knowledge – generative interplay between explicit knowledge and tacit knowing. Yet despite these differences, these viewpoints seem to have considerable potential to foreground and inform engineers' learning, which is assumed to take place through the application and creation of both explicit and tacit knowledge when performing a socially organized communicative practice.

Thus far, this chapter has reviewed sufficient relevant theories, models and concepts to foreground engineers' learning in practice, as studied in this research. The next section reviews relevant empirical studies, their conceptualization of the phenomenon under study and their methodological framework in order to inform the research questions as well as the methodology of the current research.

2.6 Individual Learning in Practice as a Unit of Analysis

Having outlined relevant theories, models and concepts of cognitive learning and knowing in practice in the earlier sections of this chapter to conceptualize engineers' learning, the current research argues for *'individual learning in performing socially* *organized communicative practice'* as a unit of analysis. This research is informed by neither solely cognitive learning nor knowing in practice; instead, a rapprochement between the two informs engineers' learning in practice. Likewise, the unit of analysis in this research is also an amalgamation of the units of analysis of both learning perspectives.

The ontological positions of cognitive learning and knowing in practice are different. Cognitive learning argues that knowledge is an 'objective commodity' that can be acquired by and stored in the individual mind and retrieved from it as and when required (Burgoyne 2002). That is why cognitive learning assumes a realist ontology and gives ontological primacy to the individual mind; hence, individual learning is the unit of analysis (Ausubel 1961, Burgoyne 2002, Easterby-Smith et al. 2008, Fox 1997). An individual's individualistic learning through his/her mental processing is not all that informs the current research because an engineer is also assumed to learn in performing socially organized consultancy practice, as well as from emotions, the body and an unspoken and taken-for-granted culture that cannot occur solely through individualistic mental processing.

On the other hand, the conception of knowing in practice believes that knowledge is an act of knowing that is situated, embedded, relational and emerges in a specific context (Blackler 1995, Gherardi 2009a, Nicolini et al. 2003). Thus, learning in practice gives ontological priority to the interaction that occurs between the human and the social worlds (Gherardi 2009a) and is assumed to be *"relational, constructive, heterogenous* *and situated"* (Nicolini et al. 2003, p.27). Given that, learning in practice argues for practice as a unit of analysis because of having social interaction within it; thus, practice is a locus of learning (Corradi et al. 2010, Easterby-Smith et al. 2000, Gherardi 2011). It does though seem difficult for a practice to become a complete account of learning in this research without considering the mental processing of its participants. This is so because an individual is also assumed to learn and create knowledge through his/her mental processing, in addition to learning-in-consultancy practice. Thus, individual and practice are argued to be entangled if learning is to take place.

These contrasting ontologies of cognitive learning and knowing in practice, and their respective units of analysis, are bridged by the conception of distribution cognition (Hutchins 1995). Distributed cognition argues that different cognitions work in parallel and in co-ordination to perform a socially organized task. An individual externalizes his/her cognition to the socially organized participants of a practice through different technological artefacts and cognition becomes rules and norms to perform the practice. In other words, an individual shares his/her cognitive structures (objective knowledge learnt through cognitive learning) with other participants and utilizes such structures in performing a socially organized collective practice. Consequently, in such practice, s/he does not only learn through his/her body but also through his/her cognition as well. Thus, it seems necessary for an individual to become part of a social situation and a social/ collective practice to learn and create knowledge, instead of solely relying upon his/her cognition. This is what is argued by Tsoukas (1996), who states that *"individual* *knowledge is possible precisely because of the social practices within which individuals engage"* (Tsoukas 1996, p.14).

In light of these arguments, the current research develops a rapprochement between contrasting ontological positions of cognitive learning and knowing in practice and their respective units of analysis through distributed cognition. This rapprochement led me to consider *'individual learning in socially organized collective practice'* as a unit of analysis in this research.

So far, I have developed a theoretical lens comprising a rapprochement between cognitive learning and knowing in practice that best informs the phenomenon under study of this research, i.e. engineers' learning. The next section reviews relevant empirical literature to identify research gaps, define ways to address those gaps and join the research debate, and inform the research questions and research methodology.

2.7 Review of Existing Literature, Gap-spotting and Joining the Research Debate

The current section reviews existing empirical literature informing the current research. The section is divided into three parts. The first sub-section reviews theories, concepts, models and empirical literature on knowing in practice to spot research gaps, join the debate, address those gaps and how this literature review informs the main research question and research methodology. Further, as the current research studies learning in practice of engineering consultancy, which is collectively performed by local and foreign engineers in the context of an international consultancy alliance, a great deal of cross-border sharing of existing practices and related knowledge is involved in engineers' learning. It is assumed that engineers from both NESPAK and its foreign partners share their practices and knowledge with each other to complete projects through meeting their specific requirements. Thus, the second and third sub-sections, respectively, review empirical literature on cross-border sharing of practices and cross-border sharing of relevant knowledge and its influencing aspects to spot research gaps, join the debate and address those gaps, and inform the sub-research question and research methodology.

2.7.1 Knowing in Practice

The concept of learning has been differently theorized by a variety of theorists. It is variously defined as cognitive change (Argyris & Schon 1978, Huber 1991, March & Olsen 1975) and behavioural change (Cyert & March 1963, Miller & Friesen 1980); identifying and addressing errors through single loop and double loop learning (Argyris & Schon 1978); codification of organizational routines (Cyert & March 1963, Levitt & March 1988); and information dissemination in organization (Huber 1991). Learning in organizations has been viewed as either related to the processes or outcomes of learning. Some theorists (e.g. Argyris & Schon 1978, Fiol & Lyles 1985) give primacy to the contribution of learning for organizational performance (outcome). On the other hand, Huber (1991) views organizational learning as a change in people's behavior (process). However, Dodgson (1993) argues that since learning is related to organizations, it encompasses both processes and outcomes. Besides this, the social constructionist perspective on learning gives primacy to the processes through which organizations and their employees learn and create knowledge (Brown & Duguid 1991, Gherardi & Nicolini 2000, Lave & Wenger 1991). The field of organizational learning has been developed through many debates (Easterby-Smith, Crossan & Nicolini 2000). The first debate is about the unit of analysis i.e. does learning in organizations take place at the individual, team or organizational level? Is the organizational learning simply the sum of the learning of its employees or is it more than that? Fiol and Lyles (1985) argue that organizational systems and structures influence individual learning – focusing on individual learning. Other schools of thought argue that learning in organizations is stored in the systems, procedures and processes of the organization (Hedberg 1981, Shrivastava 1983). While this debate between individual and organizational learning was developing, the focus of researchers shifted towards learning at team, community and inter-organizational levels (Easterby-Smith et al. 2000, Gnyawali 1999, Lucas & Ogilvie 1999).

A second debate is about the cognitive-behaviour framework of learning (Fiol & Lyles 1985). This debate focuses on the relationship between cognitive change and behavioral change that subsequently results in change in performance. A third debate was initiated by Argyris (1976) about single and double loop learning. This debate encompassed a tension between incremental and transformational change which was addressed *"by the recognition that what appears to be incremental change at one level of analysis* *(individual) may appear transformational when viewed from another level of interpretation (organization)"* (Easterby-Smith et al. 2000, p.42).

A fourth debate is about unlearning (Hedberg 1981). The major focus of unlearning is on discarding knowledge however, this process is still considered as a matter of learning versus unlearning. A further debate is between organizational learning and learning organization. Senge (1990) states that the learning organization develops its capacity to continuously change and adapt. He views the learning organization as being beyond the traditional view of an organization as a social institution and considers it as a social organism that is also a knowledge system: organizations learn just as individuals learn (Senge 1990).

These debates are all related to learning at the organizational level. Although one of these debates is related to the unit or level of analysis i.e. individual, team and organization, its focus is still on the ways individual or team level learning contributes towards organizational level learning. The current research also studies learning in an organizational and inter-organizational context however, its main inquiry is: 'how do engineers learn'? Thus, this research does not explore team or organizational level learning. Therefore, reviewing empirical literature regarding the aforementioned debates on organizational learning does not come under the scope of this research.

As the main inquiry of the current research is informed by the practice-based studies (PBS) in general, and specifically by one of its themes of knowing in practice, the current research mainly reviews the literature on learning that is informed by knowing in practice. Many empirical studies have explored practice in the fields of sociology and organization studies. Some of these studies explore: participation in online communities through a practice-based approach (Rivera & Cox 2016); situated knowledge and learning in dispersed teams (Sole & Edmondson 2002); the practice of client-consultant interaction for the production of professional services (Nikolova, Reihlen & Schlapfner 2009); practice-based learning in construction projects (Kokkonen & Alin 2015); job placement practice (Bou, Sauquet & Bonet 2014); technology-mediated network relations (Schultze & Orlikowski 2004); entrepreneurial learning in family business through a situated learning perspective (Hamilton 2011); and the construction of the entrepreneurial context through a practice-based perspective (Chalmers & Shaw 2015).

There are many other similar empirical studies that, in one way or another, use the practice lens to study different phenomena. Since these studies, in addition to the aforementioned literature, are informed by other themes of PBS (that is, other than knowing in practice), and their conceptualization of practice does not embrace its full account as the theme of knowing in practice does, those studies are out of the scope of the current research and I do not review them in the below literature review section.

Furthermore, the current research is informed by an abductive research approach alongside systematic combining through moving forth and back to create coherence between theory and data (Dubois & Gadde 2002). The abductive research approach required me to successively modify the literature review chapter and retain/include the reviews of only those studies that specifically inform or aligned with the findings of the current research. The detail of the abductive research approach is given in section 3.4.1. Being informed by this approach, the current research reviews only those empirical studies which have specifically explored knowing in practice and are informed by the key aspects of this theme i.e. *knowing in collective, knowledgeable and recursive doing of socially/relationally organized, emergent, situated, embedded and embodied practice* (these aspects are discussed in detail in section 2.3.4). There is a serious scarcity of empirical studies that are informed by the full account of practice and its aforesaid characteristics. Further, I could not find a single empirical study that is informed by the rapprochement between cognitive learning and practice perspective of learning. To the best of my knowledge, there are very few studies exploring knowing in practice which are informed by the aforementioned conceptualization of learning in practice. These studies present a reasonable account of learning in practice and relevant underlying concepts of practice. Following is a review of the theories and methods which inform those studies and how the current research contributes to the existing debate.

Orlikowski (2002) explores knowing in practice in a large software firm, 'Kappa', headquartered in the Netherlands. Acknowledging the limitation of not being a purely ethnographic study, Orlikowski collected data mainly through interviews and document analysis, and analysed these using inductive qualitative techniques (Agar 1980, Glaser & Strauss 1967, Strauss & Corbin 1990). The study finds different forms of knowing constituted in different practices. These include *"knowing the organization, knowing the players in the game, knowing how to coordinate across time and space, knowing how to develop capabilities and knowing how to innovate* , while these forms of knowing are constituted in practices of *"sharing identity, interacting face to face, aligning effort, learning by doing and supporting participation"*, respectively (Orlikowski 2002, p.257).

Gomez et al. (2003) explore learning in cooking practice in the kitchen of a Parisian restaurant through ethnographic observation. The study found that learning does not only take place by the chef sharing cooking practices and activities with his/her colleagues; instead, it requires learners to practically perform their cooking practices recursively in their daily routines through engagement of their bodies and senses with the practice and its activities. The study explicitly argues that *"cooking knowing is highly tacit, embedded in physical activities, and actually bridges theory and practice, subjective and objective knowledge, technical skills and rule enforcement, knowing both in body and mind"* (Gomez et al. 2003, p.123). At the same time though, this quote acknowledges cognitive learning in knowing in practice through arguing for a bridge between subjective and objective knowledge. The study also acknowledges explicit knowledge by stating that *"not all knowledge can be codified ... not all knowledge can be made explicit"* (Gomez et al. 2003, p.123), indicating that there is some knowledge in practice that can be codified and made explicit. This acknowledgement seems to have implications for the key argument of this research, i.e. the rapprochement of cognitive learning (objective knowledge) and knowing in practice and the role and creation of explicit knowledge in practice.

Nicolini (2011) studied knowing at a site of telemedicine practice in the healthcare sector of Northern Italy. Fieldwork was done through observation, interview to the double, semi-structured interviews and recording phone calls. The study shifts the unit of analysis from the individual to the organization, arguing that they

> *"take bundles of real-time practices and their relationships to be the site in which, and through which, knowing manifest itself … which is distributed and dispersed among a variety of people, things, and practices. The site of knowing is thus totality of these interaction and mutually dependent instances of local knowing and practices"* (Nicolini 2009, p.616-617).

In this way, the study adds the idea of practice as a 'site of knowing' to the existing body of knowledge.

Gherardi (2010) studied learning in doing the practice of telecardiological consultancy in an advanced cardiology centre located in Northern Italy. Being an ethnographic study, it collected data through observation, ethnographic interviews, focus groups and recording phone calls. The transcripts of telephone calls became the main focus of analysis in this research. The analytical framework of the study proposes three interpretative lines including reading ICT mediated telecardiological practice *"from outside (as a patterned set of activities), from inside (as knowing in practice), and reading as a social practice (as a doing of society)"* (Gherardi 2010, p. 501). The study contributes by understanding telecardiological practice as a 'material-semiotic practice', a relationship of humans and non-humans wherein practical knowledge is situated and mobilized within an action-net, so that every element has a sense and place in the interaction.

The last study in this field is by Rooney et al. (2012), who explored learning in practice of engineers' walking on a project site in an Australian construction company. The methodology used in the study included document analysis, focus groups and observation. The study reports site engineers walking onto the project site as a learning practice which is embodied, materially mediated, relational, situated and emergent, while their learning takes place in performing this practice of site walking, including observation of work being done and discussions of problems with engineers working on the site.

Gap-spotting and Joining the Research Debate

While earlier studies provide a reasonable account of knowing in practice, the current research advances this field in different ways. First, this research studies learning in practice performed in a different context. Previous studies have explored learning in practices that are already well situated, embedded, historically emerged and relationally organized in the indigenous context of a single organization. But this research examines learning in a practice which is assumed to be developed and emerged via the integration of practices and activities in the context of an international consultancy alliance, whilst the practices and activities were developed earlier in different social, historical, organizational and national contexts. Further, previous studies have also been done in different countries and organizations, as reflected in **Table 2.1**, below.

Table 2.1: Existing empirical work informed by Knowing in Practice

Author(s)	Method	Location (company)
Orlikowski (2002)	Interviews, document analysis	Netherlands (software development company)
Gomez et al. (2003)	Ethnography (observation)	France (restaurant kitchen)
Nicolini (2011)	Ethnography (observation, interview to the double, semi-structure interviews and recording phone calls)	Italy (healthcare)
Gherardi (2010)	Ethnography (observation, interviews, focus group and recording phone calls)	Italy (healthcare)
Rooney et al. (2012)	Ethnography (document analysis, focus group and observation)	Australia (construction)

As reflected in the table, no existing empirical studies have been conducted in the Asian context or in an engineering consultancy company, thus indicating a significant literature gap. It is argued that Pakistan has its own national culture different from that of the Western world (Hofstede 2014), and this is likely to have different implications for learning, knowledge creation and knowledge-sharing by local inhabitants. It seems difficult to claim findings drawn from other national cultures claimed to be universal.

It is thus argued that studying learning in such a newly emerged practice in the context of an international consultancy alliance in an engineering consultancy company in Pakistan is expected to make a significant contribution to the field of knowing in practice.

Second, earlier studies are fully informed by the concepts of practice-based studies (PBS) in general and knowing in practice in particular. The overall account of practice-based learning is in sharp contrast to and dismissive of cognitive learning (Gherardi 2009a, Marshall 2008), while existing texts on practice-based theories and concepts do not give much space to explicit knowledge. Similarly, empirical studies informed by this perspective also do not consider cognitive learning or explicit knowledge. With this gap in the existing literature, the current research contributes to PBS and knowing in practice by studying engineers' learning informed by: 1) a rapprochement between cognitive learning and knowing in practice, and 2) the interaction between explicit and tacit knowledge in the course of performing a practice.

Finally, earlier practice-based studies are anchored in a qualitative ethnographic and ethnomethodological framework to study practice, with practice as a unit of analysis. Within this framework, practice-based theorists argue for different methodological possibilities, such as praxeology (observation) (Bourdieu 1977), interview to the double (Nicolini 2009) and shadowing (Czarniawska 2008, Gherardi 2012). The aforementioned empirical studies were also done using ethnographic methods, except for Orlikowski's (2002) study.

Learning in the current research is not informed solely by PBS and knowing in practice but rather by a rapprochement between cognitive learning and knowing in practice. Cognitive learning argues for the individual as a unit of analysis, while knowing in practice suggests practice as a unit of analysis. This research is thus informed by a rapprochement between the units of analysis suggested by two learning perspectives, i.e. individual learning practice in shared/ collective practices. This rapprochement between two contrasting learning perspectives leads me to study engineers' learning mainly through interviewing participants, because it is difficult for me to get at participants' cognitive learning and mental processing through ethnomethodology.

Further, considering the main research question, i.e. 'How do engineers **view** their learning in the practice of engineering consultancy?', an interview method seems to better serve the research question. This is because what participants say about their cognitive learning, as well as their learning in what they do every day as they engage in engineering consultancy, can allow me to better study both forms of learning and the rapprochement between them. In this, I follow the insistence of Giddens (1984) and Giddens and Pierson (1998), in that people are reflexive and knowledgeable and they tend to know more and give a more reasonable account of both their forms of learning than researchers give them credit for. Although, the interviewing technique may seem flawed due to relying upon the interpretations of interviewees of the phenomenon under study, I have used different techniques to cross-validate the data, which are explained in section 3.7.1.

Finally, this research is informed by critical realism (CR) (cf. Bhaskar 1975, 1978) and the allied work of other critical realists (e.g. Collier 1994, Danermark 2002, Fleetwood 2001, 2005, 2011, Sayer 1992, 2000, Simm 2009). CR better serves the purpose of this research, which is to explore various underlying accounts of engineers' learning of explicit and tacit knowledge and the entities, structures and mechanisms that enact engineers' learning in doing the practice of engineering consultancy. The current research also explores sharing knowledge of modern engineering methods and technologies by foreign engineers, which subsequently facilitates engineers' learning of this state-of-the-art engineering knowledge. In this way, not only is the surface-level reality of engineers' learning studied, but the way it is enacted by its deep-rooted realities, structures and mechanisms is also vertically explored through a critical-realist retroduction mode of inference (Danermark 2002)

2.7.2 Cross-border Sharing of Practices

The second research question:

Which factors influence cross-border sharing of knowledge and consultancy practices between local and foreign engineers, and in what ways?

is foregrounded by this and the next sections through reviewing relevant literature, theories and models related to cross-border sharing of knowledge and consultancy practices.

In this field, there is only one study, by Hong et al. (2006), that has explored cross-border sharing of practices from five Japanese companies to their respective foreign subsidiaries operating in China. Informed by a social perspective of learning (Brown & Duguid 1991, Cook & Brown 1999, Lave & Wenger, 1991), the study found that practices can be transferred across borders in the form of knowledge repositories through collective routines while this transfer process is mediated by the enterprise context (Hong et al. 2006).

Gap-spotting and Joining the Research Debate

The current research differs from that of Hong et al. (2006) in many aspects and it aims to contribute to this field from different perspectives. First, informed by the theoretical lens of knowing in practice (Gherardi 2000, 2006, 2009a, Orlikowski 2002, Strati 2003, 2007), the main phenomenon under study in this research is learning in the practice of engineering consultancy. However, as this consultancy practice is developed and performed through the integration of existing local and foreign practices, cross-border sharing of practices comes under scrutiny as a relevant phenomenon of concern in this research.

Second, the main focus of Hong et al. (2006) seems to be on foreign Japanese practices and their transfer into China in the same form in which they were earlier developed and performed in Japan. Seen in this way, local Chinese practices are somewhat overlooked. On the other hand, the current research attributes equal importance to local practices as a consultancy emerges and is performed through the integration of both local and foreign practices. Engineers' learning is assumed to take place in such a newly emerged practice.

Third, the current research disagrees with the terms ‘transfer’ and ‘replication’ of OL practices used by Hong et al. (2006). Informed by a conception of practice that is situated, embedded and relational in a specific context (Gherardi 2009a, Hager, Lee & Reich 2012, Rooney et al. 2012), the current research argues that practices cannot be decontextualized from their original contexts and transferred into new ones in their original form. Instead, practices can be shared with people in another context, where they are further transformed, redeveloped and performed according to the specific dynamics of the given context. Fourth, Hong et al. (2006) explore this phenomenon in the context of a foreign subsidiary that is a child company of a parent corporation – thus it seems to be a tightly coupled strategic alliance (Steiner 2006). The cross-border sharing of practice in such alliances seems easy because of the higher stake of the parent corporation. On the other hand, consultancy firms are *“network-like organizations”* (Boussebaa et al. 2014, p.4) and their strategic alliances seem to be loosely coupled and so do not require the involvement of complete organizational systems, particularly a knowledge management system (KMS), in the alliance. Instead, there are a few highly specialized team members of the partners who work together to provide consultancy to a third party (the client). The sharing of practices and knowledge in such network-like consultancy alliances is of a different nature relative to that in a tightly-coupled foreign subsidiary form of international alliance.

Finally, Hong et al. (2006) conducted fieldwork for their study from 1999–2000. However, as the social world changes across time and space (Guba & Lincoln 1995), the findings of Hong et al. (2006) are hard to generalize now because of significant changes in the field of international collaboration due to increasing globalization and the World Trade Organization (WTO) (Subramanian & Wei 2007) and the inception of modern information and communication technologies, such as video conferencing, Skype conferencing and the like (GlobalGuru, 2010). The current study, from this perspective, also updates existing knowledge about cross-border sharing of working practices and relevant knowledge.

2.7.3 Cross-border Sharing of Knowledge

In addition to consultancy practices and activities, relevant knowledge is also assumed to be shared between local and foreign partners. Such knowledge does not only seem to be tacit in nature as explicit knowledge also seems to be significant to perform consultancy work and fulfil the technological requirements of projects. The sections below critically review existing literature, theories and models relevant to the aspects influencing knowledge-sharing in strategic alliances. After reviewing these, a table is provided to report the empirical work done in this domain, followed by gap-spotting and joining the research debate by the current research, which informs the second research question, as well as the methodology followed in this research.

Knowledge Characteristics

Knowledge-sharing is a challenging task in international strategic alliances, particularly when the knowledge that is to be transferred has certain characteristics, such as tacitness, complexity and specificity. Salk and Simonin (2011) also point out that tacit knowledge is difficult to share. Considering Polanyi's (1962) definition of tacit knowledge, that *"we know more than we can tell"* (p.4), it is argued that tacit knowledge can only be shared through socialization, observation, joint working and on-the-job training (Nonaka & Takeuchi 1995). Knowledge *complexity* is another key characteristic of knowledge increasing the difficulty of sharing it. It is referred to as a *"number of interdependent routines, technologies, resources, and individuals linked to a specific asset of knowledge"* (Salk & Simonin 2011, p.611). More complex knowledge, generating systems and technologies as well as knowledge itself, is hard to imitate in another context. Further, working approaches, organizational settings, individuals' personalities and the competencies of organizations are more likely to be *specific*. They differ from country to country, particularly in the Asian context which is quite different from the Western context; and knowledge which works well in one context might not be transmitted and reproduced as is in a new context (Szulanski, 1996).

Where these characteristics hinder inter-firm knowledge-sharing and need special treatment, other characteristics such as knowledge rareness, value, non-susceptibility and inimitability facilitate the knowledge-transfer process and make it more attractive to knowledge-seekers (Perez-Nordtvedt, Kedia, Datta & Rasheed 2008), who in turn become more eager to obtain such knowledge, which subsequently leads to the effective transferability of knowledge among strategic allies.

Willingness to Share Knowledge

Employees' intention to learn is another significant phenomenon causing knowledge-sharing in alliances (Easterby-Smith et al. 2008, Hamel 1991, Hua & Evangelista 2007). Employees with higher intention and capability are more prone to learn. They even remove barriers to learning new knowledge (Kalling 2003) and proactively boost their efforts towards knowledge transfer (Park & Vertinsky 2016).

The willingness of knowledge donors to share knowledge is of key importance to knowledge-sharing in strategic alliances. However, a knowledge donor may not be very willing to share key knowledge, technology and working practices (Salk & Simonin 2011); to maintain its supremacy, it may disallow imitation of its key knowledge and expertise (Becerra, Lunnan & Huemer 2008) and thus protect its key knowledge (Hau & Evangelista 2007). Knowledge protectiveness is higher in competing alliances because of the higher risk of imitation of core competencies by partners (Inkpen 1998, Inkpen and Dinur 1998). This can result in strong competition and changes in the relative bargaining position of partners (Dussauge et al. 2000, Inkpen 2000) and the loss of privileges and ownership (Hau & Evangelista 2007). To avoid this, knowledge donors may position gatekeepers and shields to filter information and protect key competencies. Such lack of willingness can seriously reduce knowledge-sharing in alliances (Szulanski 1996). This seriously reduces knowledge-sharing in international alliances and ultimately affects the goals of an alliance.

Inter-firm Relationship

The key purpose of a strategic alliance is to exploit the knowledge and competencies of each partner and thus address weaknesses and collectively achieve business objectives (Holmqvist 2004, Levitt & March 1988) that could not be achieved by individual partners. Employees of partnering organizations are likely to be persuaded by their respective organizational objectives to share required knowledge (Simonin 2004). This is also related to the notion that equity ties in strategic alliances increase knowledge-sharing among partners (Mowery, Oxley, & Silverman 1996). Another aspect influencing knowledge-sharing in alliances is geographic proximity (Bell & Zaheer 2007). This is particularly true for the sharing of tacit knowledge that restrains imitation (Reed & DeFillippi 1990) and requires collective work and socialization (Nonaka & Takeuchi 1995) in close geographic proximity (Pouder & St. Johns 1996). The geographic proximity of partners makes the knowledge conduit richer for sharing tacit knowledge and its subtle cues and so there is reduced knowledge loss with understanding and interpreting by the knowledge-seeker (Daft & Lengel 1986). On the other hand, explicit knowledge can be shared through documents and online communication so that geographic proximity is not required.

In addition to the organizational-level relationships of the partners, individual ties such as personal associations and friendships among employees of the partnering firms also influence knowledge-sharing (Hansen & Lovas 2004, Ingram & Roberts 2000, Krackhardt & Kilduff 1990). Friendships among them increase trust, liking, affection and association (Argyle & Henderson 1985, Krackhardt & Kilduff 1990). As a result, they stand up for each other (Argyle & Henderson 1985), talk extensively (Ibarra & Andrews 1993) and share necessary information, even if there is rivalry at the organizational level (Ingram & Roberts 2000).

Disagreements

The notion of disagreements in this research is informed by a group-decision process (Aldag & Fuller 1993) which is of the view that facile and critical agreement in a group can negatively affect problem-solving. On the other hand, disagreements can lead group members to think more creatively and analyze an issue from different perspectives in order to find innovative solutions to problems (van Woerkom and Sanders 2010). Similarly, Ellis, Hollenbeck, Ilgen, Porter, West & Moon (2003) stress having 'constructive controversies' among team members to refine ideas. Thinking about divergent ideas in a group work offers more learning and knowledge creation for group members in the end (van Offenbeek 2001**).** These theoretical assumptions inform the research question because disagreements are likely to occur in joint consultancy working and increase knowledge-sharing among them through critical evaluation of each other.

Cultural Differences

The knowledge and working practices of an organization, which are supposed to be shared in a consultancy alliance, are developed and deeply embedded in respective socio-cultural and historical settings (Rooney et al. 2012) and well-informed by participants' behavioural dispositions or ‘habitus’ (Bourdieu 1977). The de-contextualization of such situated and embedded practices and knowledge, and their sharing across organizational and national boundaries, is very difficult, if not impossible (Davenport & Prusak 1998, Gold, Malhotra & Segars 2001, Hong et al. 2006). Further, local and foreign partners are likely to use different vocabularies, terms and jargon in performing tasks. This may create misunderstandings while communicating with each other during collective work and subsequently reduce the information flow (Lyles & Salk 1996) and knowledge-sharing (Mowery et al. 1996, Simonin 1999).

Cultural differences and informed different ways of working are likely to have more adverse effects on tacit knowledge-sharing than on explicit knowledge-sharing. Tacit knowledge about working styles which is embedded in individuals and society (Polayni 1962, Nonaka & Takeuchi 1995) is difficult to share without joint working, on-the-job training and assisting/ supervising each other (Nonaka & Takeuchi 1995). Engineers belonging to different national and organizational cultures arguably have different values, vocabulary, terminologies, norms and ways of working, which can impede information flows and knowledge-sharing among them during collective work. This requires individuals from both partners to be culturally aligned with each other for effective sharing of tacit knowledge, as suggested by acculturation strategies such as assimilation[8] and integration[9] (Berry 1997).

[8] An individual gives up his/her own cultural identity and adopts the values of the dominant culture (Barney & Hansen 1994).
[9] An individual maintains his/her own cultural identity and at the same time adopts the values of the dominant culture as well (Barney & Hansen 1994).

Language Barriers

Besides cultural differences, the different languages of partners in an alliance can potentially affect knowledge-sharing between local and foreign partners. The national language of Pakistan is Urdu while most foreign partners of NESPAK are in European and North American countries or China. Feely and Harzing (2003) explain the different language barriers, such as language diversity, penetration and sophistication, that multinational companies (MNCs) are facing. They also suggest some measures to address the language barriers between local and foreign partners, including lingua franca (relying on native tongues – applicable only to English-speaking countries), functional multilingualism (mixed language), external language resources (translators, interpreters), language training, adopting a single corporate language, depending upon scarce linguistic experts who become informal language nodes, selective recruitment (only language-proficient staff), expatriate management as a language node, inpatriating local subsidiary people into the head office, machine translation (Google translators and translation apps in this era) and controlled language (Feely & Harzing 2003). Joshi and Lahiri (2015) report that the language friction index[10] significantly influences alliance formation and a language's structural differences cause incongruities at the interface between local and foreign partners in international alliances. This can subsequently influence knowledge-sharing between partners in a strategic alliance. In contrast to cross-border sharing of working practices, there is voluminous literature on cross-border sharing of knowledge in

[10] Joshi and Lahiri (2007) developed a language friction index to quantify the difference between relative linguistic structures between two languages.

strategic alliances. **Table 2.2** reports notable studies with their research approaches, phenomena studied by them and origins.

Table 2.2: Empirical Evidence Regarding the Influence of Different Aspects of Knowledge-sharing in Strategic Alliances

Sr. No	Study	Methodology	Knowledge characteristics	Partner characteristics	Inter-firm dynamics	Industry	Country	Nature of the alliance
1	Inkpen (1996)	QL	*	*	*	Manufacturing	US	IJV
2	Simonin (2004)	QN	*	*		Large and medium enterprises	US	JV
3	Gupta and Govindarajan (2000)	QN	*			MNCs	US	Foreign subsidiary
4	Steensma, Tihanyi, Lyles and Dhanaraj (2005)	QN			*	Multiple industries	Hungary	IJV
5	Hau and Evagelista (2007)	QN	*	*	*	IJVs	Vietnam	
6	Haider and Mariotri (2010)	QL		*	*	Manufacturing	Pakistan	Foreign subsidiary
7	Lawson and Potter (2012)	QN	*	*		Manufacturing	UK	B2B with suppliers
8	Schulze, Brojerdi and von Krogh (2014)	QN	*			Automotive	Switzerland, Germany, Austria	R&D alliances
9	Boussebaa, Sturdy and Morgan (2014)	QL		*	*	Services	UK	Consultancy alliance
10	Chen, Len and Yen (2014)	QN			*	Manufacturing	Taiwan	Supply chain
11	Li, Roberts, Yan and Tan (2014)	QL	*	*	*	Higher education	China	IJV
12	Khan, Shenkar and Lew (2015)	QL		*	*	Manufacturing	Pakistan	IJV
13	Ranucci and Souder (2015)	QN			*	Manufacturing	USA	Mergers
14	Park, Vertinsky and Becerra (2015)	QN		*		Manufacturing	Korea	IJV
15	Yang, Yu, Liu and Riu (2016)	QN	*		*	Manufacturing	China	Supply chain
16	Park and Vertinsky (2016)	QN		*	*	Manufacturing	Korea	IJV

Note: QL = Qualitative; QN = Quantitative; JV = Joint Venture; IJV = International Joint Venture; B2B = Business to Business; R&D = Research and Development

Gap-spotting and Joining the Research Debate

The current research explores inter-organizational knowledge-sharing in an international consultancy alliance. Existing empirical studies explore this phenomenon in tightly-coupled strategic alliances, such as international joint ventures and foreign subsidiaries, whereas only one study (i.e. Boussebaa et al. 2014) explores it in international consultancy alliances. It is assumed that knowledge-sharing in consultancy alliances is of a different nature because such loosely-coupled alliances (Steiner 2006) do not require the involvement of complete organizational systems and knowledge-management systems (KMS) in the alliance (Boussebaa et al. 2014).

Instead, there are few experts in the field who join and work together to collectively provide consultancy services to the client. The current research is thus gathering more evidence with the influence of many influential factors to enrich this field by studying knowledge-sharing in a different context to that of loosely-coupled international consultancy alliances. This is expected to contribute significant knowledge about the phenomenon under study to the existing knowledge base.

Second, although there are a few qualitative studies exploring cross-border sharing of knowledge in alliances, as reported above, the predominant literature in this field is quantitative in nature. Quantitative research does though have some advantages when statistically computing the effects of one variable on others and can make claims for the generalizability of findings from larger samples of data (Easterby-Smith et al. 2012). However, it is unable to answer 'how' research questions and provide detailed insights into the ways a phenomenon occurs, its underlying reasons and ways to address its problems and issues (Guba & Lincoln 1994). The current research, being qualitative in nature, advances this knowledge base by adding more empirical evidence through qualitatively answering the ways in which cross-border knowledge-sharing takes place, and identifying its underlying reasons, problems and issues with their respective solutions.

Lastly, Pakistani natural culture is characterized by higher power distance and uncertainty avoidance, which is the opposite of Western culture (Hofstede 2014). Cultural orientation has different implications for the learning of local inhabitants. For instance, such culture is more aligned to machine bureaucracy and a pyramid model (Mintzberg 1989), which are not supportive for learning and knowledge-sharing (Muijen & Koopman 1994). Due to learning being a social phenomenon and one highly informed by these national cultural characteristics, the findings drawn from the Western cultures are difficult to generalize in the Pakistani context. There are though two empirical studies, to the best of my knowledge, that have been conducted in the Pakistani context but the current research adds a different perspective of cross-border sharing of knowledge in international alliances. The first study, conducted by Haider and Mariotti (2010), was qualitative in nature and explored inter-organizational learning in international alliances in four automotive companies of Pakistan. In the second study, Khan, Shenkar and Lew (2015), using mixed methods, explored knowledge transfer from foreign firms to local automotive suppliers in Pakistan in the context of an international joint venture (IJV). As argued above in the first paragraph of this section, knowledge-sharing in joint ventures is of a different nature than that in consultancy alliances. Further, in an engineering consultancy, explicit knowledge, such as engineering theories and technological information, is equally shared and applied, which does not seem to be the case in IJVs examined by the aforementioned studies. The current research thus adds knowledge to the phenomenon under study from a Pakistani perspective, while being conducted in the context of a project-based engineering consultancy company in Pakistan.

In addition to the main research gaps, the current research addresses a few smaller gaps and makes various contributions to the existing knowledge base. These include studying the influence of disagreements, language barriers and personal associations and friendships on inter-organizational knowledge-sharing in the context of strategic alliances.

In light of the aforementioned gap spotting, it is argued that exploring these phenomena through in-depth qualitative enquiry in this research is expected to offer significant insights and make valuable contributions to the existing knowledge base.

2.8 Conclusion

The purpose of this chapter was to review relevant literature to inform the main and sub-research questions. To this end, **section 2.2** first critically analyzed cognitive learning theory and its perspectives of reception learning (with its types of rote and meaningful learning) and discovery learning (Ausubel 1961). The key aspects of cognitive learning theory are summarized, including: 1) the human mind is a locus of learning; b) knowledge is an information commodity and a transferable object; 3) it is created through mentalistic processing; 4) it is stored in the mind. either as an isolated piece of information or through integration with existing knowledge; 5) and such knowledge is public and objective and readily available to others.

While cognitive learning prevails in the workplace, due to the criticism of cognitive learning theory for not considering knowledge which is constructed socially in practice, it is assumed not to offer a complete account of learning and thus foreground engineers' learning in practice. This led to me review practice-based studies generally and knowing in practice specifically.

Having outlined this, **section 2.3** then critically analyzed knowing in practice (Gherardi 2000, 2006, 2009a, Orlikowski 2002, Strati 2003, 2007). The section first reflected on the theoretical foundations of the concept of practice and its implications for learning, definitions of practice and the evolution of PBS. This laid the foundations to analyze key aspects of the process of knowing in practice. **Sub-section 2.3.4** thus analyzed key aspects of knowing in practice, including participation in practice and the union between mind and body, as informed by Dasein's term 'there-being', and the construction of knowledge not only through thoughts but through the body and emotions as well; the construction of tacit knowing; practice as a shared and relationally organized activity among human and non-human actors, situated in a time and a place, recursive but emergent, and embodied; the constitutive entanglement of social and material agents; and the role of context.

Similar to cognitive learning, knowing in practice is also found to offer a complete account of learning and thus foreground engineers' learning in practice due to being in sharp contrast to cognitive learning (Marshall 2008) and having complete reliance on social learning in practice. On the other hand, there is large amount of knowledge assumed to be constructed through cognitive processing in practice.

This then led me to develop the rapprochement between cognitive learning and knowing in practice in **section 2.4** on the basis of distributed cognition (Hutchins 1995) and the collective mind (Weick & Roberts 1993). Distribution cognition argues that the cognitive processing going on in one's head is coordinated and inter-linked to the cognitive processing going on in another individual's head, often through technological artefacts in performing socially organized work collectively (Hutchins 1995). Meanwhile the collective mind is heedful interrelation of cognitions of members of a team performing collective teamwork (Weick & Roberts 1993).

Another issue which seems to be significant is the equal consideration of explicit knowledge, in addition to tacit knowing, in knowing in practice, which is covered in **section 2.5**. The main literature on knowing in practice (e.g. Gherardi 2000, 2006, 2009, Orlikowski 2002, Strati 2003, 2007) predominantly focuses on tacit knowledge and does not explicitly acknowledge the role and creation of explicit knowledge in practice. However, there are practice-based studies (e.g. Cook & Brown 1999, Sole & Edmondson 2002) that explicitly acknowledge the role of explicit knowledge in practice. Cook and Brown (1991) even argue for a generative dance between the epistemology of possession (explicit knowledge) and the epistemology of knowing (tacit knowing), as well as arguing that one type of knowledge can be used as an aid to create a similar or other type of knowledge in practice. **Sub-section 2.5.2** thus developed the interaction between explicit and tacit knowledge in performing a practice. The knowledge spiral (Nonaka & Takeuchi 1995) and the concept of a generative dance between explicit knowledge and tacit knowing (Cook & Brown 1991) are used to reflect on how two types of knowledge interact and play their roles, as well as their creation in performing a practice.

Having outlined the theoretical lens for this research, I argued that ‘individual learning in practice’ is the unit of analysis in **section 2.6**. Since, engineers’ learning is informed by the rapprochement between cognitive learning and knowing in practice, which argues for the individual and a practice as their respective units of analysis, the current research is also informed by the rapprochement between both units of analysis, i.e. individual learning-in-practice.

Then, **section 2.7** reviewed existing literature to identify research gaps and ways to address them and inform the research questions and methodology of this research. The first **sub-section, 2.7.1,** reviewed empirical literature in the field of knowing in practice and reported that existing studies are solely informed by knowing in practice without acknowledging cognitive learning and explicit knowledge. And so all these studies, except one, were done based on an ethnomethodology framework. However, it is argued in that sub-section that the current research, being informed by the rapprochement of cognitive learning and knowing in practice as well as equally acknowledging explicit knowledge, follows a critical realist form of enquiry based upon semi-structured interviews to explore the underlying mechanisms of engineers’ learning in practice. Further, the current research, unlike earlier studies, explores knowing in practice in the context of an international consultancy alliance wherein practice is resituated after the integration of local and foreign practices and emerges in another context.

The next **sub-section, 2.7.2,** reviewed a single study exploring the cross-border transfer of practices that informs the research question, i.e. 'How are practices shared across borders?' The current research contributes to this field in many ways, such as studying the sharing of practices instead of their complete transfer and the integration of local and foreign practices instead of completely ignoring local practices, in a different loosely-coupled international consultancy alliance, and in an era of significant advancement, after earlier studies in the field of information and communication technologies that could be used in international alliances.

Sub-section 2.7.3 reviewed both theoretical and empirical literature on cross-border sharing of knowledge to inform the research question, i.e. 'How is knowledge shared across borders?', as well as to inform the methodology of the current research. The theories, models and concepts in this field argue for a large number of aspects influencing cross-border sharing of knowledge which have also been explored by empirical studies. However, existing literature in this field is predominantly quantitative in nature, which does not provide in-depth insights into the ways in which these aspects influence cross-border sharing of knowledge. Having identified that, the current research contributes to this field through qualitative critical realist enquiry for digging deep into underlying mechanisms as well as the processes/ways in which they make this knowledge- sharing happens.

The literature review informs the main research question related to engineer's learning, in sections 2.2 to 2.6, while it informs the sub-question in sections 2.7.2 to 2.7.3. On the other hand, the chapter sets the stage for the research methodology to deal with practical aspects of this research.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The objective of this chapter is to choose research methods and techniques, including a research approach, a research strategy and data-collection and data-analysis methods, which are consistent with the current research. The research follows a qualitative approach as the objective of this research is not to produce generalizable findings through collecting numeric data from a larger sample. Instead, it aims to examine the 'how' nature of the research questions posed in Chapter 1 through digging deep into the phenomenon under study and producing in-depth context-specific findings. The chapter also chooses research methods, including a single case study, to explore the phenomenon under study and its underlying structures and mechanisms in a rigorous manner.

Further, the chapter presents NESPAK, Pakistan as the research organization (case company), its engineers involved in an international consultancy alliance are the target participants who are approached through purposive and snowball sampling techniques. In addition, data-collection techniques including semi-structured interviews, observation and field notes, and documentary analysis have been argued to be suitable to collect qualitative in-depth data. To analyze the data, I chose a Straussian version of Grounded Theory and its coding methods, which are used to code data and develop categories and core categories. At the end of the chapter, research evaluation and research ethics applied in this research are discussed, followed by a conclusion which summarizes the arguments presented in the whole chapter for the chosen research methods.

3.2 Critical Realism – Philosophical Position of the Research

A relatively new research philosophy in the social sciences, Critical Realism, informs this research because of its aspects of causation and the retroduction mode of inference (Bhaskar 1978, Danermark 2002, Easton 2010, Sayer 2000). Critical realism (CR) was initially introduced by Roy Bhaskar (1975, 1978), who originally entitled his philosophy as ‘transcendental realism’. The philosophy believes that there are deep-rooted realities, processes and mechanisms that lie beneath the actual (events that occur) and the empirical (what is experienced).

Critical realism offers better ontological and epistemological positions for the current research relative to those of traditional philosophies of positivism and interpretivism. Positivism research philosophy can identify changes between two variables. An analysis of variables can only show quantifiable change, it cannot tell us how change happened (Sayer 2000). In other words, positivism does not support the exploration of deep-rooted realities that lie beneath empirical experience (engineers’ learning) and make it happen. Thus, the research questions, i.e. ‘How do engineers learn?’ and ‘How do different factors influence knowledge sharing in NESPAK’s consultancy alliances?’, could not be answered from a positivist philosophical position. The traditional alternative to positivism, interpretivism, also does not serve the purposes of this research because it rules out the likelihood of knowing what is real, denies the likelihood of discerning causality, interprets the world in its own way and offers its own interpretations (Easton 2010). The interpretation may be different from the reality. That said, interpretivism seems to deny a causal relationship between engineers' learning and the underlying processes and mechanisms that enact it or make it happen.

Thus, it is Critical Realism that helps to find a causal explanation for the phenomenon under study, i.e. what makes the phenomenon like this (Sayer 2000). Bhaskar (1978) argues that reality is stratified into three strata i.e. 'real', 'actual' and 'empirical' with their own specific residents i.e. mechanisms, events and experiences respectively. Bhaskar (1978) explains that events (the level of the actual – the second stratum of reality) are caused by their underlying real entities, events, processes, structures and mechanisms, while the empirical experiences are caused by actual events.

Thus, critical realism gives a causal explanation of the underlying realities which compel the researchers to observe the reality through its outcomes (empirical experiences and actual events). Kurki (2007) argues that to understand a causal explanation, both natural and social scientists need to unearth a deep ontology – the nature of deep truth, which involves explanations of unobservable structures causing observable events and empirical experiences to occur. The aim of critical realists, according to Delorme (1999), is *"not to identify generalizable laws (positivism) or to recognize the lived experience or beliefs of social actors (interpretivism); it is to develop [a] deeper level of explanation and understanding"*.

Having outlined the causal explanation aspect of critical realism, it can be inferred that critical realism is consistent with the objectives of the current research, which are not only to explore the surface-level realities of engineers' learning but also to offer a rich understanding and descriptions of deeply located underlying realities that make engineers' learning happen. In other words, the aim of the current research is not only to study engineers' learning but also to explore its causal explanation via different underlying processes in performing engineering consultancy in international consultancy alliances. This is not a successionist view of causation involving *"regularities among [a] sequence of events"* (Sayer 2000, p.13) or 'when A, then B' (Bhaskar 1978). Instead, it is like a critical realist view of causation that is influenced by various external enabling conditions because of the nature of open social systems (Sayer 2000). In this way, the current study intends to develop deep insights into and explanations of engineers' learning through understanding complex underlying processes that have the role of external enabling conditions of the social world. A critical realist philosophical position thus seems to better serve the aims of this research.

Critical realism does not have a flat but a stratified ontology and classifies ontology into real, actual and empirical (Bhaskar 1975). We only know one part of a thing, we do not know the structures and mechanisms that lie beneath the visible real reality. Such a stratified ontology has significant implications for epistemology. Lincoln, Lynham and Guba (2011, p.98) describe the ontological assumptions of critical realism as *"real reality: only imperfectly and fallibly apprehended"* and its epistemology as *"subjectivist: critical tradition. Findings have tendencies anchored in context."* Philosophically, critical realism is very different from positivism and interpretivism, yet it acknowledges some aspects of both of these competing paradigms (Simm 2009). It combines naturalism, though in a modified form, and interpretive understanding (Sayer 2000). In simple words, ontologically endorses realism (reality is mind-independent and exists out there) and epistemologically accepts constructivism (the social reality is significantly constructed through our beliefs and viewpoints).

This defines how critical realism acknowledges aspects of positivism and interpretivism; however, it is necessary here to differentiate it from competing paradigms. The key feature of any form of realism is that the reality is out there and independent of our knowledge of it (Blaikie 2007, Easterby-Smith et al. 2012). This is true for the natural sciences where scientists measure objects directly with various measurement systems (Sayer 2000). For the social sciences, however, critical realism modifies its position and also acknowledges the social construction of reality (Simm 2009). This does not mean that the reality is only socially constructed; instead, a researcher has to examine different chains of durable associations enacting it because various consensuses, artefacts and many other things/ elements contribute to finalizing the reality. This is similar to what is argued by Sayer (2000, p.17), that *"there is always an interpretative or hermeneutic element in social science".*

The reality does not speak for itself; rather, science always attempts to observe, register and report the reality (Danermark 2002). The ability of scientists to *"analyze, abstract, relate, interpret, and draw conclusion is a fundamental precondition for all knowledge* *and knowledge development"* (Danermark 2002, p.79). Since research based on critical realism involves causal effects and explanations, and investigation of the causal structures that lie beneath actual events and empirical experience in social settings (Simm 2009), the mode of retroduction for inference seems to better serve the objectives of the current research.

The concept of retroduction was first initiated by Peirce (1932–1958), who gave the example of various metals and decomposition of their nature to know what made them like that, as well as the characteristics of a body as 'simple', and then to explore its compound nature to know what makes a body simple (1.68). The retroduction mode of inference involves exploration from consequences to antecedents. There is much evidence of its application in history (Psillos 2007). For instance, police start their investigations from after a crime and work backwards to identify the criminals (Danermark 2002); and medical practitioners start investigating arthritis from consequences (empirical experience of pain and de-shaped joints) to the actual events (Rh factor) and finally to the real entities (complex molecular changes in the body), their structures (complex relationship of entities) and generative mechanisms (ways of activating power) that increase Rh factor (Williams 2005).

Bhaskar (1989) is also of the view that since critical realist research involves exploring the causal structures and mechanisms that lie beneath empirical experiences and social events, and which are not directly observed, researchers need to follow an 'effects-to-cause' method and understand social events and experiences to know them, as argued by the retroduction mode of inference. The relationship of retroduction to abduction is discussed in detail in section 3.8.1. Lawson (1997, p.236) differentiated retroduction from induction and deduction as follows:

> *"...there is concern in realist accounts, with a different form of inference to the more common induction and deduction. Whereas the latter are concerned with movements at the level of events from the particular to the general and vice versa, retroduction involves moving from a conception of some phenomenon of interest to a conception of a different kind of thing (power, mechanism) that could have generated the given phenomenon."*

The aim of the current research is not to quantitatively measure the influence of different aspects on engineers' learning but to explore the ways in which different mechanisms and processes enact engineers' learning through the retroduction mode of inference, i.e. vertical exploring from effects-to-causes (Danermark 2002). Stratified realities and their causalities can be embedded in complex nets of human and non-human actors; the measurement of these phenomena and foregrounding complex structures and power mechanisms is hard if not impossible to achieve directly. Thus, I argue that critical realism better facilitates retroducing the real entities, structures, mechanisms and processes those lie beneath engineers' learning. Additionally, theories of learning and knowledge creation are multifaceted, and they have been studied with different methods proposing different implications (Lave & Wenger 1991, Mason & Leek 2008, McQueen

1998, Nicolini 2009, Nicolini et al. 2003, Nonaka 1994). The current research, involving learning, knowledge and practice, may include more complexities when organizations cross-national boundaries in order to collectively perform an engineering consultancy with a foreign consultant in a different cultural context (Easterby-Smith et al. 2008). Hence the philosophical position of critical realism is likely to yield a better understanding of the phenomenon under study.

3.3 Qualitative Research Approach

A qualitative research approach is adopted in this research as the study, being informed by critical realism (CR), intends to study causal relationships among multi-layered realities of engineers' learning in an international consultancy alliance. The empiricist methodology is of the view that quantitative methods are well suited to measure causal relationships as they produce objective and unbiased statements. Yet qualitative researchers do not adhere to the idea of drawing inferences from simple data, instead they pursue 'qualified objectivity' in research (Roberts 2014, p.2). In the same vein, Manicas (2009) argues for reflexivity on the part of the researcher and stresses asking repeated probing questions to reveal some exclusive socially complex causal mechanisms embedded in a given context. Such reflexivity facilitates answering issues of causal explanations in socially complex and embedded relationships. Seen in this way, a qualitative research approach becomes of particular use to explore complex causality, which seems congruent with the causation notion of CR.

Moreover, Roberts (2014) states that we should explore directly observable causation between different variables in a closed system through a quantitative approach. But when researchers aim to understand causal mechanisms with ‘how’ questions, where answers are not directly observable in an open social system, we need to adopt a qualitative approach. In the social world, causality is often examined through an open real context where different structures and sub-structures are integrated into a complex network, work together and generate visible outcomes. Such outcomes are not only the result of their underlying structures as their relationship is moderated by various other social structures (Sayer 2000). CR also acknowledges the fallibility of knowledge and suggests that researchers continue the exploration of causation between different phenomena across the world (Benton and Craib 2001), whereas quantitative study believes in producing scientific laws that can be generalized over time and contexts.

Finally, considering Sayer’s (2000) differentiation between intensive and extensive research, the current study constitutes intensive research as it intends to study *“substantial relations of connection”*, which is more congruent with qualitative methods rather than *“regularities and formal relation of similarity”* (Sayer 2000, p. 21). According to (Swanborn 2010), intensive research involves exploring the characteristics of the social environment in a transitory interpretation by different social actors known as stakeholders. In social research, a story in such research is often the result of negotiation between a subject (a researcher who asks questions) and an object (whom/what is being researched). Thus, it can be viewed that intensive research is not simply collecting data through a survey; rather, the phenomenon needs to be discussed in detail, between the researcher and what is being researched, to have in-depth insights.

Keeping the aforementioned arguments in mind, a qualitative research approach has been adopted as it is suitable to explore a socially complex and context-embedded causal relationship about how different structures and mechanisms enact engineers' learning in an international consultancy alliance.

3.4 Competing Research Strategies and Rationale for Case-study Research

Scholars (e.g. Bryman & Bell 2011, Creswell 2013, Easterby-Smith et al. 2012, Merriam 1998, Saunders et al. 2012) stress choosing a compatible research strategy when conducting research. Creswell (2013, p.106) proposes five different strategies to conduct research: *"narrative, phenomenology, grounded theory, ethnography and case study"*. These research strategies are of great value in qualitative research; however, research objectives are difficult to achieve if a researcher chooses a strategy that is incompatible with the research questions. Each research approach has its own worth to conduct a particular form of research. For instance, Creswell (2013) states that a narrative approach is applied to study the life events of an individual; phenomenology focuses upon a phenomenon or concept and studies the lived experience of people regarding that phenomenon; a theory is developed using grounded theory; ethnography is preferred to examine a group having the same culture; and the scope of a case-study strategy covers the examination of single or multiple cases where the researcher intends to examine an issue of a case, or a complete case, by explaining the complexity of the issue (Creswell 2013).

Yin (2003, P.13) states that a case study

> *"…investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident".*

A case-study strategy works well when a researcher is aiming to study a clearly bounded case (Asmussen & Creswell 1995), rather than *"complex, phenomena such as organizations, interorganizational relationships or nets of connected organizations"* (Easton 2010, p.123). The boundaries of a case are often not well known before approaching it. For instance, if the objective of research is to examine a single phenomenon in one or multiple cases, the boundaries of the case, including relevant phenomena, relationship and issues, may not be clear before approaching the empirical world. Using a case-study strategy, the researcher has the flexibility to deal with emergent relationships and phenomena during the course of research. That is why it is suggested to acquire comprehensive/ detailed information about the case to offer a holistic picture (Stake 1995). Further, as the research questions identified in the first chapter are based upon 'how', a case-study strategy offers me an opportunity to answer such questions through disentangling or teasing out a complex set of pre-conceived as well as emergent relationships and phenomena related to engineers' learning through the analysis of holistic information (Yin 2003).

3.4.1 What is a Case Study and why a Single Case?

A case study is the:

> *"…study of [a] social phenomenon carried out within [the] boundaries of one social system (the case), or within the boundaries of [a] few social system[s] (the cases), such as people, organizations, groups, individuals, local communities or nation-states in which the phenomenon to be studied exists"* (Swanborn 2010, p.13).

A case study in a research project can be a single or a set of individuals, organizations, communities or nation-states that the researcher intends to study. Such an individual event or organization does not necessarily have to be a single actor constituting a case, because a phenomenon may sometimes involve several people and/or collective actors. Each single or multiple case-study strategy has its own unique features which serve a particular research design. Easterby-Smith et al. (2012, p.54) state that:

> *"Advocates of [a] single case generally come from a constructionist epistemology; those who advocate multiple cases usually fit with a more positivist epistemology".*

The current study is informed by CR, and a single, non-linear, case-study strategy based upon systematic combining, as proposed by Dubois and Gadde (2002, 2014) is preferred to conduct this. On the other hand, the linear case-study approaches, as proposed by Yin (2003) and Eisenhardt (1989), are inconsistent with the current research for many reasons.

For example, for Yin (2003),

> *"[a] case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context"*.

This definition from Yin (2003) focuses on contemporary events and practices. In this way, Yin (2003) isolates the case from its history. On the other hand, Dubois and Araujo (2004) argue that contemporary events and practices are embedded in their historical context. Another inconsistency with the Yin's case-study strategy is that it is a linear approach, consisting of different sequential steps, starting from identifying the research questions to theoretical model development, data collection and analysis, and to the final write up. Some steps may though overlap, for instance data collection and data analysis, yet the overall research process is linear (Yin 2003).

On the other hand, a single case-study strategy based upon 'systematic combining' which is defined as *"a non-linear, path-dependent process of combining efforts with the ultimate objective of matching theory and reality"* (Dubois & Gadde 2002, p.556). Matching involves moving back and forth between a co-evolving theoretical model and data collection and analysis to create a fit between theory and data (Dubois & Gadde 2002). Systematic combining in this single case-study research helped me bring to the fore the complex relationship between engineers' learning and its underlying causal structures and mechanisms through exploration of the emerging case's boundaries, surprises, inclusion and exclusion of different actors, their changing roles and emergent features of the case.

To understand systematic combining in more detail, two research approaches are presented: one is *"tight and pre-structured"* (Miles & Huberman 1994, p.16). This involves complete compliance with pre-conceived theoretical assumptions and does not allow the researcher to go beyond predetermined boundaries. Thus, it is more closely aligned with deductive positivist research, in which a theoretical framework and hypotheses are established before approaching a case. Miles and Huberman criticize this research approach as it can *"blind the researchers to important features in the case or cause misreading of local informants' perceptions"* (Miles and Huberman 1994, p.16).

The other research approach is described by Miles and Huberman (1994, p.116) as being *"loose and emerging"*, which is closer to inductive grounded theory (Glaser & Strauss 1967). Such a loose research design might result in *"indiscriminate data collection and data overloading"* (Miles & Huberman 1994, p.116). In order to address this issue, Dubois and Gadde (2002) propose an abductive research approach which is developed by taking one component from each of the aforementioned approaches to make it 'tight and emerging'. The rationale for research to be tight is that *"tightness reflects the degree to* *which the researcher has articulated his preconception"*, while the reason for emergent characteristics of research is that "*empirical observations inspire changes of the view of theory and vice versa"* (Dubois & Gadde 2002, p.558).

Such a tight and emerging research approach is found to be more suitable in this research. With tightness, I entered the field with some preliminary questions conceived from a review of existing literature, theories and models. At the same time, the emergent nature of the literature review allowed me to remain open, so I experienced fuzzy boundaries of the case, an uncertain environment, new issues and novel solutions, because change and development continue to shape and reshape the organizational and social world. Thus, I changed the boundaries of my case during data collection and incorporated some surprising developments, emergent phenomena, findings and solutions into the research, which provide better answers to the research questions. It might not have been possible to answer the research questions while staying with the initial research questions and case boundaries.

Further, though a multiple case-study strategy (Eisenhardt 1989, Yin 2003) argues for the replication and extension of findings among other cases, advocates of a classic single case design question this argument by contending that observations in the social world are of a unique nature and thus *"the principle of replicability would become [a] strait-jacket that impedes rather than enhances [the] social sciences"* (Tsang & Kwan 1999, p.761). The same research cannot be repeated by the same or another researcher because the social world is continuously changing, and this may involve some surprises and elusiveness. Further, discussing generalizability, Flyvbjerg (2006) argues that researchers overvalue generalizations based upon either single or multiple cases and undervalue the strength and rigour of examples analyzed in a case.

Moreover, the positivist and linear schools of thought argues that multiple cases should be used instead of a single case for generating a theory. Proponents of these schools of thought (e.g. Yin 1994, 2003, 2009) and Eisenhardt (1989) claim that findings generated from multiple cases are more valid, and studies using multiple cases are more rigorous and provide researchers with greater confidence to generate new theory. Eisenhardt claims in this regard that:

> *"…between 4 and 10 cases usually works well. With fewer than 4 cases, it is often difficult to generate theory with much complexity, and its empirical grounding is likely to be unconvincing, unless the case has several mini-cases within it".* (Eisenhardt 1989, p.545).

The claim of these theorists regarding using multiple cases is based on the view that more cases provide more constructs, and thus findings can be better generalized. However, Dyer and Wilkins (1991) criticize the multiple case-study strategy proposed by Eisenhardt (1989) in a number of ways. They question the certain number of cases necessary for theory generation by giving various examples of previous renowned studies (e.g. Blau 1955, Crozier 1969, Kanter 1977, Lipset et al. 1956, Whyte 1943) in which theories were generated on the basis of a single case. A single case study seems more appropriate to generate a theory involving digging in depth into a complex relationship of the phenomenon understudy in a single case.

Given the aforesaid arguments, a non-linear single case-study strategy based on systematic combining has been used due to its better consistency with the current research.

3.5 Case-study Company – NESPAK, Pakistan

In order to proceed, in the section below I will give a brief introduction to the case-study company for this research, i.e. NESPAK, Pakistan, and argue why the company is a suitable case to study and helps answer the research questions.

National Engineering Services Pakistan (Pvt) Ltd (NESPAK) was established in 1973 and is known as a leading engineering consultancy company in Pakistan (NESPAK 2015a). Since it began, the company has developed in global stature as it is ranked among the top ten engineering consultancy companies in Asia and Africa, and among the top 200 consultancy firms in the world (NESPAK 2015b). The core objective of the company, since the start, has been to help professionals in all disciplines of engineering to develop and become self-reliant in the engineering field and replace foreign consultants with local ones. The company has successfully completed 3,309 projects (NESPAK 2017a). It was the first Pakistan-based engineering consultancy company to achieve ISO 9000 QMS Certification in 1998, and it is still certified by ISO 9001:2000 (NESPAK 2017b).

NESPAK is organized into eleven different divisions and specializes in almost all disciplines of engineering, having a *"power and mechanical division, water and agriculture division, architecture and planning division, highways, bridges, airports and seaports division, environmental and public health engineering division, engineering for industry division, heating, ventilation and air-conditioning division, information technology division and geographical information system division"* (NESPAK 2015c, p.1). At present, there are 4,702 full time employees of which 3,222 are qualified professionals in the fields of engineering, economics, geology, planning, architecture etc. (NESPAK 2017c).

As an engineering consultancy, the core business of NESPAK is to develop feasibility reports, concept designs and drawings for engineering projects. The engineering consultancy also includes site supervision of projects to ensure that projects are being executed according to their concept design and addressing key issues that emerge during construction work. The company's first project was to develop a concept design for the left-bank irrigation tunnel at the Tarbela Dam in 1973 at the behest of the then Prime Minister of Pakistan, Mr Zulfiqar Ali Bhutto. Prior to this, a joint venture of four multinational firms, 'Tippetts, Abbett, McCarthy and Sharton', commonly known as "TAMS", was working on the project.

Mr. Bhutto assigned this project to NESPAK with the intention of kick-starting self-reliance in engineering consultancy at a national level. The company handpicked various renowned engineers at the time from government departments and private companies, as well as Pakistan-based engineers who were working abroad. The successful completion of this project and two others, including the construction of Port Qasim and the Karachi Steel Mills building, was a breakthrough for the company. Since then, NESPAK has been offering cost-effective, practicable and realistic solutions to its clients. For the Port Qasim project, the company was lacking in the required skills and knowledge, so it identified a Pakistan-based engineer who was then working in the U.S. At NESPAK's request, the engineer came to Pakistan, shared the required knowledge and expertise with local engineers and worked collectively with local engineers to execute the project.

The engineering world is continuously evolving. On the other hand, NESPAK, being an organization in a developing country like Pakistan, is far behind the consultancy organizations of the developed world in term of innovation, state-of-the-art technologies, engineering methods and the capacity to perform complete consultancy work independently in the modern era. Yet clients require the latest technologies to increase the efficiency of projects. This leads NESPAK to form consultancy alliances with foreign consultancy organizations for those areas where NESPAK lacks the required capacity and knowledge. Hence, a project team/community is formed comprising local engineers and foreign experts to work collectively for the provision of engineering consultancy. NESPAK's engineers learn modern engineering methods and technologies, and their usage/installation, whilst working collectively with foreign experts, and thus they become more self-reliant to undertake similar projects in the future.

Thus, the main research questions identified in first chapter aligns well with NESPAK as it can be argued that the company, from the start, has believed in learning state-of-the-art engineering knowledge from foreign partners in consultancy alliances. There are numerous examples in which NESPAK's engineers learnt modern engineering methods and technologies from foreign partners in projects, while in subsequent similar projects they performed consultancy work independently, implying that sufficient learning had taken place while working together with foreign experts on earlier projects. This indicates a good case for engineers learning in international alliances, and the study argues that these examples fit well with a case-study research strategy.

3.6 Target Population and Sampling Techniques

3.6.1 Access to the Research Organization

Pakistan Engineering Council (PEC) has registered 1,963 engineering consultancy companies operating in Pakistan. However, NESPAK and DESCON are the two main Pakistan-based multinational engineering consultancy companies operating in Pakistan and abroad. Although both of these companies have completed major projects in Pakistan, NESPAK has relatively more major government infrastructural projects to its credit in which new technologies were installed and new engineering methods deployed to complete them. These projects include major dams and hydropower plants, power-generation plants, motorways, Metro Bus, Orange Line Train and the like. In every project, the government requires maximum efficiency through the application and installation of state-of-the-art engineering methods and technologies. Due to the unavailability of such expertise at NESPAK or the Pakistan level, NESPAK has to form consultancy alliances with foreign engineering companies having the required expertise and experience.

As discussed in section 1.3, NESPAK has been following a policy of gaining self-reliance since it began through learning from foreign experts in international alliances so that similar projects can later be done indigenously. However, engineering methods and technologies continuously evolve and so NESPAK has to constantly rely upon foreign companies for technologically advanced projects due to the specific technological requirements of each project. As a result, NESPAK's engineers are constantly learning modern engineering methods, activities and technologies related to engineering consultancy alliances. Such a substantial account of learning in performing engineering consultancy in international alliances is expected to offer significant insights into the phenomenon under study.

The most critical issue in any study is to enter the empirical world. To this end, the case firm was approached formally by presenting: call for invitation/sample letter to the research organization for approval of fieldwork (attached as Appendix II); recommendation letter from research supervisor (attached as Appendix III); participant's information sheet (Appendix IV); participant consent form (Appendix V), preliminary interview guide (Appendix VI), and final interview guide (Appendix VII) for approval of the fieldwork. However, this was not an easy process as there was no answer to my formal request after two months. Then, I visited the HR office in person and met one of the HR managers. The HR manager was convinced that my research topic was not sensitive but purely educational and could offer significant benefits to the organization. But he was not ready to grant formal approval, saying there was no formal policy to accommodate researchers like me. It is also found that being more formal and presenting the aforesaid documents formally make organizational personnel more conscious and alert. In return, they start thinking that the researcher intends to study some serious or sensitive issues in their organization. This often results in less likelihood of permission to do fieldwork.

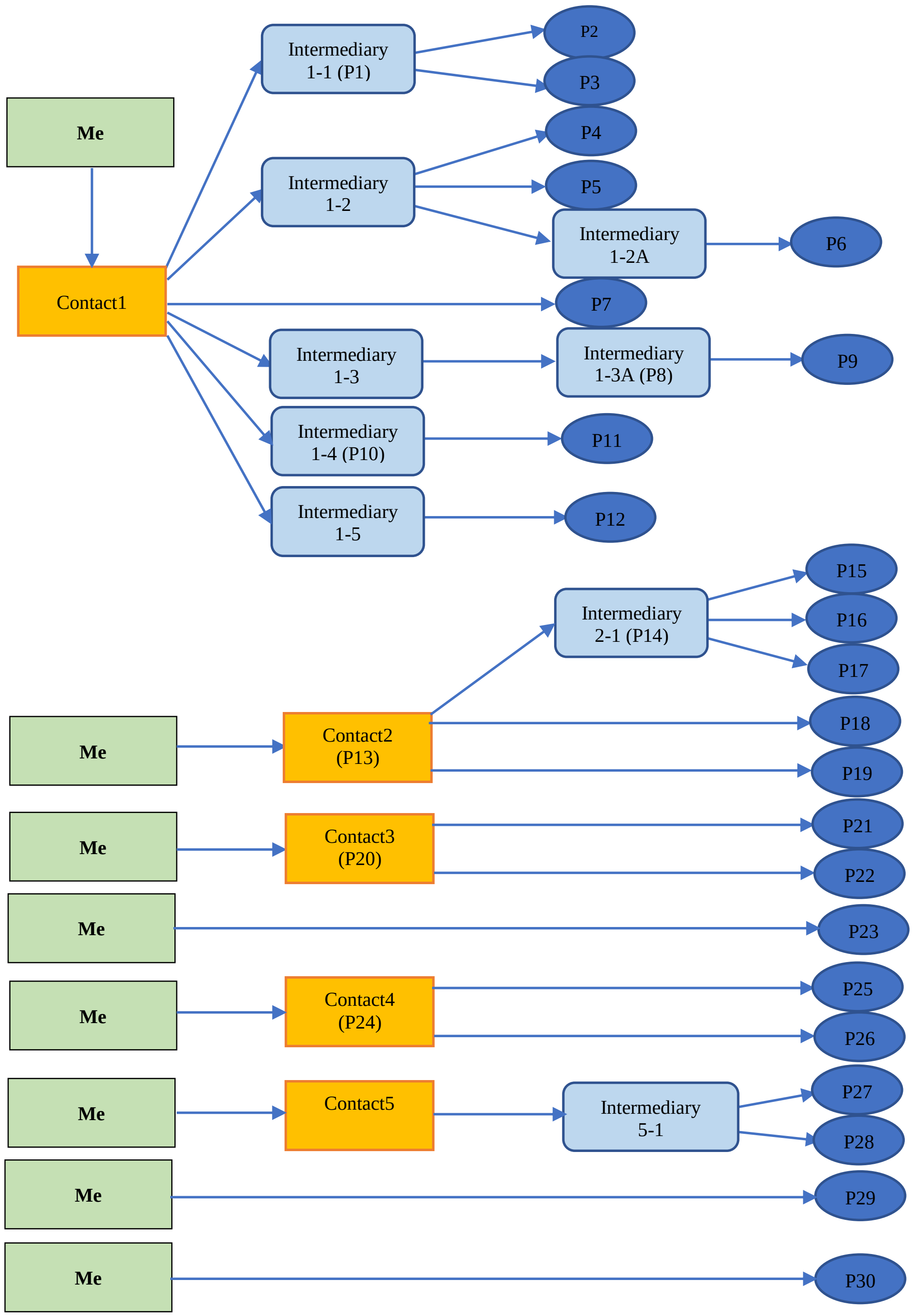
However, after the initial refusal, I searched for an informal contact through which the VP was again approached, as suggested by Easterby-Smith et al. (2012). This time, he was still unwilling to issue formal approval, but he informally/ verbally allowed me to approach and interview the participants on my own. He also made it clear that the HR department would not extend any support to approach the participants. The process took six months, as it started in January 2015 and I succeeded in conducting the first interview on 18 June 2015.

3.6.2 Sampling Techniques and Approaching Participants

To select the research participants, a combination of purposive and snowball sampling techniques was used. Using purposive sampling, I approached only those participants who were *"information-rich from which one can learn a great deal about issues of central importance to the purpose of the research"* (Patton 1990, p.169). Further, potential participants were required to have the capacity to contribute to developing a theory on the phenomenon under study (Bogdan & Biklen 1998). Thus, those NESPAK engineers were approached who collectively worked or presently were working with engineers from foreign consultant partners on local projects, wherein state-of-the-art engineering methods and technologies were used or installed. So, these were the ‘eligibility criteria’ (Easterby-Smith et al. 2012) for a participant to become part of the study.

Until then, I had developed some contacts in NESPAK. Those contacts initially arranged research participants whom they knew fulfilled the aforesaid eligibility criteria; otherwise, as an outsider, I had no idea about the participants and their potential to provide valuable data for the research. Thus, snowball sampling was used to locate such information-rich individuals. The process was started by asking my initial contacts: *“Who knows a lot about”* learning in an international consultancy alliance and *“Whom should I talk to?”* Patton (1999, p.176). As reflected in **Figure 3.1** a total of five contacts were used who arranged 27 participants including some of the initial contacts themselves, as well as intermediaries as research participants. In addition, I personally approached and interviewed three participants about whom I came to know from other participants that they had certain experience of learning. Thus, total thirty interviews were conducted from ten local infrastructural projects. The project detail is given in Appendix I. In **Table 3.1,** I give details of each participants.

Figure 3.1: Approaching participants through snowball sampling



Source = Employee of NESPAK who was approached through a personal contact.
Intermediary = NESPAK's engineers to whom I was referred to by an initial source.
P = Research participant
In the boxes for some sources and intermediaries, 'P' is mentioned, reflecting that s/he is a research participant too.

Table 3.1: Details of Participants and Projects

Participants No.	Participants' Pseudonym	Age Group	Education	Gender	Interview Date	Project
1	Arif	51-60	Graduate (M.Sc Engineering)	Male	7/9/2015	HVDC
2	Hammad	31-40	Graduate (M.Sc Engineering)	Male	7/14/2015	SHPP
3	Nayyer	51-60	Undergraduate (B.Sc Eng	Male	7/30/2015	SCADA
4	Akram	51-60	Graduate (M.Sc Engineering)	Male	8/5/2015	HVDC
5	Haroon	41-50	Graduate (M.Sc Engineering)	Male	8/11/2015	Mangla Dam Raising Project
6	Murtaza	31-40	Graduate (M.Sc Engineering)	Male	8/25/2015	Gambella Irrigation Project
7	Shafqat	41-50	Graduate (M.Sc Engineering)	Male	8/26/2015	Jallalpur Irrigation Canal Project
8	Maqsood	Above	PhD	Male	10/4/2015	FEWS
9	Yawer	31-40	Graduate (M.Sc Engineering)	Male	10/17/2015	FEWS
10	Muneeb	31-40	Graduate (M.Sc Engineering)	Male	11/12/2015	Bhikki Power Plant Project
11	Shahbaz	41-50	PhD	Male	9/19/2015	NJHPP
12	Ashfaq	41-50	Graduate (M.Sc Engineering)	Male	11/27/2015	Bhikki Power Plant Project
13	Adeel	51-60	Graduate (M.Sc Engineering)	Male	12/11/2015	Murree Cable Car Project
14	Nasir Hussain	41-50	Graduate (M.Sc Engineering)	Male	12/1/2015	Refurbishment of Mangla Dam Turbines
15	Asad	20-30	Undergraduate (B.Sc	Male	12/14/2015	Refurbishment of Mangla Dam Turbines
16	Manzoor	51-60	Graduate (M.Sc Engineering)	Male	12/30/2015	LBDCPP
17	Waseem	31-40	Undergraduate (B.Sc	Male	12/31/2015	Organe Line Metro Train Project
18	Ayla	31-40	Graduate (M.Sc Engineering)	Female	12/31/2015	Organe Line Metro Train Project
19	Abdus Sattar	51-60	Graduate (M.Sc Engineering)	Male	1/1/2016	Dasu Hydro Power Project
20	Aazaad	20-30	Graduate (M.Sc Engineering)	Male	1/6/2016	Organe Line Metro Train Project
21	Abdullah	31-40	Graduate (M.Sc Engineering)	Male	1/7/2016	Organe Line Metro Train Project
22	Majid	31-40	Graduate (M.Sc Engineering)	Male	1/13/2016	Organe Line Metro Train Project
23	Mohsin	31-40	Graduate (M.Sc Engineering)	Male	1/21/2016	NJHPP
24	Aamna	31-40	Graduate (M.Sc Engineering)	Female	1/26/2016	Kot Addu Thermal Power Project
25	Kashif	31-40	Graduate (M.Sc Engineering)	Male	8/5/2015	Water Treatment Project
26	Anwaar	31-40	Graduate (M.Sc Engineering)	Male	10/12/2015	Mangla Dam Raising Project
27	Zaidi	51-60	Graduate (M.Sc Engineering)	Male	12/21/2015	Murree Cable Car Project
28	Aqeel	31-40	Graduate (M.Sc Engineering)	Male	1/16/2016	Organe Line Metro Train Project
29	Iftikhar	Above	DAE	Male	1/31/2015	Remodelling of Warsak Canal
30	Naveed	31-40	Graduate (M.Sc Engineering)	Male	1/18/2016	Organe Line Metro Train Project

3.7 Data Collection

3.7.1 Data-collection Methods

Case-study strategies are eclectic in terms of the types of data to be collected and different data-collection tools, including in-depth interviews, researcher's observation, analyses of documents, archival and physical artefacts, can be applied (Easton 2010, Yin et al. 1994). Creswell (2013) argues for multiple data-collection methods, including interviews, observation, records and artefacts for case-study research. Data-collection methods are not only decided on the basis of the nature of the research but also on the researcher's interest and ability, which play a vital role in selecting appropriate data-collection technique(s) (Robson 1999). Similarly, Easterby-Smith et al. (2012) contend that the collection of qualitative data through interview is difficult if researchers do not have skills in conducting, organizing and structuring interviews and the ability to avoid bias. Relative to survey methods, an interview technique has many potential advantages, though some disadvantages. Ruspini (2004) suggests that interviews support the collection of large volumes of data quickly and facilitate the researcher having a deep understanding of the phenomenon under study; and they offer follow-ups, if required, for further explanation.

Similarly, Yin (2010) contends that a semi-structured interview technique is flexible and allows the researcher to collect data on wide-ranging factors. However, an interview technique may be criticized as more time and resources are required as well as the inability of the researcher to ask 'how' questions and request further details, if needed, purposively (Ruspini 2004). To address such limitations, Easterby-Smith et al. (2012, p. 136) suggest six key elements to improve the effectiveness of an interview, they mention *"obtaining trust, being aware of social interaction, using the appropriate language, getting access, choosing the location for the interviews and recording interviews"*. I understood these necessary skills before starting data collection and remained mindful of them during the whole process.

Considering the complex nature, aim and objectives of this case-study research, it was appropriate, perhaps required, to use within-method triangulation. Within-method triangulation is defined as using a variety of independent data-collection methods from the same research tradition to measure the same variables or phenomena (Denzin 1970). Thus, different methods, including semi-structured interviews, observation, field notes, informal discussions and document analysis, are used to collect data as suggested by different methodologists (e.g. Graneheim & Lundman 2004, Creswell 2013). Triangulation also helped me to verify data and confirm findings as the validity of data and research findings increases if findings are confirmed from multiple sources, and reliability may be assessed through cross-checking the internal consistency of data (Denzin 1970, Breitmayer et al. 1993, Jick 1979, Yin 2003).

Further, since a broad brush could not serve the objectives of this complex research, utilising a number of iterations of the aforesaid methods was found to be useful to study learning and its underlying structures and generative mechanisms (Graneheim &

Lundman 2004). It is possible that a key aspect related to the phenomenon under study may be overlooked in one stage using one method and in another stage using another method. Since, these independent-data collection methods have different strengths and weaknesses, using several methods can result in addressing the deficiencies of one method by using another method and vice versa; and finally, this results in sufficient breadth and depth of data about the case.

3.7.2 Data-collection process

An interview guides, as reflected in Appendix VI, was initially developed to conduct, organize and structure the interviews, considering the complex relationship of engineers' learning with its underlying structures and mechanisms. Questions about pre-conceived cross-border sharing of working practices and knowledge were developed in the guide. However, the interview guide has been modified and evolved over time as I faced different issues and boundaries of the phenomenon under studied. For instance, the initial preliminary research questions and theoretical lens of this research were about *'cross-border sharing of working practice from foreign to local partners in international consultancy alliance'*. However, during field work, it was found that the main phenomenon to be studied is *'engineers' accounts of learning i.e. how do they learn in performing consultancy practice'* while *'how do different aspects influence (facilitate/hinder) cross-borders sharing of knowledge and practices'* is found to be sub-phenomenon in this research. However, I was still focusing on the practice-based perspective of learning and tacit knowledge to capture the engineers' learning but the data was also showing the role of cognitive learning perspective and explicit knowledge for engineers' learning. Thus, I included cognitive learning and explicit knowledge in my research focus to conduct the fieldwork. Another modification made in the focus of this research was removal of the influence of HRM on engineers' learning and cross-borders sharing of knowledge due to its irrelevance to the focus of this research.

The interview guide was thus modified during fieldwork and data analysis (conducted simultaneously) to put the relative emphasis on the phenomena under studied. In this way, I added some new questions while removed some existing questions from the interview guide. The final interview guide is reflected in Appendix VII. Consequently, I revised research questions, and literature review and theoretical lens of this research to ensure a match/coherence between theory (literature review and theoretical lens) and data (findings) as argued by Dubois and Gadde (2002).

Interviewees were approached directly as well as through emails and asked for appointments at a convenient time and place for the interview. The interview guide was also emailed to them after getting appointments so that they could understand the questions and gather required information and documents to make the interviews more productive. They were requested to select appointments at a time and place of their choosing. All interviews were conducted face-to-face. In total, 26 interviews were conducted at NESPAK House[11] in the offices of respective participants. As for four other

[11] NESPAK Head Office located in Lahore Pakistan

interviews, one each was conducted at the project office,[12] in a participant's house, in a public café, on a university campus (as the participant had recently retired from NESPAK and joined the university as a faculty member).

I met each participant at the given time and place. Before starting formally, I introduced myself with my card. In almost all the interviews, the participants did not read the participants' information sheet, a summary of the research work or the interview guide before the interview. Hence, I gave them a brief introduction to the research and its objectives, and to its usefulness and potential benefits for existing literature as well as for NESPAK. Ethical considerations in the research, including the confidentiality of data and anonymising participants' identities, were communicated firmly. A digital recorder was switched on with the participant's permission. Those who did not grant permission were requested to proceed in the interview slowly, so that I could take notes. Full details of ethical considerations are given later, in section 4.9.

Interviewees were first asked questions about how engineers view their learning in the context of NESPAK's international consultancy alliances. Further key questions, as shown in the interview guide, were also asked. Being informed by the critical realist philosophical position of this research, interview questions were asked to the research participants to retroduce the deep-seated real entities following the direction of effects-to-cause. This is similar to what Lawson (1997, p.236) argues, that *"retroduction involves*

[12] The project office, located near the head office, where project team including people from local partner consultancy firms also sit

moving from a conception of some phenomenon of interest to a conception of a different kind of thing (power, mechanism) that could have generated the given phenomenon".

For instance, I asked the interviewees: *how did your learning of the subject engineering methods and technologies take place?* Following that, I asked repeat and probing questions to explore its causation through the underlying actual events which were subsequently caused by deep-seated entities, structures, processes, and mechanisms. Thus, key data and in-depth insights were gained through repeat and probing questions to elicit stories that were specific to engineers' learning of state-of-the-art engineering methods and technologies, and cross-border sharing of knowledge in the context of NESPAK's projects and its international consultancy alliances.

I used a variety of interviewing techniques, such as probes, prompts and silences. I also applied 'double attention' (Wengraf 2001, p.194), which means to listen to and understand participants' responses and, at the same time, try to ensure that each question is answered adequately. In this way, the participants were given sufficient time to answer and they were encouraged to speak more and more. At times, I needed to educate them about learning theories and methods, which enabled them to identify the relevance of different learning stories related to the research topic, which they did not initially considering worth mentioning. The participants were also asked questions about context and how it influences the phenomenon under study. However, I did interrupt if the discussion started going off topic.

In addition, the participants were requested and encouraged to highlight further relevant hidden causal phenomena and their relationship with the phenomenon under study (which were not preconceived, thus not asked about by me initially). In return, they described many informal methods and processes and told relevant stories that were being used to learn in performing engineering consultancy.

Out of 30 interviews, 25 were digitally recorded with the permission of the participants for my own immersion in the data through reading, reflection, evaluation and elaboration on the transcripts (Patton 2002). For the remaining five interviews for which participants did not allow recording, I took detailed notes; and to do this, I had to stop the participants again and again. I transcribed those interviews immediately afterwards so that no answers would be missed. Even while digitally recording 25 interviews, I took notes comprising non-verbal gestures which, in addition to post-interview reflection and immediate transcription, helped me to pay double attention to participants' responses.

I reflected immediately on each interview for preliminary manual data analysis, since *"verbatim transcription of recorded interviews provides the best database for analysis"* (Merriam 1998, p. 88). As I encountered major surprises, shocks and emerging themes related to the phenomenon under study (which were not anticipated in the literature review) during my reflection, I modified the interview guide and changed the case boundaries to cater for emerging themes in the case of the very next interview. This is mentioned in detail in the *first para* of this section that the research questions, literature review and interview questions were changed/modified to ensure a match and coherence between theory and data following systematic combining (Dubois & Gadde 2002).

To complement the interviews and follow within-method triangulation (Denzin 1970), documents were also collected to compare, confirm and validate the research findings. Documents act as ‘mute evidence’ (Hodder 1998, p. 110), *“an umbrella term to refer to a wide range of written, visual, and physical material relevant to the study at hand”* (Merriam 1998, p. 112). To collect relevant documents, all participants were requested to furnish these, including project manuals/ reports, ToR of consultancy alliances, office orders, memos, emails, published data, physical artefacts and minutes of meetings etc. that might have some relevance to the phenomenon under study. In response, a few of them showed some documents on the screens of their office computers and some had photographs of project sites, while others refused due to confidentiality.

This led me to explore and collect/ download relevant documents from NESPAK’s website and the websites of other departments, newspapers and online blogs. There are 33 PDF files containing information related to projects, government policies and local sociocultural, political and legal conditions affecting projects, as well as engineers’ learning. For instance, regarding the Lahore Orange Line Metro Train Project (LOLMTP), the conditions led the project team to get involved in court cases and consequently change concept designs and drawings. Due to this, on the one hand, the learning of NESPAK’s engineers was changed because of the extra involvement in these issues; but on the other hand, these issues caused extra learning because the project team had to work more and revise the concept designs and drawings to make the project more compatible with local conditions.

Throughout the data-collection phase, I always kept a diary and pen with me and took notes of what I was watching, including the office environment, learning culture, office design, open informal communication, teamwork, availability of ICTs, workload and pressure etc. during my visits to NESPAK. I also noted the interactions between senior and junior engineers, reflecting how senior engineers empower their juniors, value their ideas, acknowledge their learning orientation and overall value their efforts towards learning new engineering technologies. I even noted the presence of textbooks and research articles in the participants' offices, their open doors and free movement of their subordinates/ colleagues into their offices to discuss issues. Further, NESPAK's quality policy reflecting its philosophy of learning state-of-the-art engineering was also observed. Later, I made field notes on the basis of observation during each interview, as part of the data, to compare, confirm and support the findings coming from the interview transcripts (Denzin 1970). The field notes comprise 7,340 words.

Apart from these observations, I personally visited two project sites of LOLMTP. The first visit was two hours long, to the underground section of the train tunnel where I saw the application of cut-and-cover technology to develop a 1.75 km long underground tunnel for the train track. I confirmed the data given by a participant regarding the underground track and cut-and-cover technology. The second project site I visited for one and a half hours the was the train depot for which NESPAK rejected the concept design and drawings received from its Chinese counterpart and instead used its own more cost-efficient design to build the base surface for the depot. During this visit, I confirmed that NESPAK does not always rely upon foreign engineering methods but can also innovate and use its own engineering methods that best fit the local context. Approximately 20 photographs and five videos taken at the two sites are part of the data set.

Further details and measures to improve the quality of data, data collection and overall research are given later in section 4.8 on research evaluation.

3.8 Data Analysis – Grounded Theory

The Straussian version of grounded theory (GT) (Strauss & Corbin 1990) is used for data analysis in the current research. The first version of GT was initially developed by two sociologists, Barney Glaser and Anselm Strauss, in 1967 (Glaser & Strauss 1967), and this opened up a new avenue to develop contextualized theories. GT offers a well-defined method to analyze data encompassing basic description, conceptual ordering and theory development (Strauss & Corbin 1998). It is preferred when researchers investigate social situations and problems (Strauss & Corbin 1990), aiming to elucidate *"how social circumstances could account for the interactions, behaviours and experiences of the people being studied"* (Benoliel 1996, p.431). Further, it helps researchers move from an account of what happens to insights into the process through which it happens (Strauss & Corbin 1998). This feature encouraged me to use it in this critical realist research in which underlying causal structures, mechanisms and processes that make engineers' learning happen are studied. Further, the consistency of grounded theory with critical realism in general, and with Straussian GT in particular, is discussed in the following section.

3.8.1 Critical Realist Grounded Theory

Despite the aforementioned advantages that GT offers to qualitative research, it is essential to develop its consistency with the philosophical position of the current research, i.e. critical realism (CR). GT is eclectic in the way that it can be operated across wide-ranging theoretical perspectives (Glaser & Strauss 1967) and traditional epistemological positions of CR, given the different philosophical backgrounds of its creators (Oliver 2011). GT lies in the post-positive school (Guba & Lincoln, 1994) *"including that of critical realism"* (Simm 2009, p.149). Kempster and Parry (2011) argue that grounded theory is best suited to critical realist research. With the continuous evolution of GT, its implications have now been developed within so many theoretical domains that it embraces wide-ranging ontological positions. It can be comfortably used in critical realist research since the philosophy is also eclectic – supporting any empirical method (Scott 2005). Further, given the symbolic interactionist[13] background of Straussian GT, critical realist GT caters for both events themselves and the meanings made of them (Corbin & Strauss 2008). Not only are events in research of importance,

[13] Symbolic interactionism involves how *"people act toward things based on the meaning those things have for them, and these meanings are derived from social interaction and modified through interpretation"* (SSSI 2017, p.1).

but the meanings given to those events by different persons, according to their views, experiences and biographies, are also important to study deep-rooted realities (Corbin & Strauss 2008). Such connection of participants with their experiences and biographies and subsequent sense-making of events can help to achieve practical adequacy through epistemic gain. Thus, while we can have better knowledge of the reality, it is still fallible because all knowledge is constructed socially through discourse (Sayer 1992).

Critical realist methodology demands conceptualization and reconceptualization (Pratt 1995) to develop practically adequate knowledge and an explanation of the reality to confirm, modify or replace pre-existing temporary, tentative and partial knowledge with new but still fallible theory (Oliver 2011). The constituents of conceptualization, such as GT's open coding, constant comparison and questioning the data, lead researchers beyond a pre-conceived understanding and help them to address epistemic fallacies. They can even avoid the most flexible interview frameworks and sampling techniques to capture emergent phenomena, participants' contexts and experiences, through which they can make meaning of a phenomenon. This is what Corbin and Strauss (2008, p.144) mention, that *"the researcher is like a detective. He or she follows the leads of the concepts, never quite certain where they will lead, but always open to what might be uncovered"*.

Such openness allows researchers to reframe the notion of saturation and accept fluidity in knowledge creation instead of a preconceived fixed method to discover a theory. As Glaser (1998) acknowledges the modifiability of all theories while Corbin and Strauss

(2008, p.x) allow researchers *"to use the procedures in their own way"*, researchers have enough flexibility during field work and analysis for conceptualization and reconceptualization to address fallibility through practical adequacy. The analysis can be stopped when the researcher realises that most of what something is covered, the context and relationship of the researcher and what is being researched have been sufficiently addressed, and so theoretical saturation is achieved.

More importantly, retroduction, being the mode of inference of a critical realist enquiry (Danermark 2002), is the key point where CR and GT are consistent. However, the classic version of GT from Glaser and Strauss (1967) and Glaser's continuous positioning with induction (e.g. Glaser 1978, 1992, 1998) make it ill-suited to a critical realist enquiry due to its retroduction mode of inference. On the other hand, Strauss, belonging to the same symbolic interactionist school as Charles Sanders Peirce, acknowledges that his abduction (Oliver 2011) is 'a route to knowledge' (Peirce 1932-1987). Easterby-Smith et al. (2012) also mention that Glaser believes in the emergence of theory *"from data itself"*, while Strauss and Corbin believe in the generation of theory from *"theorist/ data interaction"* and *"insights from many sources"*. This clearly reflects that Strauss and Corbin follow abduction instead of induction. Dubois and Gadde (2002) explain that abduction-based study

> *"requires an integrated approach, because the main difficulty of case studies is handling the interrelatedness of the various elements in the research work* (p.555) *... In studies relying on abduction, the original*

> *framework is successively modified, partly as a result of unanticipated empirical findings, but also of theoretical insights gained during the process."* (p.559)

Thus, studies following abduction need to have a preliminary tentative framework and there should be integration of framework and data through successive modifications to both to ensure systematic combining. Abduction has also been increasingly used by constructivists as the main epistemology to develop a flexible approach.

With the shift from induction to abduction, GT embraces a researcher's preconceived theoretical knowledge, hypotheses and hunches as a starting point. However, s/he must understand that such knowledge is tentative and can be replaced and modified once the enquiry proceeds.

The acceptance of abduction by GT has laid a foundation to develop consistency between CR and GT. Retroduction is an advanced form of abduction with *"a specific question in mind"* (Oliver 2011, p.10), which is 'what made something like this' or 'what made this possible'. In the social sciences, retroduction suggests vertical exploration for all possible structures and generative mechanisms located at a deeper ontological level, which makes the actual and subsequent empirical reality like this. This is not a forced stretching of GT, instead it motivates researchers to understand events and their different meanings given by different actors (Corbin & Strauss 2008). These actors can also be non-human, such as underlying social structures, generative mechanisms, overall context and their complex relationship which makes the empirical reality like this and/or gives a certain meaning to it. Further, GT proceeds from initial open coding to axial coding and selective coding of underlying deep realities, such as open and axial coding and categories which establish core categories, which is consistent with critical realist vertical exploration.

The above discussion indicates some consistency of CR with the Straussian version of GT. However, no single theory serves the purpose of a critical realist enquiry. So, I need to understand points of difference between Glaser (who remains faithful to their initial position (Glaser & Strauss 1967) and Strauss and (Corbin) who present a different version of GT. Easterby-Smith et al. (2012) summarize their points of difference, as reflected in **Table 3.2**. Thus, considering the absence of complete consistency of any of

Table 3.2: Point of differences between Glaser and Strauss and Critical Realist Grounded Theory for the current Research

Point of Difference	**Glaser**	**Strauss (and Corbin)**	**Critical Realist GT for this research**
Researcher's role	Maintain distance and independence	Active interrogation of data	Active interrogation of data collected from many sources in case-study research
Theory	Emerges from data themselves	Arises from theorist/ data interaction	Arises from theorist/ data/ context and participant/ context interaction
Ontology	The world is 'out there'	Reality and experience are constructed	The reality is real and independent of observation (for underlying real reality), but actual events and empirical experiences (upper strata of reality) are mind-dependent and socially constructed in the social sciences, thus fallibly apprehended
Pre-understanding	Avoid literature from the immediate area	Flexible approach, insights from many sources	Develop tentative theoretical assumptions and research questions before starting empirical work, as well as insights from many sources

Source: Adapted from Easterby-Smith, M. P., Thorpe, R. & Jackson, P. 2012. *Management research: theory and research,* London, Sage, p.101. Further revised by the author the GT versions, I evaluate the points of difference of both theories and their respective consistency with CR. In the following, I establish new features on the basis of the same points of difference after a little modification. These are presented in the newly added fourth column in **Table 3.2**.

It is worth mentioning that these points are still closer to Straussian GT and its features, as noted by Easterby-Smith et al. (2012), in addition to the aforesaid retroduction mode of inference. Thus, a Straussian coding method is used for the following data analysis.

In discussing the first two points, it is noted that Glaser argues for maintaining some distance from the data and discovering theory purely from data through induction (Easterby-Smith et al. 2012, Heath & Cowley 2003). In contrast, Strauss and Corbin (1998) suggest the researcher actively interrogates the data. Critical realist GT in the last column argues for the collection of data from many sources to present a holistic picture of the case (as a requirement of case-study research) (Stake 1995), in addition to active interrogation of data and existing theory simultaneous to data collection to create a fit between theory and data (Dubois & Gadde 2002). Further, Straussian GT is of the view that theory *"arises from theorist/ data interaction"* (Easterby-Smith et al. 2012, p.101). However, this is not enough, and so interaction between the participants and their construction of the reality with the context also needs to be studied because participants are strongly connected to the context and their construction of reality is embedded in its context.

As far as the third point of difference is considered, Glaser, being a strong positivist, believes that the "*reality is out there*" (Easterby-Smith et al. 2012, p.101) and independent of observation (Simm 2009). However, Straussian GT, in its later version, accepts relativist epistemology and, as Corbin and Strauss (2008, p.10) mention, *"concept and theories are co-constructed by [the] researcher out of stories that are constructed by research participants"*. So, the two versions of GT have entirely different ontological positions.

On the other hand, CR is metaphorically different from positivism and interpretivism but it accepts the features of both philosophies and draws its own distinctive features (Simm 2009). The central feature of any form of CR is its belief in the independence of knowledge. This is entirely acceptable for the natural sciences, but CR somewhat modifies its position in the social sciences (Simm 2009) and believes that reality is socially constructed and such knowledge is fallible (Sayer 2000). The ontology of CR, presented by Lincoln and Guba (2000, p.168) is *"real reality: only imperfectly and fallibly apprehended"*, reflecting that while it is thought that reality is real, it is fallible due to its social construction.

Further, the intransitive dimension of knowledge is independent of observation (Bhaskar 1975) and thus consistent with realist ontology, as argued by Glaserian GT (Glaser, 1992). In CR's stratified reality, these are deeper level 'real' realities causing actual and subsequently empirical realities to happen (Sayer 2000). On the other hand, the transitive dimension of knowledge is not independent of observation; rather, it is socially constructed. This dimension of knowledge includes empirical and actual reality and is consistent with relativist epistemology, thus consistent with Straussian GT (Corbin & Strauss 2008). However, as argued by Sayer (2000), the world is construed, and sometimes constructed, by human knowledge. Thus, when CR is used in the social sciences, knowledge is socially constructed because it is subjective social knowledge. Still, this knowledge is not merely social construction, rather it is the emergence of its pre-existing underlying structures and generative mechanisms (Bhaskar 1978, Collier 1994, Fleetwood 2005). Thus, for the current critical realist enquiry, I establish in the third column of the table that reality is considered to be out there and real, but it is socially constructed and can be fallibly apprehended due to the social nature of the enquiry.

Finally, Glaser (1992) is of the view that the literature should be reviewed once the data are analysed and findings are produced, as he asserts that pre-existing literature can stifle, pollute or obstruct the efforts of researchers to generate categories. However, the current study is not consistent with such a constrained Glaserian version of GT (Glaser & Strauss 1967, Glaser 1978, Glaser 1992). In contrast, the present research ***is*** consistent with Straussian GT, because it follows the retroduction mode of inference and intends to develop systematic combining through creating a fit between theory and data (Dubois & Gadde 2002). To support these features of the current research, Straussian GT asserts that *"the research question in a grounded theory study is a statement that identifies the phenomenon to be studied"* (Strauss & Corbin 1990, p.38). This notion allows for the role of pre-conceived theoretical assumptions to develop an understanding of what is to be researched and to devise key interview questions. In the same vein, Dubois and Gadde suggest that:

> *"…concepts should be used in a sensible way to create a reference and to function as a guideline when entering the empirical world"* (2002, p.558) and *"the original framework is successively modified, partly as a result of unanticipated empirical findings, but also of theoretical insights gained during the process."* (2002, p.559)

This is what suggested by Straussian GT in **Table 3.2**. Preconceived knowledge, as suggested by both Straussian GT and systematic combining, helped me to develop theoretical assumptions at the initial stage of the research and to devise the main interview questions and phenomenon to be observed during field work. Following systematic combining, I collected and analysed data, critically reflected on the interviews, transcripts and field notes in relation to the preconceived framework, added further questions and deleted /modified some questions to cover emergent phenomena and surprises so as to create a fit between the interview guide and the boundaries of the case. Then, the tentative framework was extensively modified to theorize emergent phenomena.

Critical realist GT is thus developed by considering the features of both versions, as presented by Easterby-Smith et al. (2012). Thus, the coding methods of Straussian GT have been used to code and analyze qualitative data. Some of these causal structures were preconceived but emerged differently in the NESPAK context, while some new phenomena also emerged during field work. Besides, following critical realist GT, I have not reshaped/ sacrificed the original concepts of GT such as theoretical sampling and coding, iterative field work and the data analysis process, causes and consequences and the hierarchy of abstraction. Instead, rich and rigorous critical realist grounded theory is used, which is more consistent with this research and helps to better explain the structures and generative mechanisms that underlie engineers' learning.

3.8.2 Operating Grounded Theory

I started transcribing interviews during data collection, which took much more time as each interview lasted from one to two hours, while each transcript contains 2,000–8,000 words with an average word count of 4,100. I conducted 30 interviews and their transcripts comprise 123,242 words in total, while field notes (in one Microsoft Word file taken during all interviews) comprise 7,340 words based upon 30 observations. The total data to be analyzed number 129,154 words, in addition to digitally captured field notes, such as pictures and videos and relevant documents collected from participants and downloaded from various websites.

Computer-aided qualitative data-analysis software (CAQDAS) NVivo11 was chosen for the data analysis, considering *"the computer's capacity for recording, sorting, matching and linking"*, which *"can be harnessed by researchers to assist in answering their research questions for the data, without losing access to the source data or contexts from which the data have come"* (Bazeley & Jackson 2013, p.2). Further, considering grounded theory (GT), I am interested in delving deep into data and contexts and actively interrogating the data to develop a deep understanding from stories told by the participants (Easterby-Smith et al. 2012, Corbin & Strauss 2008). Hence, it was too difficult for me to search for keywords and develop and manage hundreds of codes without CAQDAS.

3.8.2.1 Grounded Theory Methodology/Grounded Analysis

Grounded theory methodology is systematically operated to analyse the data presented in this section. The three stages of coding suggested by Straussian's GT, open coding, axial coding and selective coding (Strauss & Corbin 1990), are followed to analyse the data. To further elaborate and operate Straussian's GT, Easterby-Smith, Thorpe and Jackson (2015) describe grounded analysis comprising seven steps: *"familiarization, reflection, open coding, conceptualization, focused re-coding, linking and re-evaluation"* (Easterby-Smith et al. 2015, p.192-193). Following these steps in combination with GT's three-stage coding helped me to operate GT systematically and ensure that no important elements of GT were omitted. The following sections present the stages/steps of combining GT methodology with grounded analysis.

Grounded analysis is not performed with a predefined data analysis structure drawing from a theoretical framework; rather, concepts and theories are developed through a systematic and rigorous examination of data (Charmaz 2006). A pre-conceived conceptual framework helped me to design key questions to be asked during the interviews; however, phenomena that emerged during fieldwork and theory-data interactions are not omitted in order to ensure the richness and rigour of the research.

Thus, construction of the phenomenon under study, based on the participants' views and voices, and its interaction with theory occupy a central position to discover a theory considering the Straussian version of GT (Easterby-Smith et al. 2012). Thus, GT is not operated through a predefined structure borrowed from theoretical assumptions, rather I moved extensively forth and back between theory and data to create a match through systematic combining (Dubbois and Gadde 2002).

Familiarization

The first step involves the researcher's familiarization with all available data, which began during the field work, as Miles and Huberman (1994) state that data analysis in qualitative research starts with the data-collection process. For this purpose, I transcribed all the interviews, which contributed to developing my familiarity with the data, plus some field notes were also drawn from digital recordings as I listened to some verbal gestures, such as:

- umm,
- long silence in response to a question
- participant's telephonic and face-to-face conversation with his/her colleagues

Further, I read transcripts and field notes time and again, which let me become much more familiar with the data. This subsequently reminded me of the focus of the research and what data suggest, as asserted by Glaser (1978). One of such field note is:

When I asked participant 1: ***"In what ways do you share knowledge (gained from a foreign partner) with your fellows and project members?",*** *he smiled confidently and replied:* ***"You'd better ask this question to my fellows."*** *The confidence in his gesture strongly indicated that he was sharing knowledge sufficiently. As a big 'YES' was reflected in his gesture, he believed that his fellows would also acknowledge and recognize that he was sharing knowledge sufficiently.*

Reflection

An initial reading of the transcripts and field notes led me to a thinking process which is called reflection by Easterby-Smith et al. (2015). During this process, I made extensive evaluations of the data in relation to the preliminary framework and research questions. This does not mean that the data analysis structure was extracted from a theoretical framework; instead, similarities and differences between the theoretical framework and the data were thought through to answer the following six questions (Easterby-Smith et al. 2015, p.192):

- *"What are these data about?*
- *Do they support existing knowledge?*
- *Do they challenge it?*
- *Do they answer previously unanswered questions?*
- *Are they different?*
- *What is different?"*

Keeping these questions in mind, I started analyzing the nature of the data and its focus on learning. Personal reflection helped to ensure whether the data had capacity to serve the objectives of the current qualitative in-depth research or not. Given the second and third questions, data and participants' views and voices were compared with the existing theories on learning such as cognitive learning, distributed cognition and knowing in practice and how they are supported by cross-border and inter-firm sharing of existing knowledge and working practices. Subsequently, it was thought through whether the data were consistent with the preliminary framework or challenged it with emergent phenomena or a relationship amongst them. Further discussion on how empirical data are consistent with or different from preliminary theoretical assumptions is covered by answering the fifth and sixth questions.

As far as the fourth question is concerned, it is difficult for me to claim that the data have the potential to answer all the unanswered questions and unexplored areas in the relevant literature. However, after a careful comparison of empirical data with theoretical assumptions, it can be safely stated that the research questions of the current study can be properly answered with the empirical data collected from NESPAK, Pakistan.

Considering the fifth and sixth questions, my personal reflection came up with different dynamics of engineers' learning and boundaries of the case, which were overlooked in the theoretical assumptions. Thus, empirical data challenged the preliminary theoretical assumptions. The initial research question, *"How are organizational learning practices transferred from a foreign to a local context in an international consultancy alliance?"*, was replaced with new research questions to fit the empirical data. During fieldwork, I found that an engineering practice is not transferred as it is from a foreign country to Pakistan-based engineering projects because it is situated, embedded and relational in a specific context. Instead, local and foreign engineering consultants work collectively in collaboration to provide a novel engineering consultancy for a project. They collectively develop a unique concept design, drawing and feasibility study, as well as developing novel working practices for a project through sharing and applying existing knowledge and engineering practices at NESPAK and those of the foreign collaborator involved in the project. This led me to change the research question to: *How do engineers' view their learning of engineering consultancy in the context of an international consultancy alliance?*

The learning of NESPAK's engineers, which is the focus of this research, takes place while developing and performing such practices. Normally, NESPAK's practices to prepare/ input data about local technical conditions, such as the project site's dynamics and local environmental dynamics and performing civil work, are well developed. However, they need to modify these practices when they have to use a modern technology or new method, particularly in civil work. For instance, they are using Chinese construction codes for the first time in civil work at LOLMPT, so their existing practice of performing civil work has been modified and their learning takes place in understanding and applying Chinese construction codes in that local project.

Further, civil work, including concept designs and drawings in every project, needs to be compatible with new technologies involved/ to be installed in the project. For this purpose, existing working practices to perform civil work are modified and novel civil work is done considering the requirements of a project, the technologies involved in it and inter-organizational relationships in every different alliance.

Further, it was preconceived in initial theoretical assumptions that NESPAK is a knowledge receiver while foreign collaborators are knowledge donors. However, this is not true as both partners share their existing knowledge and working practices, which are new to each other, and they develop and perform new working practices which are also new to both partners. The knowledge and skills learnt in a project are utilized in upcoming similar projects, thus the input of foreign partners is reduced and NESPAK's self-reliance in terms of having the required knowledge is boosted. There are many other phenomena that emerged during fieldwork, which are presented and discussed in the finding chapters.

Thus, due to the aforesaid different dynamics of NESPAK's engineering learning in the context of an international consultancy alliance and various relevant emerging phenomena, the preliminary theoretical assumptions were modified and new research questions were formed, as shown in section 1.5. This was done by moving extensively back and forth between theory and data to create a fit and systematic combining between them, as advised by Dubois and Gadde (2002). For this purpose, new theories and literature were consulted and reviewed and theoretical assumptions and research questions are revised to address emerging dynamics of learning.

The next four steps are similar to Strauss and Corbin's (1990) three stages of coding, open, axial and selective coding, and these stages are covered by the last four steps of grounded analysis (Easterby-Smith et al. 2015). Thus, the core data-analysis process revolves around these four steps, which are discussed below:

Open Coding

In open coding, data are elicited through asking wh- questions, including 'who? why? what? when? how? how much?' (Strauss and Corbin 1990, 1998). It is an *"analytical process through which concepts are identified and their properties and dimensions are discovered in data"* (Strauss & Corbin 1998, p.101). Starting open coding, for which the same term is used by both Easterby-Smith et al. (2015) and Strauss and Corbin (1990), all transcripts were loaded into NVivo11. The data were initially broken down into open codes by reading each word, line and sentence of the transcripts. With open coding, I remained open to all potential directions that emerged through reading the transcripts. Though these codes reflect the *"meaning of a chunk of data"* (Easterby-Smith et al. 2015), these are not merely labels assigned to the data, rather it involved developing links which led me from *"data to idea, and from the idea to all the data pertaining to that idea"* (Richard & Morse 2007, p.137). The following key questions were considered while initially open coding, as suggested by Easterby-Smith et al. (2015, p.192):

- *"What are these data about?*
- *Whose point of view is reflected in the data?*
- *How is this view expressed?"*

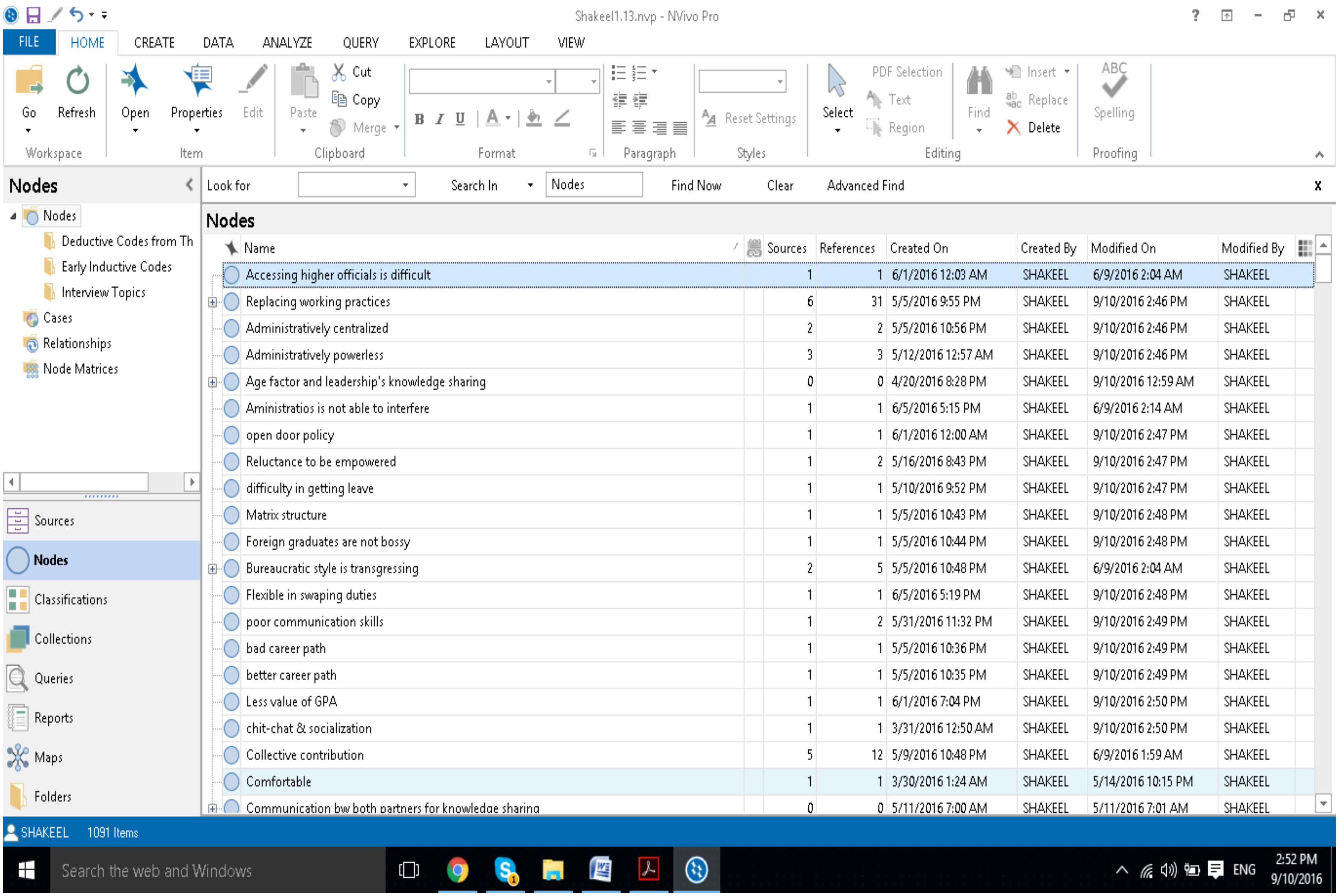
Various coding methods have been used for open coding by considering the coding manual of Saldana (2013). **Table 3.3** reflects these coding methods, with respective examples of codes and relevant quotes. In conjunction with the aforementioned coding methods, sub-coding (Gibbs 2007, Miles & Huberman 1994) has also been used. For instance, an open code labelled as 'project wise: new foreign practice' was developed for the foreign practices under study and their transformation and development in the local context.

Following these steps, initially, 11 transcripts were coded and a snapshot of the open codes is reflected in **Figure 3.2.** It is further stated that the first and second transcripts emerged with 241 and 194 open codes, respectively; however; the number was reduced to 75 while coding the eleventh transcript. In this way, a total of 1,020 open codes were developed, with 11 transcripts in the first cycle.

Table 3.3: Coding Methods

Coding method	Code examples	Relevant quotes (data)
Descriptive coding: Summarizing data in a word or short phrase (Hammersley & Atkinson 2007, Saldana 2009)	Contribution by NESPAK	We give them input about local conditions
	Library	We have a large library here in the head office wherein all reports, working papers etc are available and only NESPAK employees can access them
In vivo coding: Referring to the 'term/word or short phrase' actually used by the participant (Charmaz 2006, Corbin & Strauss 2008)	A manufacturer's knowledge is far superior	As I already mentioned, that manufacturer's knowledge is far superior to our own. A user cannot have the same knowledge as the manufacturer has
	We did the initial work	In this process, our engineers started working and did the initial work, such as preparing the design and civil works, as well as initial work on the mechanical and electrical side
Process coding: Using gerunds ("-ing" words) (Saldana 2013, p.96) to connote any action in the data (Charmaz 2014)	Doing wrong intentionally	Sometimes, we intentionally do wrong work and through correction they share their knowledge and experiences
	Asking questions	We raise questions such as what are the indicators of a part being faulty, what it looks like etc.
Evaluation coding: Making judgements (Patton 2008)	Misworking	We are just working, not managing, according to the orders of superiors. no matter whether it is completed on time or not
	Unfair performance appraisals	There are some incidents where people are punished unnecessarily
Causation coding: Coding the causes of something (Maxwell 2012, Miles & Huberman 1994)	To develop teams	We are confident that sharing knowledge develops teams, which is ultimately beneficial
	To make their life easy	Leadership also has a stake in sharing knowledge with colleagues and making them independent in performing tasks so that leaders can make their own lives easy

Figure 3.2: Open Coding



Conceptualization

Conceptualization is part of open coding according to the Straussian version of GT (Strauss & Corbin 1998), while Easterby-Smith et al. (2015) identify it as a fourth step of grounded analysis. I moved forward to conceptualization once initial open codes were developed to identify patterns among open codes and develop categories through grouping *"similar events, happenings, and objects under a common heading or classification"* (Strauss & Corbin 1998, p.103). These categories were developed through assessing their *"similarity, difference, frequency, sequence, correspondence or causation"* (Saldana 2009, p.3). Strauss and Corbin (1998) define categories as *"concepts, derived from data, that stand for phenomenon"* (p.114) and properties as *"characteristics of a category, the delineation of which defines and gives it meaning"* (p.101). So, categories were built based on concepts grounded in the data, and their respective characteristics are their properties.

Again, coding methods suggested by Saldana (2013) were applied to develop categories. First, focused coding was applied, which *"is a streamlined adaptation of classic grounded theory's axial coding"* (Saldana 2013, p.213). Similar open codes were merged together, while the *"best representative codes"* (Boeije 2010, p.109) were selected as categories. For instance, an open code labelled 'symbiotic alliance relationship' (in vivo code: the term used by a participant) means that NESPAK has a symbiotic alliance relationship with a foreign partner and both partners contribute in an integrated way to perform consultancy work for a project. Other similar codes, such as at-par relationship, cordial relationship and personal relationship, which were developed by merging initial open codes through pattern coding, as discussed below, were linked as properties of the symbiotic relationship category.

Pattern coding (Miles & Huberman 2013, Saldana 2013) was also applied to develop category labels that represent similarly coded data. In this way, large amounts of data were organized into categories with meaning for the organization. For instance, different open codes reflecting the bossy attitudes of NESPAK's managers were merged together under the label 'Bossy Attitude'. Similarly, other open codes relating to NESPAK people's working styles were merged together with different labels, such as 'diplomatic attitude, poor work-life balance, poor management skills and truanting'. As all of these open codes reflect the characteristics of the working styles of NESPAK's employees, they are considered to be properties of the category (developed to group them) labelled as 'NESPAK unorthodox working style'. In this way, 45 categories and 277 properties were developed in the second cycle of coding.

This continuous thinking process during category development led me to write analytic memos for each category as an analytical part of conceptualization in grounded analysis, *"memos are sites of conversation with ourselves about our data"* (Clarke 2005, p.202). This helped me to identify and catalogue concepts (Easterby-Smith et al. 2015). Considering Saldana's (2013) guidelines, these analytic memos are written while: reflecting on the research questions of the current study and their possible answers with their connections to theory; choices of codes and categories and their operational definition (defined by both data and theory); reflecting on emerging categories and concepts (how codes merge together to develop categories and properties or themselves become categories or properties with their own connections); and reflecting on problems occurring during the study. An example of a memo is shown in **Figure 3.3.**

Table 3.4: Analytic memo for the category of Cultural Openness and Adjustment

6/21/2016 7:45 PM *Though category of cultural openness and adjustment by NESPAK is developed, still need to think of an appropriate term. Need to read own theoretical assumptions and other literature.* *6/28/2016 4:05 PM* *After thorough understanding of data and consulting literature, NESPAK has to be open despite its unorthodox working style and make necessary adjustments to it because it is NESPAK which joined hands with foreign partners just to learn new technology, new working practices and advanced knowledge. So being a recipient of new technology and necessary knowledge, it is NESPAK's responsibility to be on a par with foreign workers in terms of their working style. This is what the literature says about the nature of inter-firm relationship for sharing knowledge.* *I was amazed when participants reported differences in their and foreign partners' working styles and this led me to thinking how they overcome these differences to be on the same page and work collectively in an efficient manner. I found the answer while reading more transcripts. The participants told me that not only NESPAK but most of their foreign partners have long experience of working with expatriates so both, despite their own different styles, are open to change and readjusting themselves, such as approaching work on time, replying in a timely way, raising critical questions etc. Working with people of different cultures as a team helps them to develop harmony between them. So, different working styles of both NESPAK and foreign partners emerged as properties (with their respective categories) of the main category of 'Cultural Openness and Adjustment'*

Axial Coding

Axial coding refers to *"the act of relating categories to categories along the lines of their properties and dimensions"* (Strauss & Corbin 1998, p.124). So, similar categories are grouped and collapsed under relevant main categories. For instance, there are different technologies involved in every project, so all of these categories are grouped and combined under the main category of 'technology involved in each project'.

Focused Re-coding

As the most significant categories and their properties are developed, I loaded the rest of the 19 transcripts and digitized field notes and relevant documents into NVivo for focused re-coding (Easterby-Smith et al. 2015). Similar coding methods (as applied in initial open coding) were again applied to develop initial open codes for all transcripts. Further categories and properties were developed because every interview essentially threw up certain new codes, considering the unique working practices involved in every project. Not only consultancy activities but also related knowledge, local conditions and issues and problems are different in every project. Moreover, every project and its related interviews involves unique foreign partners and related issues such as cultural values and language barriers and unique Terms of Reference (ToR) for each consultancy alliance.

For the rest of the phenomena under study, most of the newly developed open codes were collapsed into existing properties or emerged as new properties of existing categories, considering their similarities and regularities. For instance, a new code emerged with the label of 'weaker soft skills' representing data related to poorer soft skills of NESPAK's employees compare to foreign counterparts. Seeing its relevance to other properties of an already developed category of 'NESPAK's unorthodox working style' and to the category itself, this code was linked as a new property of this category.

However, few new categories and properties emerged during coding of the newly loaded 13 transcripts and no new categories or properties were found during re-coding of the last six transcripts. After focused re-coding, a total 60 categories and 377 properties emerged.

This indicates approaching theoretical saturation, which is *"saturation of the properties of a theoretical category"* and it *"occurs when gathering more data sheds no further light on the properties of their theoretical category"* (Hesse-Biber & Leavy 2010, p.167). The development of further categories and properties stopped and the boundaries of the categories were well defined until coding the 24th transcript. However, I completed the coding of all 30 interviews to be on the safe side in terms of theoretical sampling (Saunders et al. 2012).

Further, the iterative essence of grounded theory (Charmaz 2006, Denzin & Lincoln 2006) was taken care of as I kept moving back and forth between successive data-collection and -analysis processes and later on between data analysis and theory, making comparisons between them and asking analytical questions to strengthen grounded theory analysis. Thus, data-driven categories and properties have been approached.

Selective Coding (Linking)

The sixth step in grounded analysis (Easterby-Smith et al. 2015) is known as selective coding (Strauss & Corbin 1998). Selective coding is *"the process of integrating and refining the theory"* (Strauss & Corbin 1998, p.143). As mentioned by Easterby-Smith et al. (2015), the analytical framework and explanations became clearer at this stage and patterns emerged between concepts. Thus, I moved on to integration in selective coding which is done to decide on the central or core category, which is defined as *"the main theme of the research … it consists of all the products of analysis condensed into a few words that seem to explain what 'this research is all about'"* (Strauss & Corbin 1998, p.146). It means that the central category (it may be one of the related categories or a new label) should carry meanings of all relevant categories and pull them together, considering their explanation in data, while it should also consider variations among categories. Selective codes are umbrella terms representing all the codes from initial open codes and categories developed so far (Saladana 2013) and which move the *"analytic story to theoretical direction"* (Charmaz 2006, p.63).

Strauss (1987) offers a set of guidelines to develop a central category:

- It should be central while all categories must be related to it
- It should appear frequently (however, a word or set of words can be used if it has the capacity to cover the meanings of the other categories and it pulls all the other categories together, no matter if it is used more or less frequently)
- It should be developed through a logical pattern/relationship among categories
- It should have explanatory power
- It should have the ability to explain contradictory categories and variations within them

Thus, reflection on categories and their properties was again done and analytical memos written earlier were consulted again to understand the specifications of the categories and case differences and variations within categories, and to synthesize ideas (Glaser 1978). This provided an explanation for developing the core categories through systematically linking the categories to each other and assigning them suitable terms. These terms are 'sufficiently abstract' for the data/ explanation represented by the category (Strauss and

Corbin 1998). In total, two central categories are developed, which are discussed in the following two chapters (one core category as discussed above was removed).

Re-evaluation

The last step of re-evaluation (Easterby-Smith et al. 2015) is what Strauss and Corbin (1998) call *"refining the theory"* (p.156), which can be done through *"filling in poorly developed categories, trimming the theory, validating the theoretical scheme and building in variation"* (p.158-160). At this stage, no category is poorly developed while all of them are dense enough and have a wide range of properties and explanations, so it can be claimed that the categories have the required density. Second, the category of 'strategic conflict' was dropped because it did not fit into existing core categories. Strategic conflicts arise due to the strategic interests of foreign players, funding agencies and the Pakistani government that lead to the abandonment of projects. Once a project is abandoned, there is no more consultancy work done on the project, thus no learning takes place locally or while working with foreign consultants. Third, core categories are validated through comparing them with raw data and presenting them to the research participants. Finally, there are a few outlying cases (negative cases) and variations within and between categories. These variations are natural, as Strauss and Corbin (1998) mention. These core categories are presented and analyzed in the next two chapters.

3.9 Research Evaluation

In order to improve the quality of the research and reduce the chances of misinterpretation, I followed the criteria for quality in qualitative research suggested by Lincoln and Guba (1985) and Tracy (2010). The criteria impose a variety of responsibilities on the part of the researcher to ensure that the research has achieved sufficient quality to be presented as credible, trustworthy and interesting for its audience. The first criterion is a worthy topic and research issue to study through data collection and analysis (Miles & Huberman 1994, Tracy 2010). Given the current topic, an evidence of a research gap identified through a rigorous literature review made it worthy for examination and one that could be interesting for readers and lead them to think in a new way. The current topic does not *"displace lay probing of social problems"* (Schwandt 1996). Instead, it presents new knowledge on the phenomenon under study, while being informed by modern learning theories and studying the phenomenon with different methodological choices and evidence from an entirely different research context yielding theoretical and methodological contributions.

Validity and reliability are well known phenomena in quantitative research, measured with various statistical tools, and they play a key role in ensuring the quality of quantitative research (Tracy 2010). These are of equal importance but highly contested in qualitative research with no unified definition, so methodologists suggest a variety of criteria to ensure the validity and reliability of qualitative research (see Creswell 2007, Easterby-Smith et al. 2015, Lincoln & Guba 1985, Patton 2008, Shenton 2004, Schwandt, Lincoln & Guba 2007).

On the other hand, methodologists (e.g. Lincoln & Guba 2000, Tracy 2010) stress evaluating qualitative research through alternative criteria instead of validity and reliability. Lincoln and Guba (1985) suggest the criterion of trustworthiness, which includes creditability, transferability, dependability and confirmability. Credibility is concerned with whether the *"reader feels [research is] trustworthy enough to act on and make decisions in line with it"* (Tracy 2010, p.843) and whether the findings are a true representation of the views and voices of the research participants (Wittemore et al. 2001).

To increase the likelihood of the phenomenon under study being correctly and adequately described, I spent almost one year in the field (from initial informal discussions to the last interview and site visit) to acquaint myself with organizational routines related to the phenomenon under study. The interviews were conducted in much detail as well as in a somewhat informal environment as I first got to know the participants through general discussion. This led the participants to present a true instead of a rosy picture, which led me to drill down into the phenomenon and ensure rich rigour (Tracy 2010). At the same time, I always interacted with the participants in a professional way by emailing an information sheet and a consent form to them prior to interview, taking extra copies in a formal office file for interviews and presenting myself in formal dress to avoid the risk of being taken for granted (Patton 2008). At the end of each interview, I presented a card box[14] to the participants as a token of thanks and in recognition of their contribution. This always worked for me as some of the participants arranged further suitable participants for interview (snowball).

A set of methods increases the rigour of research as it captures different views and voices embedded in different perspectives with the occurrence of various things at the same time (Denzin & Lincoln 2011). Given that, I followed within-method triangulation (Denzin 1970) and collected data through interviews, observation, field notes, documents and visits to project sites to cross-validate the interview data. Participants' claims were also cross-validated through interviewing different participants who had worked/ were working on the same projects as well as people in the same hierarchy (e.g. Subordinate ➔ Manager/ Subordinate ➔ Manager). Further, the interviews were transcribed personally and transcripts were cross-checked with a few respondents (only four participants cross-checked); however, all of them approved their respective transcripts or trusted in my capability for data analysis. I often had de-briefing sessions with my supervisors and got the transcripts scrutinized by them. Such debriefing sessions and critique/ review/ feedback are a considerable source of credibility (Creswell & Miller 2000), so these sessions kept me going throughout my research journey. The transcripts were also shown to and discussed with my colleagues for critique, feedback and scrutiny. I analyzed the data through rigorous grounded theory (Strauss & Corbin 1990), while field notes, documents, news reports and pictures and videos of the sites were equally

[14] Wooden boxes to keep business cards were presented to the participants as a token of thanks for their participation in this research.

considered in understanding the data analysis and findings. Further, throughout the course of the research, I remained visible through self-reflexivity, while being thoughtful and assessing my own values, predispositions and motivations and their potential influence on the research process (Tracy 2010). During interviews, I often conveyed my viewpoint to the participants and asked for their feedback about a phenomenon. Detail about everything is given in relevant sections of this chapter. The ultimate purpose was to ensure credibility (Lincoln 1995), rich rigour and transparency (Tracy 2010) and the adherence of methodological choices to ‘scientific standards’ (Seidman 2013, p.12).

A thick description of the field, its context and working conditions was also given in field notes. Data in the form of documents, pictures and videos of project sites, news reports and other documents provide thick descriptions of the data that are in line with Tracy’s (2010, p.842) argument that *“data must [show] rather than [tell] readers what to think”*. The complete qualitative data are embedded in context. Presenting verbatim quotes (data) with context in findings will lead readers to put themselves in the shoes of informants (Patton 2008). Besides, findings may be transferred if the readers do not detach themselves from their context. Instead, they need to understand the findings including their interaction with the context because the reality/ knowledge created in this research is contextual not universal.

The criterion of dependability replaces reliability (Shenton 2004), which involves producing consistent results with repeated work. However, Merriam criticizes this approach, saying *“reliability is problematic in the social sciences simply because human behaviour is never static”* (Merriam and Tisdell 2015, p.250). Still, I have given full details of my immersion in the data, their analysis and the overall research process. Finally, the criterion of confirmability is satisfied through keeping a complete record, including information about participants, interview transcripts, interview notes, field notes and pictures and videos taken at project sites for future reference. This is an honest way to ensure the quality of the research. I hope that readers will understand my role and hear my voice as an observer and participant, in addition to a researcher.

3.10 Ethical Considerations

The research follows the ethical principles laid down by Patton (2008). These include *"explain the purpose of the research, promise and reciprocity, risk assessment, confidentiality, informed consent, data access and ownership, interviewer mental health, advice, data collection boundaries and ethics vs. legal"* (Patton 2008). The first six and the eighth and ninth principles were communicated to the participants before interviews. I emailed an information sheet and an interview guide to every participant before their scheduled interview along with a participant's consent form. However, only one participant read these documents before the interview while others could not find the time even to open my email because of their busy schedules. To address this, I always kept copies of these documents while going to each interview, which were presented to them to read before the interviews. Once they finished reading, I explained to them the purpose of the research and its potential contribution to existing academic knowledge as well as to NESPAK in Urdu. It was communicated that the research was approved by the Lancaster University Ethical Committee after a rigorous process, so I would not violate research ethics. They were also told that there was no risk, legal implications or psychological distress to their personal or professional positions from taking part in the research. In this connection, I told them that:

- their names and positions would be kept highly confidential
- I would assign anonymous identities in place of their names
- core data would be saved in a locked cabinet at my home while digital recording and transcripts would be saved in password-encrypted files in my personal laptop, which is not accessible to anyone else
- nobody except me would have access to raw data, including interview recordings and interview notes

In addition, I informed them that I could even choose a dummy identity for their company in my thesis and research publication if they had any concerns. However, everybody allowed me to use their company name and said there was no harm in it. However, I told them clearly that I would use anonymous quotes in my thesis and research publication but I would still let them confirm through reading quotes that they did not reflect any kind of identity such as identifiable positions of the participants. Initially, some participants had concerns over recording, but most of them agreed after being assured anonymity and confidentiality. There were only five participants who refused digital recording, but as they were willing to be interviewed, I took detailed notes. For this purpose, I often had to stop them as I had to write their complete answer before asking the next question.

After communicating the whole procedure and necessary assurances, they were told that if they still felt any harm or risk to their personal or profession position, they could refuse to participate. They were also told that they could quit at any time during the interview if they felt any risk or harm and I would immediately discard the digital and manual recording of their interview in front of them. It was also assured that they could even ask me to discard their interview within two weeks of the interview and I would do so. However, after making interviews and transcripts anonymous, I would not personally be able to identify each interview and transcript.

Moreover, they were informed that I might ask the same question in different ways and/or rephrase the wording or ask for additional clarification or details. However, they had a complete right to refuse to answer any question at any time. Finally, it was mentioned on the information sheet and communicated personally that if they wanted to report any unethical conduct on my part to my research supervisor or head of department, their complete address details were given. There were a few times when different participants refused to answer some questions; however, no participant quit during their interview or asked me later to discard their interview, and overall the field work was completed smoothly. The only problem I faced was the extra workload of the participants who worked day and night, even at the weekend, on projects the government wanted to complete by any means before the next election in 2018. This was also the reason why no participant showed a willingness to review their transcript on my request. Still, I personally showed three transcripts to respective participants during later visits to NESPAK and they did not suggest any additions or deletions. However, some of the participants were interested to see the final findings of the research, which I promised to provide after publication.

Before going for an interview, I sufficiently assured them that there was no physical or emotional risk in conducting the interviews. Site visits were difficult but not risky at all because the projects were going on in the same city I reside in and I visited the sites with references from participants who informed the site engineers of my visits. Finally, I do not only conform to the Data Protection Act 1984, which is in place in the UK, and Lancaster University's Ethical Guidelines, I have also tried to be very conscious in this regard. For instance, I removed the names of other employees (not part of this research) who were mentioned by the participants.

3.11 Conclusion

Aligning with the research questions posed in Chapter 1 and the philosophical position of this research presented in the last chapter, the current chapter chooses the research methodology and its different components, including research approach, research strategy and data-collection and data-analysis methods. Section 3.2 argues that critical realism can better serve answering to the research questions. After critically evaluating qualitative and quantitative research approaches in terms of their respective alignment with the current research, a qualitative approach is followed due to the current research's requirement to produce in-depth subjective findings related to the phenomenon under study. This is covered in section 3.3. Further, it is discussed in section 3.4 that a classical linear case study strategy is inconsistent with the current research due to its linearity (Yin 2003) and the requirement of having 4 to 10 cases to generate a theory (Eisenhardt 1989). Instead, a single case study is chosen due to its flexibility to modify theoretical assumptions after finding emergent phenomena during field work in order to create a match and systematic combining between theory and data (Dubois & Gadde 2002, 2014).

Section 3.5 has presented the case company, i.e. NESPAK, a Pakistan-based engineering consultancy company that is working in international consultancy alliances with different foreign consultancy firms on different Pakistan-based infrastructural projects. This highlights the potential of the case company to answer the research questions. Section 3.6 discusses the target population, which is NESPAK's engineers who work on local projects with foreign consultants in consultancy alliances and use/ install modern technologies in projects. The section also discusses the process of approaching the research organization and purposive and snowball sampling to select and approach participants for this research.

Section 3.7 discusses different data-collection methods, including semi-structured interviews, observation/ field notes and documentary analysis, used in this research to collect qualitative in-depth data. The section also covers the data-collection process. For data analysis, the Straussian version of grounded theory (Strauss & Corbin 1998, Corbin & Strauss 2008) being informed by critical realism (Bhaskar 1978, Sayer 2000) is argued for in section 3.8, given its potential to better serve the objectives of a critical realist enquiry. The section comprises the complete set of data-analysis methods used in this research. Section 3.9 discusses research evaluation followed by section 3.10 covering ethical considerations during the research.

CHAPTER 4: PRESENTATION AND ANALYSIS OF FINDING I – LEARNING IN ENGINEERING CONSULTANCY PRACTICE

4.1 Introduction

The first core findings of the current research, 'Learning in Engineering Consultancy', are presented and analyzed in this chapter. These are findings about NESPAK's engineers' different accounts of learning in performing engineering consultancy for a Pakistan-based project.

Given that engineers' learning takes place in the context of international consultancy alliances, I first explain the scope of the consultancy work and the process of the formation of consultancy alliances with foreign partners.

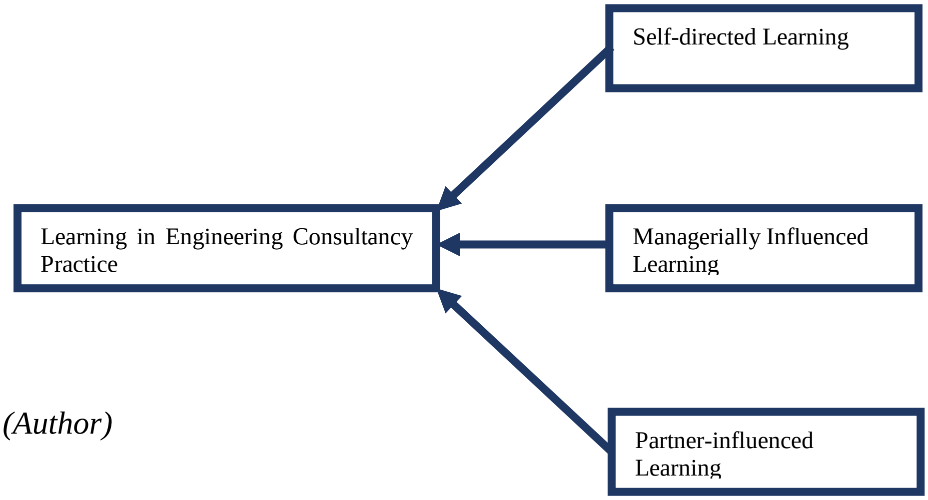
As an engineering consultancy company, the business of National Engineering Services of Pakistan (NESPAK) is to provide engineering consultancy for infrastructural projects. Engineering consultancy includes the development of feasibility reports, concept designs and drawings for engineering projects. It also includes site supervision of projects to ensure that the projects are completed according to the concept design and to address any issues and problems that may arise during construction work.

Initially, when a project is advertised by a client (usually the Government of Pakistan), NESPAK applies for the project and starts to understand the project requirements regarding the engineering methods and technologies to be used/ installed, the project budget, completion date and other relevant issues. Then, NESPAK evaluates these requirements in relation to its skills, expertise and capacity and identifies areas where external support is required. In the meantime, NESPAK has detailed deliberations with the client and the contractor to finalize the project's ToRs. Once NESPAK has a tender accepted and its ToRs are finalized, a NESPAK project team is formed involving engineers from all the divisions involved in the project. The project team must first understand the scope of the consultancy work, i.e. what is to be done for the project, the technologies to be used/ installed and the ways to use/ install those technologies.

After finalizing the scope of the consultancy work, NESPAK identifies foreign consultants for assistance/guidance to perform those areas of consultancy work where NESPAK lacks expertise and skills. In most projects, NESPAK relies upon foreign partners for modern technologies and engineering methods. Thus, a project team comprising local and foreign engineers is formed to do advanced level consultancy work.

This practice of engineering consultancy is performed through three interrelated categories, which are inductively developed based upon my empirical data. In other words, the core category of Learning in Engineering Consultancy Practice constitutes three categories. These are Self-directed Learning, Managerially Influenced Learning and Partner-Influenced Learning. The chapter presents and analyses these findings.

Figure 4.1: Learning in Engineering Consultancy Practice



Source: (Author)

Section 4.2 presents and analyzes the findings for Self-directed Learning. At the start of a project, engineers learn basic theories, models and knowledge related to engineering methods and technologies through studying academic and project-related texts. This section presents relevant evidence from different interviews and their analysis. To conclude the category /section, a summary of findings presented throughout the section is given.

Section 4.3 presents and analyzes the findings for the second category i.e. Managerially Influenced Learning, for which I present evidence from different interviews and different ways in which engineers' learning is influenced by their managers. Once local engineers have a reasonable understanding of the project site and are conversant with relevant theories and engineering methods, they start working collectively to analyze the project site and identify compatible engineering methodologies and technologies for the project. The section concludes with a summary of findings.

Once the NESPAK team have completed as much consultancy work as it can do in-house, they start working collectively with foreign partners to complete the project. **Section 4.4** presents learning during joint working with foreign partners in order to adapt technologies according to local on-site conditions. These findings are presented under the category of Partner-influenced Learning. The section presents different ways in which foreign partners influence the learning of local engineers. Finally, **section 4.5** concludes the chapter with a summary. The section also highlights how, overall, ‘Learning in Engineering Consultancy Practice’ takes place through these categories. Further, the section mentions that these categories and learning in performing them are both sequential and simultaneous. For instance, in some cases, learning takes places and work is done in one activity and used in next-level activities, while in some other cases, both types of learning and working occur simultaneously in the same category.

The respective findings and analyses are also displayed at the end of each category according to an analytical framework informed by the critical realist philosophical position of this research. Being informed by critical realism, these findings are explored through a retroduction mode of inference (Danermark 2002) and vertical exploration of deeply located entities, factors and processes that cause and enact understudy phenomena. In other words, critical realism helps to identify underlying contextual and project-related influential entities, factors and processes which cause and enact events and experiences, and subsequently final outcomes (the categories drawn in this research).

Thus, the current research explores not only the characteristics of these categories but also their causes, explained by respective underlying processes (e.g. how did they come into being?), factors and entities (e.g. what enacts them or makes them happen).

4.2 Self-directed Learning

Self-directed Learning emerges as the first category of the core category of Learning in Engineering Consultancy Practice. It is called Self-directed Learning because, in the initial phase of every project, NESPAK engineers complete basic consultancy work independently, given that they are BSc, MSc and PhD qualified and have the capacity to do such initial work. Self-directed Learning mainly involves learning explicit knowledge through cognitive learning. The main purpose of this learning is to develop a basic understanding of relevant engineering theories, models and methods as well as survey the project site and collect and analyze information regarding geological, geographical and general environmental conditions. Engineers' learning taken place at this stage and input regarding project site's conditions developed at this stage are utilized at later stage of consultancy work. This section presents and analyzes how these activities help engineers to learn the required knowledge.

The evidence below is about the different activities that NESPAK engineers perform in which their Self-directed Learning happens. Such activities were part of the initial work they did independently on the Neelum Jhelum Hydro Power Project (NJHPP). NJHPP was one of NESPAK's key projects in which water tunnels were built for a hydropower plant using modern engineering methods and technologies. There were new technologies for NESPAK's engineers to learn as these types of tunnels were being built for the first time in Pakistan. NESPAK provided engineering consultancy as the lead consultant in this project, along with two local and two foreign consultants. As NESPAK's engineers did not have experience of developing designs for such tunnels, they first learnt relevant explicit knowledge, such as basic theories, models and engineering methods to do the consultancy work. A participant in the NJHPP project explained it as follows:

> As these days, latest engineering theories and models are written and published, so we consulted literature and [published text] a lot to understand the tunnelling process … Information and knowledge is also available on the Internet in the form of text, pictures and videos … Apart from this, we had to do a lot of work to collect information about the site as it is highly sensitive, being exactly on an earthquake fault line. So, each member [of the NESPAK project team] worked on their respective part of the consultancy, including studying soil characteristics, rock conditions, reservoirs dimensions, potential storage for water and its flow and discharge. We then analyzed this using different software[15] in order to develop a compatible concept design for the project. [Shahbaz]

Before working formally with partners, NESPAK's engineers learnt relevant theories (explicit knowledge) related to the tunnelling process, and also analyzed the site's geological conditions using analysis software. Such learning seems to be informed by reception meaningful cognitive learning (Ausubel 1961) as the engineers receive

[15] Such analysis software will be mentioned later.

information from the external world, memorizing it as it is or relating it to their existing cognitive structures, and drawing meaningful insights. The data reflect how every engineer involved in this project performed such initial work independently, because they are academically qualified with sufficient experience of site analysis on other projects. However, given that they did not have direct experience of site analysis for such a complex hydropower plant and tunnelling on an earthquake fault line, they felt a need to first have a basic understanding of underlying theories and engineering methods related to the task.

Engineers' Self-directed Learning also takes place when learning new software and working methods, as proposed by NESPAK's foreign partners. In the Lahore Orange Line Metro Train Project (LOLMTP), it was a requirement of the Chinese partner to follow Chinese construction codes for civil work on the project. NESPAK engineers realized that they had to learn Chinese construction codes on their own, given there was no cooperation from their Chinese counterparts. Ayla mentions the ways she learnt these codes:

> … we have to use Chinese construction codes on this project, though we have been using British and American codes in civil work for a long time. Whenever we ask them to provide relevant chapters of particular codes, they don't provide them … [so] I started analyzing Chinese construction codes and comparing them with American and British codes. I made so many comparisons between them that I had these things at our fingertips. Further, I have to use Chinese software. Though the theory and logic behind all software are the same, their interface was in Chinese … We adopted their ways of working, such as their software, construction codes and calculation methods, and developed our own excel sheets with macros to do calculations. [Ayla]

She already had explicit knowledge in the form of American and British construction codes and tacit knowledge of their application in civil engineering work. On the other hand, it was favourable for her that the underlying formulas and calculation methods of all construction codes are almost the same. She learnt Chinese construction codes using existing relevant explicit knowledge (calculation formulas already stored in her memory through cognitive learning, as well as in written form in construction codes) and tacit knowledge. Thus, using both explicit and tacit knowledge, she did calculations using formulas from each code, compared their outcomes, identified similarities and differences among them and finally developed Microsoft excel sheets equipped with specific macros for calculations that are explicit codified knowledge. In this way, she learnt Chinese construction codes individualistically.

On the same LOLMTP, Abdullah, one of the NESPAK engineers, was assigned to work on concept design and drawing (civil work) for 1.75 kilometres of underground track for the project, and for this 'cut and cover' technology[16] was decided to be followed. This technology was not used previously in Pakistan, so there was no local expertise available in the country. Abdullah said that it was initially assumed by the NESPAK team that Chinese engineers would assist and guide local engineers, but their cooperation was insufficient. So, Abdullah had to work on this part of the project independently. He

[16] "cut and cover construction involves using excavation equipment to dig a large trench or rectangular hole in the ground which is then covered by a concrete deck" (Metro Tunnel, 2018, available at: https://metrotunnel.vic.gov.au/construction/building-the-tunnels-and-stations/cut-and-cover. Retrieved 24 June 2018).

described such learning as ‘desk study’ and ‘self-study’, from which I conceived the title of ‘Self-directed Learning’ for this category. He reported:

> I watched videos of cut and cover technology available on YouTube and watched the whole process … this is just like that I, myself made this movie … with the help of videos, I understood the construction of piles and the overall cut and cover tunnelling method. [Abdullah]

The data reveal that online videos are a significant source of knowledge that helps engineers understand technical work through observation so they get the basic idea of an engineering method. Abdullah developed his basic understanding of ‘cut and cover’ technology as shown in the videos and evaluated its application in alignment with local on-the-ground conditions. Here, Abdullah seems to be engaging in cognitive discovery learning (Ausubel 1961) as he understands and analyzes principle contents of cut-and-cover tunnelling technology through watching videos (external information), relates it to already available information that he possesses in his cognitive structures, related to LOLMTP site conditions, and arrives at a discovery or solution to problems of compatible application of cut-and-cover technology in this project. He then stores such solutions in his memory like it happens in rote learning.

NESPAK’s engineers also learnt in the initial stages of the project through analyses of earlier projects’ reports, the technologies used in those projects and their on-the-ground conditions. The company is working on the Murree Cable Car Project to install a state-of-the-art cable car to cover the maximum number of tourism spots in the hilly areas of Murree. NESPAK engineers completed some initial work independently, such as site analysis, studying earlier projects' reports to understand available cable-car technologies and their alignment with the project site's conditions. A participant working on this project reported:

> We examined work and technologies that were used in different cable -car projects developed across the world and the performance of those technologies. [This includes studying] places where a project was done such as at mountains or at a beach, whether it is on aggressive salt or on a road where vibration is higher and technologies used in those projects. And the time: when the project was done, like whether the project was accomplished 2 years or 20 years earlier. What technological infrastructure was available during that era and used in those projects. We also surveyed the geological and geographical conditions of the local project site and studied specific environmental behaviour [influencing the project]. Then, we compared those technologies with current technologies and equipment that the vendor was suggesting for the current project. [Adeel]

The data reveal that understanding compatibility between technologies and project site conditions also offers significant learning for engineers. NESPAK engineers study, survey and analyze geological and broader environmental conditions of the project site and those in earlier projects completed where new state-of-the art technologies or engineering methods were used/installed. In this project, NESPA engineers consulted existing explicit knowledge available in reports on earlier projects and studied the compatibility between the technologies used in those projects and their respective site conditions. The above data also reflect that the engineers consulted explicit knowledge available in local environmental reports to understand the geological and geographical conditions of the project site and other environmental factors influencing the project. This enabled them to identify certain forms of cable-car technologies and specific civil work for this project that would support compatibility between technologies and local on-the-ground conditions. In fact, civil work bridges the gap between site conditions and technologies in the way that it is done according to both on-the-ground conditions and the technological requirements of a project. This is a form of cognitive discovery learning (Ausubel 1961) in which engineers consult existing information, analyse it and discover solutions regarding specific civil work which is compatible with the on-the-ground conditions and cable-car technology.

Summary of Findings

Being informed by critical realism, the philosophical position of this research, a summary of findings is displayed through the critical realist analytical framework presented below in **Table 4.1.** According to Bhaskar's (1978) stratification of reality, the assumed empirical experience/reality in this category is Self-Directed Learning. The data presented above reflects its various underlying actual events and real realities. Following the retroduction mode of inference with the inquiry starting from effects-to-cause (Danermark 2002), I asked repeat and probing questions to vertically explore the underlying actual events and deeply located real entities, events, processes, their structural relationships (structures) and their generative mechanisms (ways of activating power to enact actual events and empirical experiences subsequently). The multi-layered realities related to this category are summarized in **table 4.1.**

Thus, the reality at each level is enabled by its lower level reality, which increases the depth of vertical exploration to approach the ultimate underlying real entities

(Danermark 2001). Such a vertical exploration also provides a better explanation of an empirical reality through giving its underlying causes (Lipton 2003) instead of constructing only a surface level reality. The findings of this research have also been explored vertically but they are presented horizontally through critical realist analytical frameworks as reflected in **table 4.1 (and the rest of the analytical framework tables)** because of space constraints.

It is further indicated on the upper side of the **table** that the direction of effects among multi-layered realities is from deep-seated realities to surface level realities – from cause-to-effects (from left to right side of the table). However, the direction of exploration, which is indicated on the lower side of the table, is from surface level realities to deep-seated realities – from effects-to-cause (from right to left side of the table). This is in line with the examples of the investigations of arthritis and crime reported in section 3.2.

Thus, following the retroduction mode of inference, I explored a variety of deep-seated real entities, events and processes related to the overall context and engineering projects which are presented in first two columns of **table 4.1** under the heading of 'Domain of Real'. From this category of Self-Directed Learning and its verbatim quotes given above throughout this section, I found a variety of real entities and processes including NESPAK's engineers, engineering theories and models, calculation methods and formulas, project reports, pictures and videos, information about the project site, ICT's facilities and relevant software, project requirements, compatibility between technology and project conditions, and such like. These real entities have interrelationships with each other by virtue of their nature, thus they form a structural relationship with each other (structures). These structures activate their power through certain mechanisms and cause actual events to happen. In simple words, the deep-seated realities are different, but they are interrelated and interdependent to cause something to happen in the surroundings. Thus, they work together in interrelated and interdependent manners and enact different actual events such as studying, analysis and preparing input.

These actual events are reflected in the third column which are causally explained by the aforementioned context and project-related entities and processes. These actual events in this category are: studying, consulting and analyzing aforementioned available resources individualistically in order to complete as much work as possible by individual engineers. Such actual events (individual level studying and performing consultancy work) subsequently constitute and shape NESPAK's engineers' Self-directed Learning (empirical experience/reality) which is reflected in the fourth column of the below table. These findings are reflected in the below **table 4.1.**

PS: Such critical realist analytical frameworks have been developed for each category and presented in their respective sections in the findings Chapters 4 and 5. The findings of each category have been explored through the same retroduction mode of inference with the same direction of exploration from surface level to deep-seated realities. So, such critical realist discussion will not be given in much detail for the rest of the analytical frameworks in order to avoid repetition.

Table 4.1: Critical Realist Analytical Framework for the category of Self-directed Learning

Direction of Effects/Causal Explanation (From Cause-to-Effects – From Real-to-Actual-to-Empirical)

Domain of Real		**Domain of Actual**	**Domain of Empirical**
Reported and observed influencing contextual factors (including entities, processes and relations)	**Reported and observed features of consultancy projects (including entities, processes and relations)**	**Inferred composite events and experiences**	**Reported and observed outcomes of mechanisms (and ensuing strategies)**
-Purpose is to develop an initial understanding of the project at the individual level -Engineers having codified engineering knowledge, tacit skills and experience -Theoretical literature, models and imaginaries of physical laws and processes -Reports on previous projects -Processes of consultancy work -Pictures & videos comprising practical demonstrations of engineering methods and technologies -Internet as a facilitator to connect with a web of information -Software (analysis tools for complex data to form it into meaningful information) -Project's concept design (design and layout of an overall project)	-Allocation of initial project work at the individual level -Completing as much project work as possible individually -Site conditions, such as geological, geographical and general environmental conditions, affecting the project -Compatibility of technologies with site conditions	-Studying literature, theories and models -Watching videos on the application of engineering methods, the installation of technologies and pictures of technological instruments -Surveying and studying the site and the local environment -Analyzing project-site conditions -Doing software-based and manual calculations and comparing their outcomes -Developing customized computerized sheets for calculations -Preparing input and information about site conditions and local environmental conditions -Analyzing previous projects, their technologies and site conditions, and understanding the compatibility between site conditions and technologies -Exploring compatible engineering methods and technologies for the project	Self-directed Learning of the basics of relevant theories, engineering methods, technologies and project site conditions through the processes and activities reported in the third column

irection of Exploration (Retroduction: From Effects-to-Cause – From Empirical-to-Actual-to-Real)

4.3 Managerially Influenced Learning

Managerially Influenced Learning in this study is referred to as learning which takes place with the supervision, assistance and guidance of local divisional heads, project managers and senior colleagues. In the Self-directed Learning reported in the previous section 5.2, engineers learn by working/ studying independently, because they are able to complete such initial work. There is usually no guidance, feedback or knowledge-sharing by divisional heads and senior colleagues. However, it is found that they are unable to perform complete consultancy work independently; instead, they need to have guidance and facilitation from their managers to work and learn complex consultancy tasks. So, engineers' learning of such tasks is influenced by managers.

Given that there is no certain standard to make subordinates learn, senior engineers use their own ways, which vary across managers. These ways are also specific to the technological requirements of each project, including the nature of the project, the technologies used in it and the learning methods of subordinates. Besides this, such Managerially Influenced Learning also takes place even during joint working with foreign partners, because the local project team works in collaboration with those foreign partners and they influence each other's (local members of the project team) learning in overall consultancy work. Below, data analysis reflects how engineers' learning is influenced by their managers.

The HVDC transmission-line project is in the development phase in collaboration with SNC Canada. In this project, HVDC lines are being installed between the north and south of the country to save line losses. There is provision in the project's ToRs for a local engineer to visit a foreign country where HVDC transmission lines are already installed. The client, the Government of Pakistan, wants consultant engineers (NESPAK's project team) to have a complete understanding of technologies and equipment related to HVDC so that local engineers may not only make the maximum contribution to the installation of HVDC lines but also oversee their maintenance after completion. So, one of the senior engineers visited Croatia for this project and saw power houses and HVDC transmission line there. He explained how he assisted his subordinates in learning about HVDC transmission lines with the knowledge he acquired in Croatia.

> I visited HVDC transmission lines in Croatia last year for two weeks and I observed how transmission lines have different operating functions … I took around 2,000 pictures and videos of the functioning of different equipment on my mobile phone ... I gave a detailed presentation to my fellow engineers and shared those pictures/ videos so that they can understand the basics and have fundamental knowledge about HVDC technologies. [Arif]

The data above reveal how a senior engineer assisted his junior engineers and subordinates with knowledge of HVDC transmission lines that he gathered during his visit to Croatia. It seems that he had stored knowledge in his memory through meaningful learning (Ausubel 1961) after observing and analyzing HVDC functioning and drawing meaningful insights about it. Knowledge also seems to be stored as material artefacts, i.e. pictures and videos he took during his visit. Engineers' learning is influenced by Arif through the sharing of pictures and videos and giving a presentation regarding the functioning of HVDC transmission lines. This is aligned with Hutchins' (1995) notion og distributed cognition as the mental processing of Arif's subordinates (who all work as networked team members) takes place while being connected with the mental processing of Arif and with the external memory provided by him. His fellow engineers (who had neither direct experience of working on such projects nor a basic understanding of HVDC) were expected to develop a basic understanding through observation and analysis of pictures/ videos and attending the presentation. With such fundamental knowledge, they are likely to work with foreign experts during advanced stages of the project and have productive project-related discussions with and learning by foreign experts.

Engineers' learning has not always only been influenced by senior engineers but also by peer colleagues who often contribute substantially. A SCADA (supervisory control and data acquisition) project was done for the first time at the start of the last decade in Pakistan to develop supervisory control for power distribution. It was mostly related to computer modelling and installed in major power-distribution centres in Pakistan. While considering new technologies for local engineers, the project managers tried to maximize communication among local engineers through weekly meetings so that they could get feedback on their work from their peer colleagues. A participant reported how such weekly meetings influenced engineers' learning.

> It was only a one-hour activity during any free time in the week. Everybody was supposed to present his work done throughout the week and seek feedback. In this way, he/she did not only have others' points of view on the work; weak areas were identified by others but there was also an opportunity to know more about others' work. In return, the engineers

> not only knew what was going on in the project but this also facilitated them creating compatibility among different forms of engineering involved in the project. [Nayyar]

Here, engineers' learning is influenced by their fellow members of the project team. Weekly meetings of the local project team constituted a collaborative learning activity facilitating and influencing learning of an engineer by his/her participants in the meeting. This facilitation of learning takes place through the identification of weaknesses and problems in a participant's work by his/her fellow participants in the meeting, and their suggestions about possible ways to improve the work. Second opinions from others offer a different perspective on novel work which can be easily overlooked by humans. The data reflect that the identification of such overlooked perspectives in these weekly meetings influence an engineer's learning and leads him/her to ponder on those perspectives. This is also a way of knowing about others' work, which helps them to integrate the work of different forms of engineering, such as civil, electrical and mechanical, in overall consultancy work. Such a weekly meeting also helps develop the coherence and integration among different engineering works being done in a project.

Engineers' learning has also been influenced by the project manual developed by a divisional head for his subordinates. The FEWS project began in 1970s and was later upgraded in almost every decade according to the advances in relevant technologies. During a recent upgrade, the vice president (VP) of a division developed a project manual to help junior engineers understand the project and relevant technologies. The VP reported what the project manual includes and how his subordinates learn FEWS technology through studying it.

> In the FEWS project, I prepared a project manual comprising modelling and schematizing FEWS technology with local on-the-ground conditions and relevant calculation methods and formulas once I became head of the division. I gave it to all the junior engineers and advised them to work on the concept design of the FEWS upgrade project after studying FEWS technology installed earlier. In response, [after learning from the project manual and working on respective parts of the consultancy work] they presented their work, followed by feedback, the identification of mistakes and suggestions made by us to address those mistakes. This helped them to understand the basic engineering work, concept design, formulas and calculations used in the project. [Maqsood]

Given that the junior engineers are BSc qualified and have some experience of NESPAK, they were able to understand FEWS technology somewhat through studying the project manual and became able to work on concept design. They consulted explicit knowledge codified in project manuals, applied this knowledge as well as their tacit skills in doing calculations and operating software in their work and developed their respective parts of consultancy work. In this way, their learning was facilitated and influenced by the VP, who developed a project manual for subordinates, reviewed their work, gave them feedback, identified mistakes and suggested solutions. They learnt the basics of the project and FEWS technology, which was expected to enable them to work on advanced stages of the FEWS upgradation collectively with foreign engineers. Thus, not only is the cognitive learning of all the junior engineers informed by the same external memory i.e. the project manual, but their cognition and mental processing also take place while being connected with the cognitions of each other and that of Maqsood (Hutchins 1995). This helps develop better coordination among participants of the engineering consultancy practice.

It was revealed through data that some project managers use case/problem-based learning to assist their subordinates' learning. Given that team leaders/project managers are unable to study a technology from scratch, due to their many commitments, they give such problem-based tasks to their subordinates for initial work. This method was used in analyzing the site conditions and developing concept design in NJHPP. Shahbaz explained how he influenced his team members to learn about a new technology for this project.

> The best way I used was to give them [subordinates] a case/problem, ask them to explore [relevant theories and models] and acquire relevant knowledge, solve the problem/case and share their findings with me. Once shared, I evaluate it from my understanding and point out more ways to improve the solution. In NJHPP … we planned for a combined study … So, under my supervision, the project team studied tunnel engineering extensively in available texts and foreign project reports; compared them with on-the-ground project conditions; and compared the output of manual calculations with that of software. I assigned different tasks to different colleagues while I was also studying tunnelling techniques at the same time. After they worked, we had long deliberations over their work, identified problems in the design and explored ways to address those problems. (Shahbaz)

The engineers learnt through studying relevant theoretical literature, analyzing relevant technologies and understanding technological congruence with the site conditions through different site analyses. It looks to be a mode of distributed cognition (Hutchins 1995) as engineers studied academic texts and previous project reports and learnt tunnel technology while being connected with their managers and other team members. So, their cognition takes place either in parallel or in coordination with each other. However, while doing their allocated tasks individualistically, they seem to be learning through cognitive learning. For instance, they seem to be storing calculation formulas in their cognitive memory (receptive rote learning (Ausubel 1961)); and analysing a wide array of information/theories regarding tunnel engineering and project site's conditions, finding optimum solutions for the project related problems and memorizing those solutions in their cognitive memory (cognitive discovery learning (Ausubel 1961)). They do not only share such cognitive knowledge (learnt through cognitive learning and distributed cognition) with their team members in order to ensure coordination within the project team, as distributed cognition argues (Hutchins 1995), but also utilize their existing cognitive and explicit knowledge such as calculation formulas and methods (acquired earlier) in performing the activity of site analysis. Thus, their learning seems to be a mix of both cognitive learning and knowing in practice with the role of distributed cognition used as a conceptual rapprochement between these contending perspectives of learning. Since the team leader was also studying tunnelling technology at the same time, he became able to supervise and influence their learning through reviewing work done, sharing his insights for improvement, addressing overlooked issues and ways to address them.

Most of NESPAK's managerial-level engineers believe in helping their subordinates develop, because then, after certain training and development, they are likely to take up less of the time of senior engineers and do most of the work independently. This, as a result, eases things for senior engineers. A participant reported the overall crux of Managerially Influenced Learning.

> They [junior engineers] don't do everything [moderate level work] on their own due to the lack of expertise … So, I give them hints, ideas, book chapters, journal articles and ask them to study and complete tasks because they have enough time to do dedicated study … We have to train them [junior engineers] in every aspect. For this purpose, we often call them into meetings no matter whether their presence is necessary or not. On this project, I often ask these guys to present their work first at a local team level and then during meetings with the Chinese [engineers]. Further, I ask them to prepare presentations for us that are to be presented by us [anyone from the seniors] at division or project level. This helps them to learn how to respond to the objections and concerns of other participants and foreign partners. [Abdullah]

As the data reflect, senior engineers, even in a small team, assist junior engineers/ subordinates and influence their learning of relevant technologies and engineering methods. The junior engineers are not able to work independently on complex tasks because of a lack of experience. They often do not know which exact sources to study a particular technology being worked on in a project. In such a scenario, senior engineers, as Abdullah mentioned, identify resources such as academic literature, project reports and other relevant material for junior engineers to study and understand a technology and engineering methods. Junior engineers have relatively more time to do such basic detailed study, search and summarize key points and present them to their seniors. The above data also reflect that senior engineers do not only influence their cognitive learning by providing such resources of explicit knowledge, but also provide them with opportunities to develop their tacit skills, such as how to deliberate with others in meetings, as well as presentation skills by presenting work in meetings with the local team and foreign engineers. Preparing presentations for senior engineers also requires learning explicit knowledge as they combine information (Nonaka & Takeuchi 1995) from different sources of knowledge. Knowing tacit knowledge also occurs while preparing presentations, using certain software and preparing answers for questions. The above verbatim quote also reflects that the mental processing of junior engineers also takes place while being informed by the same external memory (Hutchins 1995) such as books, book chapters, research articles or other resources. Such a coordinated occurrence of cognition of all engineers helps them to develop a coordination that is required to perform the socially organized and coordinated practice of engineering consultancy (Gherardi 2013).

Summary of Findings

The critical realist analytical framework for this category is presented below in **table 4.2**. I identified a number of real entities and processes from the verbatim quotes presented above in this section under the category of Managerially Influence Learning. The context related real entities include the local project team and its working norms, consultancy tasks which are to be done at NESPAK level, sources of academic and project related knowledge identified and arranged by supervisors, analysis tools and techniques etc. While project-related real entities include project site conditions and identification of various technologies according to the project site. These real entities are shown in first two columns of the below **table.**

These contextual and project-related factors and entities collectively prompt and enact different actual events and activities (reported in third column of the **table**), such as consulting sources of relevant knowledge suggested and arranged by managers (project manager, team leader etc.), completing civil and other consultancy tasks as per agreed ToRs of the alliance, developing integrated consultancy work across engineering disciplines involved in the project, and exploring the compatibility of engineering methods and technologies with specific project conditions under the close supervision and guidance of managers. Engineers, particularly junior engineers, learn through this teamwork and their learning is facilitated and influenced by team leaders, project managers, divisional heads and peer colleagues. Thus, the empirical reality of Managerially Influenced Learning of engineers is enacted and causally explained by the aforementioned actual events and real entities.

This work enables local engineers to work with foreign partners on advanced stages of a project through learning the basics of a project and relevant engineering methods and technologies. Self-directed Learning (presented in the previous category) also has a logical sequential connection with Managerially Influenced Learning, as learning and work done independently are used as an input in this stage to perform the consultancy work at local level.

Table 4.2: Critical Realist Analytical Framework for the category of Managerially Influenced Learning

Direction of Effects/Causal Explanation (From Cause-to-Effects – From Real-to-Actual-to-Empirical)

Domain of Real		**Domain of Actual**	**Domain of Empirical**
Reported and observed influencing contextual factors (including entities, processes and relations)	**Reported and observed features of consultancy projects (including entities, processes and relations)**	**Inferred composite events and experiences**	**Reported and observed outcomes of mechanisms (and ensuing strategies)**
-NESPAK's project team comprising engineers of different levels and divisions -Working norms -Consultancy work at the local level -Purpose – to complete NESPAK's part of overall consultancy work -Theoretical literature, models and imaginaries of physical laws and processes -Videos and pictures exhibiting engineering methods and technologies -Project reports and manuals -New engineering methods and technology -Processes of consultancy work -Analysis tools and software -Intranet -Meeting room	-Site conditions, such as geological on-the-ground conditions of a site according to which engineering work is to be done -Input and information regarding those conditions -Relevance of earlier projects to the current one -Integration of different types of engineering involved in a project -Presentation of project work	-Watching videos and looking at pictures provided by managers -Studying academic literature provided by managers -Analyzing previous project reports under the supervision of managers -Presenting work to managers and getting their feedback -Discussions with managers -Attending presentations given by managers -Doing problem-based case studies under the supervision of managers -Identification of the relevance of previous projects and their technologies to the current project -Ensuring the integration of different types of engineering involved in a project -Finalizing input and information regarding local conditions -Exploring the compatibility of engineering methods and technology with site conditions -Completing civil work and other consultancy tasks that are assumed to be done at local level according to the ToRs of the alliance	-Managerially Influenced Learning (engineers' learning takes place, being influenced by managers in the activities reported in the third column)

Direction of Exploration (Retroduction: From Effects-to-Cause – From Empirical-to-Actual-to-Real)

4.4 Partner-influenced Learning

Partner-influenced Learning takes place in joint work with foreign partners to transform modern technologies and engineering methods (which are first installed/used in Pakistan-based projects) according to the technological requirements of a project. The compatibility of modern technologies and engineering methods with on-the-ground conditions, particularly the geological conditions of the project site, is ensured through developing compatible concept designs and drawings for projects. There are two types of joint working with foreign partners, through which consultancy work is done. First, foreign experts come to Pakistan and work with NESPAK's team collectively, in close geographic proximity, whether in the project office or on the project site. Second, foreign experts work from their home countries on consultancy work through virtual/ online networks. However, in most projects, foreign partners spend some time in Pakistan, collect required information, attend necessary meetings and complete consultancy work which must be done while being collectively in close geographical proximity. After that, they go back to their home countries and continue to work collectively through virtual/ online networks. They come again as and when required. In this joint work, local engineers learn how to use/ install modern technologies and engineering methods to successfully complete the project and achieve the organizational aim of self-reliance for similar projects in future.

The data presentation and analysis below show the ways in which engineers' learning is influenced by foreign partners collectively performing engineering consultancy.

In the HVDC Transmission Line Project, foreign partners shared a report regarding the technical details of technologies. They also shared a macro-equipped Microsoft Excel spreadsheet with NESPAK engineers to do certain calculations. Following this, both partners worked collectively on different parts of a feasibility study and concept design for the project. The following quote reflects joint working in which local engineers' learning seems to be influenced by the foreign partner.

> SNC's engineers developed a document/report comprising different chapters including different disciplines of core engineering involved in the project, finance, economics and system studies for HVDC transmission lines … our engineers studied their relevant chapters and discussed them with foreign engineers in a similar field … To understand the report and do calculations and analyses, we used a Microsoft Excel spreadsheet (from our foreign partner) equipped with relevant macros. In case we faced problems in understanding anything, we sometimes used a trial-and-error method and sometimes consulted foreign partners for further clarification. So, using the reports and [Microsoft Excel] spreadsheet and with the constant assistance/ guidance of SNC's engineers, we completed a feasibility report and concept design for the project. [Arif]

Consultancy collaboration does not always involve joint working under close supervision and monitoring by foreign engineers. Instead, since local engineers are also qualified engineers as well, as they have already learnt to some extent on their own by doing initial consultancy work on a project, they become able to understand the utilization/ application of advanced technologies. So, they can do relevant consultancy work even with just a moderate level of joint working and facilitation by a foreign partner. In the above account, the foreign partner influenced local engineers' learning by sharing a report (explicit knowledge) and its relevant customized Microsoft Excel spreadsheet for doing analyses and relevant calculations. Local engineers worked on relevant tasks according to their specialties, applied their cognitive learning and explicit knowledge (which they had already learnt via Self-Directed Learning) while using the report and the spreadsheet provided by the foreign partner. They utilize such knowledge in their socially organized doing of the activity of analyzing and making certain calculations. This is in line with Cook and Brown who argue for the *"use of* [existing] *knowledge as a tool of knowing within situated interaction with the social and physical world"* (Cook & Brown 1999, p.383). They work as independently as they can, and the account reflects that they even used a trial-and-error method to solve a problem. However, as they were connected with engineers in a similar field, of a foreign partner, they discussed issues and problems with foreign engineers for further guidance to address these. In this project, sharing only explicit knowledge takes place through sharing reports, spreadsheets and verbal communication.

Further, in this learning about HVDC transmission lines, existing explicit knowledge (available in the form of a report as well as what local engineers have already learnt through Self-directed Learning and Managerially Influenced Learning in the initial stages of the project) and tacit skills are utilized to analyze the report and do calculations and analyses. However, such explicit knowledge is simultaneously studied and learnt through cognitive discovery learning as local engineers study the report and seek solutions (through certain calculations) for the installation of HVDC transmission lines in Pakistan. Thus, their learning seems to be a mix of both cognitive learning and knowing in practice.

The Mangla Dam Raising Project is one of the key projects that NESPAK has done so far. Through personal discussions with NESPAK's employees, I learnt that the height of any dam cannot normally be increased once it is built. However, the Mangla dam had a provision in its basic design to increase its height by 40 feet. However, it was a very complicated and challenging project. NESPAK has a collaboration with MWH US on this project. The quote below reflects joint working with a foreign partner and how local engineers' learning is influenced in such joint working.

> Initially we worked on both [types of] cores,[17] i.e. inclined and straight; however, they [MWH's engineers] suggested building an inclined core after analysing their [both inclined and straight cores'] compatibility with the dam's conditions … They guided us in how to operate a lot of new software. Through analyzing the dam's conditions with this software, they suggested redesigning the foundations because of the extra load and redesigning the galleries to release extra water pressure. We did so while they were supervising and guiding us in each stage. We also installed new pressure gauges, tunnel instruments and pore pressure measurement instruments under their supervision and they trained us while working collectively. Measurement software was also replaced with modern versions in collective work … they told us about new features in modern software and trained us to operate the whole dam's functioning with this software. We did everything with our own hands, but under their supervision. [Haroon]

The above data show the joint working of both local and foreign partners on the project site while existing knowledge and working practices are being shared by MWH's engineers in this mode of working. The knowledge being shared is a blend of both explicit and tacit knowledge. Explicit knowledge includes information/ input of

[17] "The core is a membrane built within an embankment dam to form the impermeable barrier" (Henry 2016, p.1).

evaluations/ analyses being made by the foreign partner; as Haroon mentions, they suggested building an inclined core after evaluating the comparative compatibility of inclined and straight cores with the site conditions. Information about new features in relevant software and modelling tools, conveyed by the foreign partner, is another form of explicit knowledge. On the other hand, shared tacit knowledge includes expertise and skills for analyzing the site, redesigning the galleries in project concept designs and drawings, using appropriate software, operating the whole dam's functioning and the installation of pressure gauges. Such tacit knowledge was shared collectively through performing socially organized and mutually dependent engineering consultancy. In such joint working, they share tacit knowledge through demonstrations and closely supervising and presenting their work to local engineers. These knowledge-sharing processes are in line with those of Nonaka and Takeuchi (1995), i.e. a combination of information, document-sharing and verbal communication for pooling explicit knowledge, plus socialization, on-the-job training and collective work for sharing tacit knowledge.

At the start of the FEWS project during the 1970s, NESPAK surveyed the complete river network of Pakistan, from the Chinese border to the Arabian Sea, and prepared the required input/ data on the river geometry of Pakistan. The first FEWS model was installed in early 1980s. Since then, the model has been continuously upgraded with modern technologies as and when invented. Yawer reports how they learnt during a recent upgrade of the FEWS model in joint working with DHI's engineers.

> In addition to the initial input already developed and utilized in FEWS [in previous phases during the 1970–80s], we surveyed our weather conditions, cloud thickness, wind direction and pressure and moisture levels in the air to

> prepare input/ data for satellite forecasting. Initially, [later,] we sat in the committee room [of NESPAK] with them [foreign engineers], they gave us a presentation about the [revised FEWS] model and its functionality, followed by cross-questioning, debate, discussion, agreement/ disagreement, deliberation and reading project manuals. We also had a working lunch and informal discussions in the same room throughout the meeting. After our initial understanding, we started joint work on an upgrade of the model [FEWS currently installed in Pakistan]. Since they are the creators of the model, they were in the lead; however, model development, its schematization, installation and data input and output were jointly worked on by both partners. We used to sit together at the same desk and work collectively during the development, installation and configuration of the model. We also collectively installed new radars in Lahore, Sialkot and Mangla … In addition to joint working, they gave us formal on-the-job training at the end to further enhance our skills to operate the model, calculate the input and interpret the output to forecast rainfall, floods and damage in case [excess rainfall and flood]. [Yawer]

The above data acknowledge input developed indigenously that offered Self-directed Learning and Managerially Influenced Learning during early stages of the project. Importantly, local engineers' basic learning about the FEWS project took place with the assistance of a project manual developed by the VP of the division (as discussed earlier in section 4.3), which enabled them to work with foreign partners at an advanced level of the project. NESPAK's engineers shared what they had already learnt (through Self-directed Learning and Managerially Influenced Learning) with their foreign counterparts to have coordinated project work. Arguably, such sharing of cognition and coordination within a team is similar to the distributed cognition (Hutchins 1995, Zhang & Norman 1994). In their joint working, DHI's engineers shared explicit knowledge through presentations and post-presentation discussions, deliberations, question/ answer sessions and informal discussions. After developing an initial understanding of what is to be done to upgrade the FEWS model, local and foreign engineers started joint consultancy work for developing the model, its configuration, schematization, installation and operation. Radars were also installed by both partners working collectively for weather forecasting. Thus, not only is their cognition distributed at this stage (Hutchins 1995), but their doing of engineering consultancy practice is also socially shared, organized, coordinated and distributed (Gherardi 2009a, 2013).

Foreign engineers influenced and facilitated local engineers' cognitive learning through presentations, verbal communication, and collectively performing the activities of development, schematization and installation of FEWS model and radars. Explicit knowledge was shared through sharing of documents and survey input and verbal communication. This is in line with the off-loading of cognition and knowledge stored in their cognitive memory to other members of the team using social and technological means (Zhang & Norman 1994). While, tacit knowledge was shared through collective work, demonstrations, socialization and on-the-job training, as argued by Nonaka and Takeuchi (1995).

As shared by the participants, NESPAK has sufficient expertise in civil engineering, so it did the initial civil work independently on the Bhikki Power Generation Project. However, it could not be made final without understanding the technical installation requirements of Combined Cycle Technology (CCT). So, a foreign partner, i.e. Lehmeyer (Germany), introduced a modern version of CCT and shared the technological requirements of civil work for the installation of CCT and its power-generation turbines. Both partners started working collectively to develop a feasibility report, concept design and drawings for this project. Talking about joint working to do consultancy work, Muneeb mentioned:

> Both us consultants initially [collectively] prepared the concept design and drawings for the project. In this process, we were good at civil work while Lehmeyer was good at electro-mechanical work. So, we prepared drawings and a detailed design in alignment with the technological aspects of CCT and power turbines, for which information was shared by Lehmeyer. There were lively meetings as the Germans came here and we used to discuss the design and drawings while sitting at the same table. When they could not be here, we conducted meetings through a video link … Apart from CCT, Lehmeyer introduced new technology for a modern environment-friendly FM200 fire-fighting system. This required specific construction drawings … They helped us finalize the drawings for its installation. [Muneeb]

NESPAK is self-reliant in completing civil work for local projects. Its engineers become self-reliant in performing certain activities because they learn the fundamentals of underlying engineering theories and models and complete basic work in every project before working with the foreign partners. They utilize such explicit and tacit knowledge, learnt both through cognitive learning and practice-based learning, in their collective doing either at local level or with foreign partners. This indicates the distribution of existing knowledge to all members of the project team as argued by the perspective of distributed cognition (Hutchins 1995, Zhang & Norman 1994).

NESPAK's engineers also need certain information from foreign partners regarding technological equipment and its installation so that a compatible concept design and civil work may be developed. Similarly, for this project, the concept design and drawings were developed by NESPAK's engineers in alignment with CCT, for which technological information was shared by Lehmeyer (Germany). So, this reflects mutually dependent consultancy work. The necessary information was shared through both face-to-face and online meetings, discussions and deliberations. That information was utilized when developing the concept design and drawings. So, foreign engineers influenced the learning of local engineers through sharing technological requirements for the development of specific civil work. Not only was joint work done in the geographic proximity of a foreign partner, but necessary information, knowledge and guidance seem equally to have been shared online as well.

In the project of the turbine refurbishment of Mangla Dam, consultancy work included an assessment of existing power turbines and their electro-mechanical parts for replacement or repair. NESPAK had never handled such projects, so foreign experts from MWH USA were included in a consultancy alliance. They demonstrated by performing real work for local engineers. In this way, they shared knowledge about the assessment of turbines with local engineers who learnt about it in joint work with foreign partners. Nasir mentioned:

> Only they were capable to make assessment while we were assisting and facilitating them in the whole process. They consider us CHOTA[18] in the joint work so CHOTA [we] also learnt in working with senior experts … This was sort of on-the-job training as we worked collectively … and they continuously guided us through practical demonstration of the whole process … The work was performed through seeing and touching turbines' parts, listening their voices, observing the working of whole turbines and

[18] The term 'CHOTA' is particularly used in Pakistan for young boys (below 18 years) working in mechanical workshop to learn the art of vehicle repairing.

> their parts and observing foreigners working on it who assessed their functioning. We asked questions about what the indicators of a part being faulty, how it looks like etc. and they answered it through practical demonstration. [Nasir]

Given that turbine refurbishment is complex, technical and applied work for which local engineers had no expertise, they worked as helpers or assistants of foreign engineers on this project. Consultancy work was done under the close supervision of foreign experts, who shared tacit expertise, processes and activities of the assessment of turbine parts, identifying their faults and making decisions to replace or repair parts. Such tacit expertise and skills could only be shared through closely supervised on-the-job training and apprenticeships, such as joint working in which foreign engineers demonstrated the turbine assessment process practically to local engineers. In this process, engineers did not only work through their minds but also through their bodies and senses, such as sight to observe the current condition of turbines and their parts, touch to identify faults through touching, and hearing to listen to the sound of turbines while functioning. The assessment process was purely tacit and personal and could not be shared and learnt without such joint working and involvement of the body and senses. Foreign engineers, in this case, influenced the learning of local engineers through practical demonstration.

For NJHPP, NESPAK hired two Swiss professors. Each of them is a world-renowned expert in civil engineering and tunnel engineering for hydropower projects. NESPAK's team was working practically on the concept design, while the professors were constantly supervising and providing guidance at every stage. Shahbaz explained how local engineers learnt such complex consultancy work while being supervised by foreign experts.

> They [Swiss professor] suggested to us that we use a soft-layer technique in alignment with the fault line, so that the dam can absorb shocks. This concept was further explored by us in relation to the on-the-ground conditions, while remaining in constant communication and having discussions with them. They gave input in the form of calculation methods and formulas, checked our simulation results, gave feedback and made suggestions to address problems. For instance, they suggested using a pseudo static or response spectrum approach for the approximation and estimation of outcomes as a result of earthquake shocks. We subsequently used these techniques in our consultancy work. [Shahbaz]

The above data reflect an amalgamation of Self-directed Learning and Managerially Influenced Learning with Partner-influenced Learning. Local engineers, after studying engineering theories and models of tunnel engineering as shown in the discussion of Self-directed Learning, utilize objective knowledge (such as calculation methods, formulas, solutions, and meaningful information) in their doing of consultancy activities collectively with foreign professors. NESPAK's engineers would be unable to perform their consultancy activities without sharing of such objective knowledge with foreign professors and its application in the collective doing. Hence, it seems impossible for engineers to perform the practice of engineering consultancy without application of cognitive learning and objective knowledge – indicating a necessary rapprochement between cognitive learning and knowing in practice perspectives through the concept of distributed cognition.

In this joint working, Swiss professors influenced local engineers' learning about how to develop the concept design for the project through online communication. They suggested and guided their use of a soft layer technique, which was further studied/ explored by local engineers individualistically, as well as in teamwork, so that a soft layer could be developed in line with on-the-ground geological conditions of the dam. This guidance from Swiss professors involved sharing explicit knowledge about the technique. Their guidance was on certain calculation methods, such as a pseudo static or response spectrum. Further knowledge was shared through reviewing documents, discussions and feedback. Thus, objective knowledge of the aforementioned engineering methods has been shared by the Swiss professors through social and technological means – that is in line with the off-loading of cognition as argued by distributed cognition (Zhang & Norman 1994). Such objective knowledge was utilized by local engineers to analyse the project site, do analysis tests and develop the concept design. Further, engineers studied the soft layer technique theoretically and included its application in concept design development; they transferred knowledge from minds to hands and applied it in practical engineering consultancy work. It implies that the engineers' learning was not informed only by cognitive or practice-based learning but instead seems to have been a combination of both learning perspectives.

Summary of Findings

Similar to the categories and their critical realist analysis presented earlier in the chapter, the category of Partner-influenced Learning is also presented through a critical realist analytical framework as shown in **Table 4.3**, below. The context related entities which result in and shape this category include joint working between NESPAK and foreign engineers, the purpose of joint working, i.e. to successfully apply and install the required technology in the project, NESPAK's office and project site, their respective working dynamics, specific ICTs, scientific instruments and analysis software. Project-related entities and factors, as reflected in the second column of the table below, include technological requirements of the project, local working conditions, project concept design, drawings and overall consultancy work.

These contextual and project-related factors, entities and processes collectively enact certain events and activities performed by both partners, which are presented in the third column of the table. These activities are mainly related to collectively completing consultancy work, sharing required information, knowledge and consultancy practices by both partners, supervising and assisting each other both in NESPAK's office, as well as on the project site, and such like.

These activities are reportedly as having effectively taken place in all projects through joint working and enact the empirical reality of Partner-influenced Learning exhibited in the fourth column of the table. In other words, engineers' Partner-Influenced Learning takes place via the underlying contextual and project-related factors, and subsequent activities and events that took place during joint working with foreign partners. NESPAK's engineers learnt modern engineering methods and technologies from their foreign counterparts through joint working. Thus, their learning was also influenced by their foreign partners.

However, in the case of working with a Chinese partner, the mechanism encounters a barrier and there was a significant gap and lack of collective work and required cooperation. While, NESPAK's engineers could not do something significant that might change the attitude of the Chinese engineers towards the project work. In result, engineers' learning did not reportedly take place while working with the Chinese partner. Hence, the engineers had to learn on their own through a laborious method and their Partner-Influenced Learning is seriously compromised.

Table 4. 3: Critical Realist Analytical Framework for the category of Partner-influenced Learning

Direction of Effects/Causal Explanation (From Cause-to-Effects – From Real-to-Actual-to-Empirical)

Domain of Real		Domain of Actual	Domain of Empirical
Reported and observed influencing contextual factors (including entities, processes and relations)	**Reported and observed features of consultancy projects (including entities, processes and relations)**	**Inferred composite events and experiences**	**Reported and observed outcomes of mechanisms (and ensuing strategies)**
-Joint working with foreign partners in close physical proximity and through online networks -NESPAK house (NESPAK head office) and its working conditions -Purpose of joint working – to meet the technological requirements of the project and build self-reliance for future projects -State-of-the-art engineering methods and technologies and their first-time application and installation in Pakistan -Explicit and tacit knowledge -ICTs -Scientific models -Scientific instruments -Analysis tools and methods -Calculation formulas and methods -Simulation test	-Project site and its working conditions -Project concept designs and drawings -Project technological and administrative requirements -Integration and compatibility between civil work, technology and site conditions -Problems and issues related to consultancy work -Site supervision	-Sharing of explicit and tacit knowledge of engineering methods, technologies and consultancy and general practices by both partners -Sharing of project site and local environment-related information by NESPAK -Sharing of state-of-the-art engineering methods and technologies by foreign partners -Sharing of analysis tools, such as software, customized Microsoft Excel spreadsheets and analysis software by foreign partners -Customization of engineering methods and technologies for specific site conditions -Installation of scientific instruments with close supervision and assistance from foreign engineers -Assessment of mechanical parts under the close supervision of foreign partners -Presentation by foreign engineers and post-presentation discussion & question/ answer session -Collectively developing scientific models, and their schematization, configuring and installation in the project -Collectively installing scientific instruments -Doing simulation test with the assistance of foreign partners -Collectively performing site supervision -Discussions, debates and deliberations through online communication and in live meetings -Collective working, supervision and assistance, on-the-job training, observation, practical demonstrations, socialization during collective working -Sharing of reports and codified knowledge	Partner-influenced Learning **Reported Strategies when the mechanism encountered a barrier:** **Reported in Alliance with Chinese Partner** NESPAK engineers made different attempts at an individual level (e.g. personal association and friendships, persuasion etc.) and at an organizational level (e.g. persuasion and getting the client involved). Despite this, these strategies were reportedly ineffective, so local engineers' learning was reportedly compromised

Direction of Exploration (Retroduction: From Effects-to-Cause – From Empirical-to-Actual-to-Real)

4.5 Conclusion

The core category of Learning in Engineering Consultancy Practice is constituent of three interrelated categories: Self-directed Learning, Managerially Influenced Learning and Partner-influenced Learning. Being part of organizational consultancy work, these activities were performed by NESPAK's engineers in different phases of a project. As a result, NESPAK's engineers learnt explicit and tacit knowledge of new technologies and engineering methods to build self-reliance for future projects. Their learning of explicit and tacit knowledge seems to have been a mix of both cognitive learning and knowing in practice.

Engineers' learning in these activities contributes towards their overall learning of doing engineering consultancy. These activities are interrelated in that Self-directed Learning and input developed in independent working are used in Managerially Influenced Learning and consultancy work being done by a local project team. Further, engineers' learning and work done in two earlier phases of the project are used in consultancy work being performed in joint working with foreign partners. Engineers' learning of installation of state-of-the-art technologies and engineering methods is influenced by foreign engineers, Partner-influenced Learning.

Further, an analytical framework for the findings of each category has been given in tables shown at the end of each section. These tables further contribute to developing the comprehensive learning model presented in Figure 6.1 in Chapter 6.

The next chapter presents and analyzes the findings of the core category of a Symbiotic Learning Alliance, involving findings about the influence of different factors on sharing knowledge and working practices between local and foreign partners during joint working.

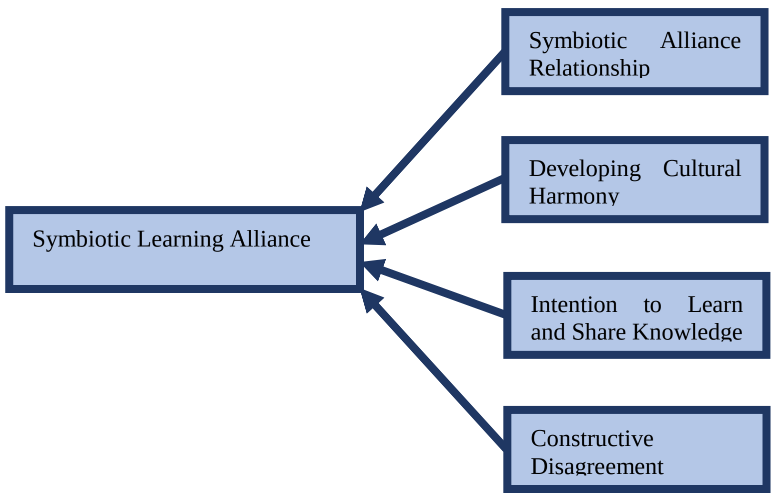
CHAPTER 5: PRESENTATION AND DISCUSSION OF FINDINGS II – SYMBIOTIC LEARNING ALLIANCE

5.1 Introduction

Sharing existing knowledge and consultancy practices by consultant partners is of great importance in order to provide the required consultancy in a project, as argued in the preceding chapter. Such knowledge and consultancy practices are utilized/ performed to provide engineering consultancy for a project. Knowledge and consultancy practices, particularly those of foreign consultants, are developed in entirely different organizational, sociocultural, historical and economic settings (Hong et al. 2006). Thus, these are situated in, and tied to, their original contextual settings and distributed among specific human and non-human actors through particular relational arrangements in their home organizations. Thus, these need to be transformed/ customized for a local project according to a project's technological requirements and site conditions.

This chapter presents and analyzes a core category of **Symbiotic Learning Alliance,** involving an alliance between consulting partners for cross-border sharing of knowledge and consultancy practices. The core category comprises four categories, as reflected in **Figure 5.1**. These categories present and analyze various aspects that facilitate or hinder cross-border sharing of knowledge and consultancy practices. These categories also report different ways that NESPAK engineers use to address hindrances which occurred in the learning of subject engineering methods and technologies and the sharing of knowledge and consultancy practices by foreign partners.

Figure 5.1: Symbiotic Learning Alliance



Source: (Author)

The next **section 5.2** presents the category of Symbiotic Alliance Relationship, and it analyzes the nature of a consultancy alliance, respective positions and the roles and responsibilities of each partner, issues arising as a result of wrongdoing by any of the partners and the nature of working and personal relationships between local and foreign engineers. The category also explains what makes the alliance more conducive for sharing knowledge and consultancy practices. Then, **section 5.3** presents the category of Developing Cultural Harmony, which includes two key aspects. These are the different working styles of local and foreign engineers and the language barrier between them. The category also presents different strategies to bridge those differences and address language barriers, plus the effectiveness of those ways.

The category of Intention to Learn and Share Knowledge is presented in **section 5.4.** The category covers the degree of intention of local engineers to learn as well as the extent of foreign engineers' willingness to share knowledge and consultancy practices, along with their respective underlying reasons. The category also reports different methods that NESPAK engineers use to convince unwilling foreign engineers to share knowledge. The last category of Constructive Disagreements is presented in **section 5.5**. The category highlights the necessity for constructive disagreements in joint working for higher learning, sharing more knowledge and refinement of consultancy work, issues over which disagreements arise, ways to address them and ways through which knowledge-sharing and learning increase as a result of such disagreements.

Similar to Chapter 5, the respective findings and analyses are also displayed at the end of each category, as a table comprising an analytical framework. The analytical framework is developed according to the key assumptions (e.g. stratified reality and their causation) of critical realism, i.e. the philosophical position of this research. These findings are explored through the critical realist retroduction mode of inference (Danermark 2002) and vertical exploration of deeply located entities, factors and processes that cause and enact the phenomena under study. In this way, the current research explores underlying contextual and project-related influential entities, factors and processes, and the ways they cause and enact events and experiences, and subsequently final outcomes (the categories explored in this research). Thus, the current research not only explores the surface-level characteristics of these categories but also their underlying factors and entities (e.g. what enacts them or makes them happen), and the ways they are enacted (e.g. how they come into being). The chapter concludes with a brief summary of the findings presented throughout the chapter.

5.2 Symbiotic Alliance Relationships

The first of four categories of Symbiotic Learning Alliance is Symbiotic Alliance Relationships involving the formation of an alliance and deciding on its terms of reference (ToR). The alliance relationships between NESPAK and its foreign partners are mutually dependent, integrated and symbiotic. This is why this category is called Symbiotic Alliance Relationships. An alliance relationship involves mutually beneficial collective work (based on the consultancy fees/profit decided upon according to each party's contribution to the overall consultancy work) in a consultancy alliance.

The category further covers deciding the positions, roles, responsibilities and consultancy fees of each partner, plus personal cordial relationships among the engineers of both partners. The formation of an alliance and developing formal and informal relationships set the stage for engineering consultancy to be provided to local projects. Data quotes and their analyses are given below:

As the key focus of the study is the learning of NESPAK engineers in consultancy alliances with foreign partners while working on a Pakistan-based infrastructure project, it is necessary to first decide the ToR of an alliance immediately after NESPAK wins and is assigned a project. External factors, such as the preferences of the client and funding agency, a project's nature, size and budget and the respective capacities of consultant partners are also considered to decide a project's ToR and positions for members of the project team. The verbatim quote below reports the process of forming a consultancy alliance and deciding its key features:

> Consultant partners decide lead and associate positions and the shares of consultancy fees, divide up certain positions such as project manager, geo-tech engineer, hydrologist etc., considering the qualifications of engineers from each firm. The lead partner has a higher level of responsibility as they are directly responsible for the success or failure of a project. The role of a foreign partner is not very significant at the start of a project and they work from their home countries. However, they visit Pakistan for joint working when there is a high-tech work which needs close physical supervision. [Maqsood]

As reported above, by Maqsood, both partners define the structure of the alliance and inter-firm dynamics, which determine the respective roles of each partner and the nature of knowledge to be shared. In fact, this is a context which determines knowledge-sharing and its formal and informal mechanisms. NESPAK's consultancy alliances are a 'loosely-coupled' form of strategic alliances because of the 'network-like' nature of consultancy firms (Boussebaa et al. 2014). In NESPAK's alliances, different roles are allocated to different engineers of the project team, comprising both partners, to perform integrated engineering consultancy work together. The positions of the partners (e.g. lead or associate partner) are also decided at this stage, but this does not have significant implications for the sharing of required knowledge because this is the sole objective of the alliance, which is often reinforced by earning consultancy fees. However, the leading partner is still likely to be more interested in knowledge-sharing than the associate partner because of its ultimate responsibility for the success or failure of a project.

In addition, it is also decided between the partners when foreign partners will join the project in Pakistan. As discussed in the last chapter, NESPAK's local project team completes initial level work independently and have meetings with foreign partners through a virtual network. Explicit knowledge is and can be shared through such online meetings and communication. However, during the advanced stages of a project when advanced complex engineering methods need to be applied or technology is to be installed, foreign engineers join the local NESPAK team and both partners start working collectively, in close physical proximity, and share tacit knowing and skills. Thus, working through networks or in close physical proximity has different implications for the sharing of specific types of knowledge.

The international consultancy alliance at NESPAK forms a symbiotic relationship between consultant partners, wherein their roles and responsibilities are mutually dependent. The project's accomplishment normally requires knowledge of modern technology by foreign partners and knowledge/ input about local conditions from NESPAK. Both partners work together in an inter-dependent manner using knowledge of modern technology and input about local conditions to transform technology for the current project. Shahbaz mentioned the following:

> There is a symbiotic relationship between us, because completion of the project is to the benefit of each partner. We seek knowledge about new technologies, advances and improvements in the field while sharing input about our local geological, economic and political/ legal conditions. We

> [both partners] then collectively work to transform technologies according to local specific conditions. So, the contributions of both partners are of great value. [Shahbaz]

As reported by Shahbaz, the NESPAK consultancy alliance requires valuable contributions from both partners. NESPAK's project team analyzes the project site while the foreign partner introduces modern technologies and engineering methods to be used/ installed in projects. Once the local project team completes the necessary site analysis, it starts working with foreign engineers. Both partners perform their roles in joint working in an inter-dependent manner, in which information about site conditions is shared by NESPAK while knowledge of modern engineering methods and technologies is shared by foreign engineers. Both partners collectively transform/ customize technologies and engineering methods according to the specific site conditions of a project, as the above quote reflects. So, the contributions of both partners are of equal value for the completion of a project and their joint working is mutually dependent and symbiotic. If any member of the project team does not share required input, knowledge or consultancy practices, the whole project is affected and may be delayed or even abandoned.

The symbiotic nature of the alliance is also reflected in the quote below; one mistake/ problem in any engineering process/part may lead to faulty consultancy work or concept design, which can result in project delay or abandonment. In this case, all partners suffer and can lose their share of consultancy fees. A crisis in the consultancy alliance for the Munda Dam Project was caused by a mistake by an engineer from one of the consultancy partners, as reflected in the verbatim quote below, which reflects mutual dependence in consultancy work:

> The concept design didn't seem workable. So, we sat together and there were many deliberations by foreign and NESPAK experts/ evaluators; it was concluded that the flood forecasting magnitude was wrongly calculated, being 30 per cent on the high side. The mistake was made by a hydrologist from ACE. The concept design was thus under-designed. Such an under-designed dam would not be affordable, because the dam could be breached in the case of a higher flood than the forecast amount. WAPDA Pakistan (the client) and the Planning Commission of Pakistan raised concerns over this issue. WAPDA was of the view that one year had been wasted, so the whole JV consultancy should be penalized. However, we are still shifting responsibility onto each other and the project has been suspended for two years. [Abdus Sattar]

In discussions with Abdus Sattar, I came to know that there was a consultancy alliance among four firms. Of those, two were foreign firms, i.e. SMEC Australia and Nippen Koei Japan, while two were local firms, i.e. NESPAK and Associate Consultants of Engineering (ACE). The above data report a symbiotic and interdependent working relationship among consultancy partners where a mistake made by an engineer from one firm resulted in faulty concept design and a delay in project completion. This occurred although shares of the consultancy fee were decided between the alliance's partners, which normally drives consultancy partners to complete their allocated work effectively. However, this mistake by an ACE engineer might have been due to his incompetence or negligence. Irrespective of the reason for the mistake, the whole project and consultancy partners suffered because of the symbiotic nature of this engineering consultancy.

It has also come to my knowledge through personal communication with the participants that the client, the government of Pakistan in most projects, often puts pressure on NESPAK to complete projects in less time and with extra features. However, NESPAK's engineers manage such over-assertiveness from the client through a cordial relationship with the partner consultant, as Adeel mentioned:

> We [both consultants] have very good professional and personal relationships. To give them more respect and make the relationships warmer, I invited them [foreign engineers] to dinner at my home and introduced them to my family. They also showed us picture of their families. Similarly, they serve us warmly when we go there. This makes the professional relationship very good at a personal level, which subsequently results in better mutual understanding. As a result, they will argue with the client over their illogical demands and refuse them on technical grounds, which we cannot do as employees of NESPAK. [Adeel]

As the above data suggest, the warm personal relationship between engineers from both partners offers extra support for each other, particularly NESPAK's engineers. The client has certain political objectives and thus undue demands, such as the completion of a project before a general election (which is sometimes unrealistic), as well as certain features of a project, such as discounted rates for general public to get political mileage. In such situations, NESPAK's engineers, due to their cordial relationships and good understanding with foreign engineers, know that there should be direct communication between the client and foreign engineers because foreign engineers will not accept pressure and will refuse the client directly on technical grounds. This is not something that NESPAK's engineers learn formally and intentionally. Instead, this took place during a meeting between NESPAK, Lehmeyer's consultancy team and the Chief Minister (CM) of Punjab, at the Bhikki Power Project, when a German engineer directly refused CM and replied that the project could not be completed within the desired timescale. Such situations sometimes offer learning about new aspects in alliances, which are not thought about or intended beforehand. NESPAK's engineers now use this method in order to avoid direct conflict with a client and possible negative repercussions for their careers. Theoretically, such learning is in line with Structuration Theory (Giddens 1984), as NESPAK's engineers interact with the client according to certain social structures, such as organizational norms, values and principles. However, their agency allows them to act differently because of their power and knowledgeability, so they do not reproduce but rather transform the practice of interaction with the client (getting it done through foreign engineers), according to the emerging context of consultancy work.

Summary of Findings

The category of symbiotic alliance relationships reports that relationships between local and foreign partners are interdependent and symbiotic. **Table 5.1** presents analytical framework to present findings of this category which are drawn through critical realist retroduction mode of inference. As mentioned in the last chapter, deep-seated real realities have been vertically explored through taking lead from empirical experience to real reality – indicating direction of exploration from surface level empirical experience -to- actual events -to- deep-seated real reality. While, the direction of effects is from deep-seated real realities -to- actual events -to- empirical experiences. In this way, multi-layered realities have also been stratified with their causal relationship.

As reflected in the first two columns of **Table 5.1**, various contextual and project-related real entities and factors such as cause and influence the formation of international consultancy alliances with foreign consultancy companies. The main factor behind the formation of such alliances is the NESPAK's lack of expertise and knowledge regarding engineering methods and technologies required by clients/ projects. In addition, NESPAK always seeks to acquire state-of-the-art engineering knowledge and technology so as to boost self-reliance for similar projects in the future. The project-related factors that are to be decided in an alliance formation are reported in the second column.

The third column of the table reflects the reported events, activities and experiences that occur in the result of formation of such alliances. These include deciding about the: ToRs of the alliance, roles and responsibilities of each partner, and lead and associate positions of the partners and their respective shares of consultancy fees. NESPAK usually completes civil work and develops input regarding local conditions, while foreign partners are responsible for designing/ recommending/ applying state-of-the-art engineering methods and technologies, with the assistance of NESPAK. However, such project consultancy work is symbiotic and mutually beneficial because the consultancy work performed by both partners needs to be compatible, integrated with each other and transformed into a unified engineering consultancy. Foreign partners work from their home countries when joint work only requires the sharing of explicit codified knowledge and reviewing and giving feedback on work done via telephone calls, emails and online meetings. However, they visit Pakistan and do complex and practical consultancy work collectively in close physical proximity, at which point tacit knowledge and consultancy practices are shared through practical demonstrations, observation and assistance to/ supervision of each other. Thus, such aforementioned real entities and their resultant causal events and activities further constitute and shape the symbiotic alliance relationship which are quite conducive, and mutually beneficial, for learning of NESPAK's engineers and cross-borders sharing of knowledge. However, NESPAK does not have such a conducive and symbiotic alliance relationship with Chinese partners which is covered in section 5.4.

Table 5.1: Critical Realist Analytical Framework for the category of Symbiotic Alliance Relationship

Direction of Effects/Causal Explanation (From Cause-to-Effects – From Real-to-Actual-to-Empirical)

Domain of Real		Domain of Actual	Domain of Empirical
Reported and observed influencing contextual factors (including entities, processes and relations)	**Reported and observed features of consultancy projects (including entities, processes and relations)**	**Inferred composite events and experiences**	**Reported and observed outcomes of mechanisms (and ensuing strategies)**
-Award of a Project by a client -Unavailability of required expertise locally in Pakistan -Pakistan being the user, not innovator, of new technologies and behind developed countries -Formation of a consultancy alliance with foreign partners to address the unavailability of expertise and knowledge -Purpose of completing the project as well as gaining self-reliance for future projects	-Agreed Terms of Reference (ToRs) for a consultancy alliance -Positions and roles of each partner -Tasks to be done by partners independently as well as collectively -Nature of the tasks -Shares of consultancy fees	- Assessment of the expertise required -Deciding the positions and roles of each partner and their shares of consultancy fees -Deciding the tasks to be done by each partner independently and collectively -Deciding the physical proximity of foreign partners for project work -Developing and maintaining symbiotic working and personal relationships -Developing personal relationships -forming an agreement for a conducive alliance for sharing required knowledge (not completely in the case of an alliance with a Chinese partner)	-Symbiotic Alliance Relationship – A well-set stage for joint consultancy work being done by NESPAK and foreign partners **Reported and observed strategies for when a mechanism encounters a barrier:** -Independent working and learning by NESPAK's engineers -Reporting to the client

Direction of Exploration (Retroduction: From Effects-to-Cause – From Empirical-to-Actual-to-Real)

5.3 Developing Cultural Harmony

The category of Developing Cultural Harmony involves cultural differences between the respective working styles of NESPAK and their foreign counterparts, as well as language barriers between them and addressing those differences/ barriers to develop cultural harmony. The data below reflect the different working styles and language barriers that NESPAK's engineers face while working with foreign partners in consultancy alliances. The category also reports ways to develop harmonious working styles and address language barriers, along with the usefulness of those methods. The findings are presented and analyzed below:

International consultancy alliances are complex arrangements formed to provide consultancy collectively for a local project. When people belong to different sociocultural, economic and professional settings, their ways of approaching work and workplace dynamics are likely to be different. However, NESPAK has worked with foreign experts/ partners since its inception, yet there remain different working styles of NESPAK and foreign engineers. As reported below, in the Mangla Dam Raising Project, local engineers faced significant differences between their own approach to work and those of foreign engineers. Such differences increase the difficulties for the knowledge-sharing process between both partners and learning of the engineers until those differences are bridged. Haroon talks about these differences and their effects on the knowledge-sharing process.

> There is a difference in time management. They come on time, work dedicatedly work for 8 hours and do not do politics.[19] However, we arrive late and sit late in our offices. [Further,] during working hours, we do many things, such as chit-chat, socialization and making phone calls to family and friends … [As a result], we continue working after normal working hours and even at the weekend … On social evenings, foreigners are very frank, having informal chit chat … and willing to discuss any issue, including work-related issues. Besides, some of us are also reluctant to talk to them because of language barriers, [Haroon]

The data above show that NESPAK and foreign engineers have their own respective ways of working, informed by local sociocultural, historical and organizational settings. Coming late to the office, extra socialization and unnecessary use of phones/ mobile phones seem to be established working norms at NESPAK. In this way, NESPAK's engineers share behavioural disposition or habitus of local culture and their working style is informed by these dispositions or habitus. On the other hand, the clients i.e. Government of Pakistan and Government of Punjab want to get the project completed in less than the due time to achieve certain political ends. As a result, engineers have to work late hours and even at the weekend. Unlike NESPAK's engineers, people from Western countries seem to have a more formal culture, so they do not tend to socialize much in the workplace. The same things happen in NESPAK's consultancy alliances, as people from Western countries who work with NESPAK engineers are more formal, observe office hours and only do official work during normal working hours. This reflects a clear difference between the working styles of local and foreign engineers,

[19] Politics in this verbatim quote means gossiping, lobbying and grouping. Foreigners do not waste their time doing these activities.

which can adversely affect cultural harmony and subsequent knowledge-sharing between them. Besides, the medium of interaction is English in this alliance, so some local engineers feel some hesitation in interacting with foreign engineers. Although English is widely taught in Pakistani universities, as well as also being an official language in Pakistan, it is still a second language and some engineers feel somewhat unable to discuss technical and innovative issues in more detail.

Further, NESPAK and foreign partners have different ways of interacting with the client. As mentioned above in section 5.2, NESPAK's engineers tolerate the over-assertiveness of clients, i.e. the Governments of Punjab or Pakistan. However, foreign engineers do not seem to be influenced by such over-assertive clients. Hence, clients cannot assert their authority over foreign engineers in the same way that they do with local engineers. In the Bhikki Power Generation Project, NESPAK works in a consultancy alliance with German Lahmeyer. The verbatim quote below reflects how a Laymeyer engineer respond to Chief Minister of Punjab province differently who is over-assertive with NESPAK engineers:

> Germans are very blunt and straightforward, they do not talk politically and do not give their sugar-coated opinions, rather they talk very specifically and to-the-point. Contrary to that, we are very careful and diplomatic while talking to powerful people [clients] … For example, Chief Minister Punjab said [in a meeting]: "We want you to complete this project in ten months." A German bluntly replied: "How is that possible? It cannot be completed in the time. That is totally unrealistic." If some of us had been in his place, he must have replied with a big YES, because we have a flattering and boss-pleasing attitude ... [The blunt response of the German proved correct later on as] our government officials later recognized that Germans didn't paint us a fake but rather a true picture of project completion … [Besides,] their bosses also work with their own hands, they do not take care for position/protocol and even work on a machine to understand a process. However, we maintain protocol and are

> used to telling our subordinates: “Listen young man!!! go, check that machine and let me know about its problems.” [Muneeb]

Similarly, Mohsin talked about differences in the priorities of local and foreign engineers he had observed while working with foreign consultants on NJHPP.

> They [foreign consultants] stress that required facilities, such as software, digital database, email, good Internet speed, printer, intranet, computers, digital storage, ICTs etc., should be available and in very good order. They don’t care if the polish on a chair is faded but they cannot tolerate any problems with the aforementioned resources. On the other hand, our management’s only focus is on office furniture, fixture, carpets and the like. [Mohsin]

German engineers will confront a client as they seem to have grown up in a culture where such assertiveness is not acceptable. Contrary to that, NESPAK engineers are unable to directly negate a client’s undue demands due to the assertiveness of their senior management and potential negative repercussions for their career growth. Thus, they don’t challenge unrealistic demands of an assertive client but rather seek to please and flatter. At the same time, they understand that their foreign counterparts are doing a good job by boldly confronting clients when necessary. In this way, an atmosphere of mutual cooperation and cordial relationship between local and foreign partners is developed, which is essential for sharing knowledge and consultancy practices, also knowledge of managing an assertive client. In addition, Pakistani people are stratified socially, they value such stratification and maintain the protocol of their positions due to ‘status-centric orientation’ (Hafeez 1985). Being more concerned with office furniture and fixtures instead of high-quality ICTs indicates how much Pakistani people are status-centric, even 33 years after Hafeez's (1985) findings. This is why they view working with their own hands as contrary to their positions' protocol and believe that they are meant only to give orders. However, as NESPAK's engineers have long experience of working with foreign consultants, and many of them have already worked in foreign countries, they have somewhat crossed the bridge and follow the ways of working of their foreign counterparts, particularly during joint work. But they become status-centric and maintain position protocols while working with local colleagues.

When such differences exist, both local and foreign partners need to be much more cooperative and accommodating of each other in order to have the desired level of harmonious working. As they need access to each other's knowledge and consultancy practices in order to develop concept design for local infrastructural projects, it is necessary for them to understand and adopt the ways of working of each other, also cultural differences and to bridge those differences. However, as NESPAK is assumed to seek knowledge about new technologies and engineering methods, it has to be more accommodating and cooperative so that foreigners will share their existing consultancy practices and knowledge. The quote below reflects how engineers from both partners cooperate with each other.

> They tend to respond properly to our emails and phone calls whenever we contact them. Although we try not to disturb them at the weekend, when handling a fast-track project, we sometimes have to contact them at odd times. They do not mind and respond properly. On the other hand, if we are expected to provide something on a certain date, I ask my engineers to complete the work and we sit and wait, even if we have to wait until midnight. I believe we should come at par as we are learning from them.

The above data reflect the ways in which cultural harmony is developed between local and foreign partners. As the data reflect, German engineers respond properly and provide necessary information/ guidance as and when they are approached. This is probably because of the equity ties and equal financial stakes of both partners. There is a huge focus on work-life balance in Germany (Adema, Clarke, Frey, Greulich, Kim, Rattenhuber & Thevenon 2017) and German workers recently won the right to a 28-hour working week (Huggler 2018). However, as regards the fast paced Bhikki Power Plant Project, German engineers respond to emails and telephone calls immediately, even after working hours and at the weekend. Further, NESPAK's engineers seek modern technological knowledge so they are more responsible when it comes to making necessary adjustments so as to be at par with foreign knowledge donors. That is why, as the above data reflect, NESPAK engineers even work until midnight to meet project deadlines.

So, adapting to each other's working style and providing required information to each, other even after working hours and at the weekend, indicates a cordial relationship and mutual adjustment between local and foreign partners. NESPAK's engineers seem to be more responsible as regards modifying their working style, according to their foreign counterparts, because they are on the receiving end and intend to learn innovative technologies and engineering methods from foreign counterparts. The phenomenon is discussed in more detail in section 5.4, which reports answers to why NESPAK's engineers intend to learn innovative technologies and engineering methods. Such adjustment reflects cultural integration (Berry 1997), which subsequently improves the sharing of knowledge and consultancy practices between both partners.

In spite of the aforementioned initiatives, cultural harmony with foreign partners cannot be developed in some projects. NESPAK's engineers could not develop mutual understanding and working harmony with Chinese engineers. As I came to realise during fieldwork, Chinese engineers deputed to work on the Lahore-based Lahore Orange Line Metro Train Project (LOLMTP) were junior level engineers. They just coordinated between local engineers and their seniors working from China. While interviewing Majid, a participant involved in LOLMTP, I observed that he was having some difficulty in approaching a Chinese engineer who was wandering into NESPAK. The following fieldnotes show the non-cooperative attitude of Chinese engineers.

> Majid asked his colleague if Zhou[20] was there. The reply was no. Then Majid asked him to find Zhou and not to let him leave without responding to some queries. The colleague replied that Zhou was not taking phone calls. The divisional head came to Majid's desk, asked about Zhou and advised all colleagues to locate and catch him. Majid said to me: "You see how it is difficult for us to approach and communicate with foreign counterparts?"

Despite harmonious relationships with foreign partners on most projects, NESPAK's engineers experienced poor coordination in its alliance with a Chinese partner on this project. After detailed discussions with many engineers involved in this project, it came

[20] Zhou is a Chinese engineer from CR-Norinko, deputed to Lahore to work on the Orange Line Metro Train Project.

to my knowledge that Chinese engineers were extra possessive of their knowledge, information, documents and the like. Because of such possessiveness, there was a huge problem with knowledge and information sharing in this alliance. It is considered difficult for any NESPAK engineers to ignore phone calls and emails from their foreign counterparts. However, Chinese engineers do not bother to take phone calls and reply to emails from NESPAK engineers, as the above data reflect, and they are not readily accessible for necessary discussions. This might be due to the funding/loan that came from China for this project. This makes NESPAK's engineers uncomfortable when working with Chinese partners and has adverse effects on the alliance relationship and knowledge sharing within the alliance.

In addition to different working styles, NESPAK's engineers face a severe language barrier with their Chinese counterparts. One out of a total 10–11 Chinese engineers (deputed in Pakistan) is proficient, while one is average at communicating in English. The rest of them were completely non-proficient at English communication. Their non-fluency in English language hinders sharing required information, knowledge and consultancy practices, as mentioned below by Abdullah:

> Their emails, construction codes and user interface for their software are all in Chinese and I can't understand anything. Even when they do calculations, write our names and phone numbers and take meeting notes, it's all in Chinese. They often use Google Translate to understand our emails but it does not work very well because actual meanings/themes of core engineering issues/problems are often lost … [As a result,] their replies are often irrelevant to what we asked about … We also have

> interpreters but they are not from an engineering background … [so] they are unable to translate technical terms such as sootar[21] into exact Chinese terms … then we tell them in Punjabi (native language) and they try to translate it into Chinese. Even then I am not personally sure that they communicate our exact message to them … so exchanges of required information is largely compromised. [Abdullah]

The medium of instruction at Pakistani universities, where NESPAK's engineers are qualified, is English. Further, there are many NESPAK's engineers who qualified abroad, so they do not face language problems while working with foreign partners from English-speaking countries or with those who are proficient in English. However, while working with Chinese engineers who are poor in English, NESPAK's engineers face huge problems of communication. The Chinese are very particular in their language, as the above data reflect. As reported by the respondent, they use it everywhere while keeping records, writing things and communicating with others. For instance, as the above data reflect, their email, software interfaces and construction codes are in Chinese. They even write NESPAK engineers' names, contact numbers and email addresses in Chinese. This reflects that they don't use any other language in their day-to-day matters, which makes communication and sharing information with NESPAK's engineers very difficult.

To address this issue, NESPAK's engineers use external language resources (e.g. interpreters) and machine translation (e.g. Google Translator), as mentioned in the above data. However, these solutions do not work very well as the true meanings and sense of messages may not reach the receiver. The interpreters NESPAK hired do not have an

[21] A sootar is a measurement scale, while eight sootar is equal to 1 inch.

engineering background and so they are unaware of core engineering terms. Similarly, Google Translator gives a variety of meanings for engineering term and it is unable to communicate non-verbal gestures and expressions. Such poor communication of information and knowledge caused by language barriers subsequently results in poor learning by NESPAK engineers. As learning takes place by doing operational activities in consultancy work, these activities are not performed well due to the unavailability of required knowledge as a result of poor communication and sharing of knowledge by Chinese partners. In such a situation, Joshi and Lahiri's (2015) proposed method of 'adopting a single corporate language', i.e. English, can be suggested as a single corporate language. However, this solution does not seem to be applicable in this consultancy, given that the Chinese, as a nation, are strict in the use of their native language as compared to Pakistani nationals who are taught English on courses and throughout their academic life.

Summary of Findings

The contextual and project related entities and factors involved in this category are related to different working styles and orientations of NESPAK and its foreign partners. As reflected in the first column of **Table 5.2,** these differences are related to ways of performing technical and management tasks, interactions with clients, managing working hours and subordinates, openness to discuss issues, status orientation, differences in priorities and assertiveness with clients, top management and subordinates. Further, there are language barriers when working with Chinese partners in particular. In addition, the context of this category also includes the position of NESPAK's engineers as knowledge seekers, equity ties between both partners and the purpose of the alliance, i.e. successful completion of the project, leading to both partners developing cultural harmony. Project-related factors and entities, as reflected in the second column, include the fast pace of Pakistani projects, local workplace values and norms, over-assertive clients, extra/ unrealistic demands from clients, the political mileage attached to projects and funding for projects that offers supremacy to certain partners.

Although, the aforementioned real entities are constraining for developing harmony however, since these constraining entities are interrelated with the real entity of objective of the alliance i.e. to successfully complete the project, both local and foreign engineers modify and readjust their respective working styles, bridge the differences between them and develop a culturally harmonious working style. Thus, as shown in the third column of the table, NESPAK's engineers tend to adopt a foreign working style as they are on the receiving end and seeking modern knowledge and technologies from foreign counterparts. Foreign engineers also modify their working style as they respond to local partners, even in their timings are off, considering the fast pace of Pakistan-based projects as well as being driven by equity ties. They also support NESPAK's engineers in interacting with clients and confronting their unrealistic/ extra demands, considering the weaker position of NESPAK's engineers vis-à-vis top management and clients. In this way, the surface level empirical reality of cultural harmony is developed through the aforementioned events and activities performed by both partners. Such a cultural harmony results in the effective sharing of required knowledge and working practices between NESPAK and foreign partners.

However, NESPAK could not address language barrier with Chinese partner. NESPAK hired interpreters and used Google Translator but these methods are reported to be ineffective, since interpreters are not familiar with core engineering terminology, and Google translator is often unable to provide context-specific meanings of technical terms. Thus, the language barrier always influences knowledge-sharing between NESPAK and Chinese engineers in an adverse manner. Cultural harmony does not develop with Chinese engineers due to their non-cooperative attitude and poor communication. As a result, cross-border sharing of knowledge and consultancy practices are seriously compromised. These findings are displayed, below, in **Table 5.3.**

Table 5.2: Critical Realist Analytical Framework for the category of Developing Cultural Harmony

Direction of Effects/Causal Explanation (From Cause-to-Effects – From Real-to-Actual-to-Empirical)

Domain of Real		**Domain of Actual**	**Domain of Empirical**
Reported and observed influencing contextual factors (including entities, processes and relations)	**Reported and observed features of consultancy projects (including entities, processes and relations)**	**Inferred composite mechanism underlying features**	**Reported and observed outcomes of mechanisms (and ensuing strategies)**
-Differences in working styles of NESPAK and foreign engineers -Extra socialization, late sessions, working at the weekend by NESPAK Engineers vs foreign engineers, more dedication and focus on work during working hours -Acceptance of over-assertiveness from clients and top management by NESPAK's engineers regarding unrealistic demands & deadlines vs foreign engineers' intolerance of over-assertiveness - Local engineers' greater status orientation and focus on office furniture and fixtures vs foreign engineers' greater focus on the availability of required scientific instruments, ICTs, and a suitable working environment -Foreign engineers working with own hands vs maintaining position protocols by local bosses/ senior engineers -Non-cooperative and casual behaviour of some foreign engineers vs commitment of local engineers to projects -Language barriers -NESPAK engineers' significant exposure to English vs Chinese engineers' non-fluency in English -NESPAK's knowledge-seeking position -Reinforcement by successful completion of projects -Equity ties	-Fast pace of Pakistani projects -Local workplace values and norms -Over-assertive clients -Extra/unrealistic demands of clients -Political mileage attached to projects -Funding for projects – offers supremacy to any partners	-Modifications and adjustments to working styles and routines by both partners – Accommodating strategies -NESPAK engineers meeting deadlines in terms of delivering their part of the work -Foreign engineers understanding the fast-paced nature of projects -Foreign engineers' timely responses, irrespective of working hours -Foreign engineers' understanding of weak position of NESPAK's engineers in relation to their bosses and clients -Foreign engineers' confrontations with clients on behalf of NESPAK's engineers and refusal of unrealistic demands from clients -Use of interpreters and Google Translators to address language barriers	-Cultural harmony and integrated and harmonious working styles (in consultancy alliances with non-Chinese partners) -Cultural harmony and harmonious working styles cannot be developed when working with Chinese partners **Reported and observed strategies for when the mechanism encounters a barrier** -Independent working by NESPAK because of being in the lead position and ultimate responsibility for successful completion of projects (happened in the case of working with a Chinese partner) -No further strategies after encountering language barriers

Direction of Exploration (Retroduction: From Effects-to-Cause – From Empirical-to-Actual-to-Real)

5.4 Intention to Learn and Share Knowledge

The findings of this category comprise local engineers' intention to learn and foreign engineers' willingness to share knowledge and consultancy practices. The first five verbatim quotes in this category reflect the degree of intention of NESPAK's engineers to learn state-of-the-art engineering methods and technologies, and their underlying reasons. The next five verbatim quotes report the willingness/ unwillingness of foreign partners to share knowledge and report different techniques or to convince them to share extra knowledge and consultancy practices. It has also been reported what local engineers do to convince foreign engineers to share required knowledge and consultancy practices. The findings also reflect how NESPAK's engineers learn on their own when, despite their efforts, they cannot receive the required support from foreign partners. These findings are presented and discussed below:

NESPAK's engineers are found to be highly focused on learning new knowledge, engineering methods and technologies. The engineering field is highly innovative and novel engineering methods and technologies are always replacing older ones. The research participants reported that NESPAK is a user of technologies that are already established and installed in developed countries. So, NESPAK engineers need to learn such modern knowledge from their foreign counterparts so as to gain self-reliance for similar projects in future. This is the key reason for NESPAK's consultancy alliances, and so it forms consultancy alliances with world-renowned consultancy companies to learn state-of-the-art engineering methods and technologies. The verbatim quote below reflects the focus of NESPAK's quality policy (company philosophy) on learning, which is one of the key factors shaping its engineers' intention to learn new engineering methods and technologies.

> Our quality policy reflects that we have been trained enough and learnt what is essential to do quality work. From junior engineers to vice presidents (my current position), the quality policy is applicable to all. The crux of the policy revolves around two aspects: 1) the engineering profession demands that we always do our best, which includes diligence, honesty, good teamwork, learning and using state-of-the-art literature and engineering, and developing oneself. 2) some learning and training [of employees] is the responsibility of the company, including training arrangements, as we offer in-house training. [Adeel]

The above report of NESPAK's policy statement indicates the company's intention to learn state-of-the-art engineering methods and technologies, which subsequently shape the learning intention of most of NESPAK's employees. Point 1 in the above data reflects that an engineer needs to study relevant literature and learn state-of-the-art engineering methods for self-development. For further development and learning of engineers, as point 2 in the above data reflects, NESPAK does not only arrange training and development (T&D) opportunities for its engineers, but also provides on-the-job training opportunities through letting them work with local and world-renowned engineers. In return, the engineers become highly intended on exploiting opportunities for working with renowned engineers and learning state-of-the-art engineering methods/ practices and technologies by using them in engineering consultancy work.

There are many other aspects that contribute to the intention of NESPAK's engineers to learn modern engineering knowledge, methods and technologies. For instance, every project raises new technological challenges, such as the application and installation of state-of-the-art engineering methods and technologies in order to improve their efficiency. These requirements lead NESPAK to form consultancy alliances with foreign expert consultants to gain assistance and expertise related to those engineering methods and technologies, so that a project may be completed according to the client's requirements. So, project completion itself reinforces engineers' intention to learn state-of-the-art engineering knowledge and technologies. The participants describe this as follows:

> Our mechanical team got an opportunity to learn this technology from world-renowned Cable Car Consultants and have their work reviewed by them … We improved our expertise in modern technology, systems and gondolas. Without this, we could not have accomplished the project … It is a constant learning process and technology is being transferred silently, because we seek their guidance constantly in a project and make key decisions after taking their input and guidance. [Adeel]

> It [knowledge sharing] influences project execution, as if we succeed in learning required knowledge and successfully apply it in project installation, it results in great success in the form of project accomplishment. Failure to do this will not only damage NESPAK's reputation but also our individual engineers' reputations, too.
> [Ashfaq]

In the aforementioned projects, NESPAK's engineers learnt appropriate engineering methods and technologies from their foreign counterparts, because they knew that, without such learning, projects could not be completed. So, their organizational objective of completing projects itself reinforced their learning. Apart from this, consultancy engineers throughout the country know each other and companies operating in Pakistan. They know which engineers or companies are working on which projects, particularly within Pakistan. Project failure can severely damage the reputation of engineers working on a project and that of the respective company. Thus, fear of failure and subsequent reputation damage is another significant reinforcer of engineers' intention to learn required engineering methods and technologies.

Local engineers are so intent on learning that they started learning Chinese construction codes on their own once they found Chinese counterparts were not ready to support them in their learning. Participants involved in LOLMPT reported that their Chinese counterparts in this project were very non-cooperative as they did not give any justification/logic for any new methods or practices, instead they just expected NESPAK's engineers to agree with them. Similarly, they required NESPAK to follow Chinese construction codes in LOLMTP's civil work, but refused to give English versions of these codes. NESPAK managed to import these codes on its own. Ayla explained why her team was willing and able to learn Chinese construction codes.

> Learning about Chinese construction is a huge addition to our personal and organizational profile and gives us a competitive edge, considering there is so much involvement of Chinese companies in Pakistan-based projects. We know that if we have knowledge of Chinese construction codes, not only will other local companies depend on NESPAK but we [individually] can also get much better salary packages within Pakistan and abroad. [Ayla]

The findings align with a knowledge-based view of the firm (Grant 1991), following which learning unique and valuable knowledge contributes significantly towards sustainable competitive advantage for NESPAK. Engineers' intention to learn Chinese construction codes is reinforced by the uniqueness, attractiveness and value of those codes, as argued by Salk and Simonin (2011), because this will not only result in an organizational competitive advantage but in engineers' individual career growth, as well. Knowledge has become a key source of competitive advantage in current knowledge-based economies (Foray & Lundvall 1998). Thus, engineers' intentions to learn Chinese construction codes is reinforced by a potential organizational competitive advantage and personal career growth after learning unique, attractive, related and valuable knowledge about Chinese construction codes. Such expertise is of great value in the current context of Pakistan, as China has invested US$46bn in Pakistan under the China Pakistan Economic Corridor (CPEC) and been involved in many development projects of Pakistan (Hussain 2017). Their involvement in Pakistan-based projects is likely to increase in the coming years with the development of Gawadar[22] and road and communication networks to make Pakistan the gateway to China for the rest of the world, after the One Belt One Road (OBOR) initiative.

However, in LOLMPT, Chinese engineers did not contribute much towards local engineers' learning of Chinese codes, so local engineers started learning on their own by doing calculations with the codes, making comparisons with British and American codes,

[22] The city of Gwadar has been developed along with its deep-sea port which is a prominent feature China Pakistan Economic Corridor (CPEC) plan.

trial-and-error methods and reverse engineering (Maedche & Staab 2001). It also highlights that local engineers' intention to learn is not reduced even if foreign engineers are not willing to share knowledge.

As discussed in the last paragraph, the attractiveness of knowledge increases its learners' intention to learn because such attractiveness can help learners in their career growth. In NJHPP, knowledge of tunnel engineering was so attractive that engineers were willing to work on the project even without any remuneration. Mohsin reported:

> This knowledge [of tunnel engineering in NJHPP] is very unique and valuable and our people learnt so much that, as far as I know, there are 25 engineers who learnt these techniques and this technology and joined Metro Riyadh Saudi Arabia for tunnel engineering. Our engineers were so eager to learn tunnel engineering that they were ready to join NJHPP without any remuneration. They knew that if they successfully learnt, this which only takes 1–1.5 years, their future would be very bright, and they could have multiple job options with salaries five times higher in the Middle East. This practice became so common that our Project Manager proposed that there was a need to get a surety bond from our engineers so that they would not leave this project before its completion. [Mohsin]

Similar to previous findings, it is evidenced in the above data that the career growth of an engineer highly depends upon his/her knowledge, expertise and qualifications to work on a certain task. NESPAK's engineers found knowledge of new technologies and engineering methods in every project highly attractive, unique and valuable for their career growth. Thus, they knew that learning tunnel engineering could mean significant breakthroughs in their careers, so they were willing to work on this project even without any remuneration. Such a large-scale tunnel had not been built before in Pakistan so they got first opportunity to learn this technology and they capitalized on it. Thus, their recognition of tunnel technology resulted in their strong intention to learn it. It is evidenced in this project that around 25 engineers left NESPAK once they had learnt this technology, even before completion of the project. They joined Metro Riyadh Saudi Arabia on many times higher salaries.

Another phenomenon explored under this category is foreign partners' willingness to share required knowledge and consultancy practices, which is also of equal importance to execute a project. The key objective of every alliance since the foundation of NESPAK is to learn modern engineering methods the company lacks. Thus, this is the key term of reference (ToR) of the alliance agreement which binds both partners to share required knowledge and consultancy practices so that consultancy work for a project may be done according to the project's requirement. Maqsood mentioned the willingness of engineers from DHI Netherland to engage in knowledge-sharing in the FEWS project.

> They [foreign engineers] were always willing and committed to share knowledge and perform their allocated role in shared work according to the alliance agreement. DHI's engineers shared complete knowledge of the FEWS model with us, but they did not share its source code. So, we could not make any changes to the software or modelling independently. But this is what we had already agreed upon [in the alliance agreement]. So they were correct. [Maqsood]

Earlier studies (e.g. Easterby-Smith et al. 2008, Inkpen 2008, Kale & Singh 2009) of knowledge-sharing between partners in an alliance were affected by the position and power of the partners. However, the structure and nature of NESPAK's consultancy alliance are conducive for knowledge-sharing in that NESPAK has also made a remarkable contribution to this project by surveying the whole river network of Pakistan, as mentioned in section 4.4. So, DHI's position is not stronger in this alliance; instead, both partners contribute valuable input as well as their expertise, which are essential for the development of a customized FEWS model fit for local conditions. DHI engineers were found to be very willing to share knowledge related to the FEWS model and its schematization[23] and customization,[24] according to local conditions, except sharing knowledge about the source code, which seems to be a source of FEWS' competitive advantage.

On the other hand, knowledge and information about local weather and geographical conditions, technological infrastructure and the river network was shared by NESPAK's engineers. Without contributions from all the partners, the project could not be accomplished, and the consultancy fee could not be earned. So, required knowledge and the consultancy practices of both partners are shared according to the alliance's agreement to complete the project.

In addition to the formal alliance agreement, *personal associations and friendships* are found to be another underlying reason due to which foreign engineers share more knowledge, expertise and skills. This is reported in many projects that influence foreign engineers to share extra knowledge. While working on NJHPP, Mohsin developed such

[23] The FEWS model is an upgrade with technological advances. For instance, it was upgraded in the last decade with the availability of satellite data and technologies to measure moisture level in the air, cloud movements, places where moisture will be converted into rain. Further, a new feature of forecasting loss in the case of a river bank being breached during flood is being incorporated into the current FEWS model (FEWS 2015).

[24] The FEWS model is customized according to the specifications of Pakistan river network and weather conditions

an informal association with a foreign engineer who, in return, obliged him by sharing extra knowledge and documents as and when required by Mohsin. He reported that:

> I had a very good friendship with one of the foreigners. We often played cricket with them … He used to ask me to arrange a cricket match … so we used to play [cricket] behind the office … Further, we often arranged hikes and trips to nearby areas which are full of scenic beauty[25]. Such events gave me opportunities to build an association and informal relationship with him, and in return he helped me along the way and discussed many other engineering methods and technologies and the nitty-gritty of each. In normal circumstances, they do not discuss anything beyond routine work. [Mohsin]

Such friendships and informal associations also influence engineers to share required knowledge who were previously unwilling to do so. As reported above, most of the Chinese engineers were not rated well by NESPAK engineers in terms of knowledge-sharing. These informal relationships even influence some of them to share required knowledge and documents with local engineers. Nasir shared such a story, recounted below:

> Once, a Chinese engineer's hard drive crashed and his data were lost. [To recover this], I personally visited Hafeez Centre[26] three times and got his data recovered. He was much obliged then; he is in China now but he always sends me documents or any information as and when I ask him. [Nasir]

[25] The area where NJHPP is being implemented is located in Muzaffarabad, the capital of Kashmir. This hilly area is full of scenic beauty and people from all over Pakistan plan recreational visits to this area throughout the year.
[26] The Hafeez centre is the main marketplace for IT and relevant technologies in Lahore.

It seems natural that when local and foreign engineers work together, a cordial relationship develops among them that is likely to create a conducive working relationship and subsequent higher level of knowledge-sharing. Relative to NESPAK's headquarters, the project site is more conducive to develop such an informal relationship because engineers spend even their off time there. Mohsin mentions above that he developed a very good personal relationship while working on the NJHPP site through playing cricket, hiking and visiting nearby attractions with a foreign engineer. With such conducive relationships and warm attitudes from local engineers, foreign engineers felt a social obligation to respond in the same way and share more knowledge. Such a reported social obligation can be interpreted by Social Exchange Theory (SET) (Blau 1964). Thus, he shared alternative technologies, engineering methods, theories and models, and their respective compatibilities for the project and justifications for choosing one of the models for the project. Such justification helps local engineers to enhance their understanding of competing paradigms through critical evaluation of different engineering methods and their respective applicability to a project.

Personal associations and friendships have such a dramatic influence on foreign engineers that they shared above and beyond what was agreed upon in the alliance's ToR. As reported above by Nasir, a Chinese engineer, who was previously unwilling to share even agreed upon information, started providing extra resources and information, as and when required, in response to the help he received related to the recovery of his data. So, local engineers sometimes help foreign engineers by doing personal tasks with the intention of accessing required knowledge and necessary documents, which would otherwise have been impossible.

As the social world varies from context to context, so local engineers use situation-specific methods to access knowledge and learn engineering methods and technologies from their foreign counterparts. They neither studied such methods in published literature nor learnt them from their senior engineers. Instead, they innovated on their own according to specific on-the-spot situations and relationships with their foreign counterparts. For instance, although MWH has collaborated with NESPAK on various projects, an engineer was reported as not being willing to share knowledge. Haroon reports what he does in such a situation.

> I confronted a guy who was reluctant to share even petty things. However, we had to grab and extract knowledge in any case for project accomplishment. [For this], I remember, I sometimes intentionally did the wrong work and tried to get him [foreign engineer] to notice it. Once he noticed, he used to make corrections and tell me the right way to do the task and its justification. I may also intentionally disagree with foreign partners on some points while knowing that I am wrong. This makes foreign engineers explain extra points and share more knowledge to prove their arguments. [Haroon]

It is a key characteristic of qualitative research that findings are not limited to pre-conceived assumptions from a theoretical framework; rather, these are completely driven by empirical research data (Easterby-Smith et al. 2015, Guba & Lincoln 1994). Intentionally doing the wrong thing in front of an expert is likely to compel him to make corrections, because it is difficult for an expert to tolerate a task being done in the wrong way. This proved true in this scenario as an unwilling foreign engineer was ready to share required knowledge through making corrections and explaining the right way to perform the task.

Haroon also mentions that *unnecessary arguments* make foreign engineers willing to share more knowledge. This seems natural as when somebody disagrees with you, you tend to use more logic and reasoning to prove your argument. Haroon applies this to extract knowledge and learn from foreign engineers, using such tactics. However, he needs to be careful with this because if a foreign engineer notices that it is a conscious non-serious behaviour by Haroon as a knowledge-seeker, he will be likely ignore the disagreement or wrongdoing and become more protective of his knowledge.

Despite all the aforementioned findings about sharing knowledge, local engineers still face difficulties in some projects as regards accessing and learning required knowledge from their foreign counterparts. I have interviewed six participants working on LOLMTP and all of them complained about the casual and unsupportive attitude of their Chinese counterparts, which seriously hinders NESPAK engineers learning new technologies and engineering methods. Local engineers learn required engineering methods and technologies using lengthy and laborious learning methods, such as the aforementioned trial-and-error method. Waseem mentioned it in this way:

> They don't share knowledge with us. Actually, when they come here, they are considered knowledge donors, so their attitude towards this collaboration and work is very casual. They stay at the Pearl Continental

> Hotel[27], often remain in the hotel and play badminton and swim there … We have to request them many times to come to the NESPAK office to discuss amatters ... then they come around 10 or 11 a.m. and leave the office at 3 or 4 p.m. … They are just like tourists so they are enjoying their time here, not working. [Further], they had to send us a drawing of an elevated station on 25 November. We came to know in October that they had done it, so we asked them to send it to us so that we could understand it before formally working together. But they replied that they would send it on the decided date. [Waseem]

NESPAK has been working with Western partners since its inception, that is why its engineers are very familiar with Western engineers and comfortable working with them. On the other hand, NESPAK's history of working with Chinese consultancy companies is relatively shorter, which is further fuelled by the language barrier reported in section 5.3. As a result, NESPAK's engineers are not comfortable working with them. Chinese engineers who are deputed in Pakistan are reportedly very casual and non-serious towards joint consultancy work. It is found through personal discussions that the Chinese are more possessive of their knowledge and less willing to share it openly in a partnership. That is why they did not share the concept design before the decided date, even though it was ready to be shared. Similarly, as mentioned above, they did not share an English version of Chinese construction codes and help local engineers to learn them.

On the other hand, both partners are required to share knowledge and consultancy practices in joint working to develop train track using modern technology in alignment with local on-the-ground conditions. As Chinese engineers are not supportive and do not

[27] The most expensive hotel in Lahore.

adequately share the knowledge required of state-of-the-art electro-mechanical and civil technologies, doing civil work in alignment with those technologies causes adversity and requires extra work on the part of local engineers. However, understanding their lead position, NESPAK's engineers performed extra work and learnt using difficult and laborious methods. For instance, they learnt Chinese construction codes independently through a trial-and-error method. However, this may subsequently lead to delays in or abandonment of the project.

Summary of Findings

This category involves two findings, i.e. the learning intention of NESPAK's engineers and the willingness of foreign partners to share required knowledge and consultancy practices. These findings are influenced by some different contextual factors and entities, that is why **Table 5.3,** below, reflecting this category is divided into parts. The contextual influential real entities and factors for learning intention are reflected in the first part of the first column of the table. These are reported to contribute towards shaping the learning intention of NESPAK's engineers. These include NESPAK engineers' intentions to seek new knowledge from foreign partners, successful completion of the project, individual and organizational repute, personal career growth and alike. Similarly, the real entities lie underneath foreign engineers' willingness to share knowledge are equity ties and objective of successful completion of the project. The real entity behind their unwillingness is foreign partner's intention to maintain supremacy and secure business in future. These are reflected in the second part of the first column. However, both of these findings share the same project-related factors because both partners work for the same projects in an interrelated and interdependent manner.

Enacted by these contextual real entities and factors, actual reality take of this category is that the NESPAK's engineers are reportedly having a significant intention to learn valuable, unique, attractive and modern engineering knowledge and technologies from their foreign counterparts. They are so intent on learning new knowledge that they learnt independently once they found foreign engineers were unwilling to support them and share required knowledge. Their learning intention is also reflected in their readiness to work without salaries to learn a new technology.

Similarly, driven by the real entities and factors, foreign engineers involved in most of NESPAK's projects are sufficiently willing to share knowledge and consultancy practices with NESPAK's engineers (actual event/reality of this category). The reported key underlying entity enacting foreign partners' willingness is equity ties, i.e. earning the agreed proportion the consultancy fees after successful completion of a project. It is also found that almost all engineers from Western countries involved in NESPAK's projects are sufficiently willing to share required knowledge. There is an exception, as reported above by Haroon, however; MWH, to which that engineer belongs, does not reportedly have such norms to withhold required knowledge.

These underlying real entities, processes and factors enact aforementioned actual events/reality which in turn constitute and shape the empirical reality of the intention of local engineers to learn new engineering knowledge and willingness of foreign engineers to share knowledge. Such a sufficient level of knowledge sharing between two partners in international consultancy alliance is enacted and caused by the aforementioned underlying real entities and actual events.

In this category, empirical experience/reality is found to have variation in it as it comprises mixed findings. Almost all of the Chinese engineers working in international consultancy alliance on LOLMTP are reportedly having unwillingness to share the required knowledge with NESPAK's engineers. Their attitude towards consultancy work was very casual and non-supportive. They did not even share agreed-upon knowledge. As all the Chinese engineers involved in this project showed the same unwillingness towards knowledge-sharing, this seems to be because of the underlying real entity of their organizational policy to maintain their supremacy in Pakistan-based projects. Most of the Western partners working with NESPAK are not like that; instead, they share agreed-upon knowledge, and more, with local engineers.

Such an empirical reality is found in this research with a variety of dynamics. For instance, in case of unwillingness of foreign partners to share knowledge, friendship and personal associations are reported to not only increase sharing routine knowledge but also sharing extra knowledge, such as competing methods, theories and technologies, and their respective pros and cons, with respect to specific site conditions. Such friendships and personal associations are also used as a substantial tool to convince those foreign engineers who are not willing to share knowledge. Intentional doing wrong work in front of a foreign expert and unnecessary disagreements with foreign engineers are also reported by one participant as a tool to access knowledge being withheld by foreign partners. However, this strategy worked for only one Chinese engineer. While working with all the other Chinese engineers, required knowledge and consultancy practices were not shared. As a result, NESPAK's project team had to learn those engineering methods on their own because they understand their lead position in the alliance which holds them ultimately responsible for the success or failure of a project.

Table 5. 3: Critical Realist Analytical Framework for the category of Intention of Local Engineers to Learn and Willingness of Foreign Engineers to Share Knowledge

Direction of Effects/Causal Explanation (From Cause-to-Effects – From Real-to-Actual-to-Empirical)

<table>
<tr><th colspan="2">Domain of Real</th><th>Domain of Actual</th><th>Domain of Empirical</th></tr>
<tr><td>Reported and observed influencing contextual factors (including entities, processes and relations)</td><td>Reported and observed features of consultancy projects (including entities, processes and relations)</td><td>Inferred composite events and experiences</td><td>Reported and observed outcomes of mechanisms (and ensuing strategies)</td></tr>
<tr><td>-Constant engineering and technological innovation
-Conditions of innovativeness in Pakistan
-Pakistan is not an innovator but a user of new technology
-Technological requirements of projects
-Objective is successful project completion
-Organization and individual reputation
-Lead or associate position in an alliance
-Local engineers being knowledge-seekers
-Knowledge attractiveness
-Organizational competitive advantage
-Personal career growth</td><td rowspan="2">-Pakistan-based infrastructure projects
-Consultancy alliances of NESPAK with foreign consultants
-Equity-based consultancy alliances for projects
-Requirement for the application of new engineering methods and the installation of new technologies for maximum efficiency of projects</td><td>-NESPAK's engineers are having a significant intention to learn modern knowledge and consultancy practices of state-of-the-art engineering methods</td><td>-Accessing and learning required knowledge and consultancy practices by NESPAK's engineers from their foreign counterparts</td></tr>
<tr><td>-Equity ties of alliances
-Objective of successful completion of projects
-Foreign engineers being knowledge donors
-Supremacy of foreign partners as knowledge donors in alliances
-Degree of support and seriousness of foreign engineers towards project work</td><td>Degree of willingness of foreign partners to share knowledge and consultancy practices in the application of state-of-the-art engineering methods and the installation of new technologies (greater willingness of foreign engineers, except Chinese engineers who are highly protective of their knowledge)</td><td>-Sharing of required knowledge by foreign partners
-No sharing of required knowledge by a Chinese partner.
Reported and observed strategies for when a mechanism encounters a barrier
-Personal associations and friendships
-Intentional wrongdoing in front of foreign experts and unnecessary disagreements
-Trial and error
What if these methods still don't work (only in case of alliance with Chinese):
engineers independently learnt through laborious trial-and error-methods, but still their learning was compromised</td></tr>
</table>

Direction of Exploration (Retroduction: From Effects-to-Cause – From Empirical-to-Actual-to-Real)

5.5 Constructive Disagreement

When both partners work together, certain disagreements arise over different work-related issues. Disagreement in this research involves differences of opinion over the compatibility of engineering methods and the customization of technology to the project site. Engineers find innovative, positive and better decisions/ solutions for the application of engineering methods and the installation of technologies as a result of such ‘constructive controversies’ (Ellis et al. 2003). Such better solutions are unlikely to be achieved in the case of ‘uncritical and facile agreement’ (Aldag & Fuller 1993). The findings of this category report the frequency of disagreements between local and foreign engineers over the consultancy work, the reasons for disagreements, ways to resolves them and the influence of disagreements on the sharing of knowledge and consultancy practices between partners. These findings are presented and analyzed below:

Disagreements among engineers seem to be inevitable in NESPAK’s consultancy alliances because problems and issues should be properly addressed in the design development phase before any damage is done in large infrastructural projects. For instance, there was a problem with miscalculation of flood magnitude in the Munda Dam project, as reported in section 5.2 under the category of Symbiotic Alliance Relationships. If the calculation could have been debated, critically evaluated and disagreed at an earlier stage, the partners could have done the right calculations and the project would not have been abandoned. Similarly, disagreements in every project are likely to be essential in order to fix errors in concept design in the initial stages. The following findings reflect the significance of disagreements over knowledge-sharing and adopting consultancy practices of each other to develop the concept design for a project.

> It [disagreement] happens in technical knowledge sharing and it is not a problem, rather a positive sign. Disagreements arise because we belong to the local context of which we have better knowledge, we have a data bank of the local environment and we are superior in this respect. So, we disagree when we observe that a technology or engineering method is not suitable in these conditions. We [local engineers] then disagree with foreign engineers who identify faults [in their proposed technology and engineering methods] so that issues may be resolved before moving forward. Knowledge-sharing increases because both parties debate the issue, explain justifications [for their preferred methods] and share more points to convince each other. On the other hand, silence leads nowhere. [Akram]

The first line of the above quote shows that NESPAK's engineers understand the usefulness of disagreements in consultancy work. The key reason behind disagreements is that NESPAK's engineers survey the local geological and geographical conditions of a site and the overall environmental conditions and so they know the project site better than their foreign counterparts. Further, local engineers are not laymen but qualified engineers and have long experience of engineering consultancy for such projects. Thus, they are capable of easily sensing an error in concept design though they may not know the solution. On the other hand, foreign partners are usually superior in terms of having expertise in state-of-the-art engineering methods and technologies. Disagreements arise over the transformation and customization of those engineering methods and technologies according to the local geological and geographical conditions of a project site. Further, disagreements also occur when local and foreign practices/ activities and working styles are integrated to develop an overall practice of engineering consultancy for a project. Due to disagreements, errors and problems in concept design are identified at an earlier stage before construction work begins and huge damage to a project can be avoided.

The above quote also shows that a ‘premature consensus, facile and uncritical agreement’, as stated by Aldag and Fuller (1993), between NESPAK’s and foreign engineers can lead to an ill-refined concept design and wrong drawings, which are not affordable at all. A single wrong line in a drawing can damage a whole project and incur a huge cost. Further, disagreements increase knowledge-sharing because both local and foreign engineers are likely to become more open and criticize each other and their suggested methods. They come up with divergent ideas, philosophies, arguments and solutions to develop a consensus and find common ground that can best serve the client’s interests. The preparation of divergent solutions and ideas by NESPAK engineers themselves and understanding those of foreign engineers results in greater learning that is not possible in the case of uncritical facile agreement. It can thus be argued that disagreements in NESPAK projects lead to innovativeness and creativity in its engineers as engineering methods and technologies are applied/ installed in novel ways in the unique conditions of a project site as well as novel solutions being found to address unique site-related problems.

NESPAK has successfully completed the project of Mangla Dam Raising in collaboration with MWH USA. Like any dam in the world, the Mangla dam has unique dimensions, so measurement instruments were installed in alignment with those dimensions. During raising of the dam, these instruments were customized and programming of relevant software was done according to the dam’s dimensions, such as its height, the amount of water discharged and the size of the dam’s head and core. As NESPAK initially surveyed the dam’s dimensions and prepared input for the dam-raising project, its engineers often had disagreements with MWH’s engineers over the compatibility of new technologies and instruments with the dam’s dimensions. Haroon reported in this regard:

> We do not always say YES. Instead we disagree when we see that the proposed method does not fit the dam’s dimensions. In deciding the specifications of the Pesometer [both local and foreign engineers collectively proposed its design to the vendors for specific manufacturing], we had many disagreements, debates and deliberations with MWH’s engineers. We also disagreed many times when selecting the points where the Pesometers were to be installed, as well as on the ways to install them. We also had disagreements regarding configuring the software with the dam’s dimensions. [Haroon]

If engineers did not disagree with each other over the design of the Pesometers and their installation or configuring the software and showing their agreeableness in uncritical agreement, the design of compatible Pesometers could not have been proposed to the vendors. NESPAK’s engineers knew more about the dam’s dimensions and geometry because the company had already surveyed and analyzed those dimensions before jointly working with MWH. On the other hand, MWH has experience of designing measurement instruments and configuring computer software for dams all over the world. When both partners worked together, they customized those instruments and software according to the dam’s specific dimensions. In such a situation in which no partner has a complete picture, disagreements are inevitable but necessary for specific customization of instruments and software. Ellis et al. (2003) call such agreements constructive controversies. A greater focus on either side might overlook the other side of the coin and lead to ineffective dam functioning. For instance, a greater focus on the dam's dimensions may not fully capitalize on measurement instruments and software. Whereas, greater technology orientation can lead to the installation of incompatible technology and measurement instruments, which might not work with the specific dimensions of the Mangla dam.

In LOLMPT, there were many disagreements with the Chinese counterpart. NESPAK did not work so much with Chinese consultants, so there were various differences in the respective working styles of Chinese and NESPAK engineers. For instance, an issue arose when the Chinese partner finalized a drawing for train stations on which points for earthing were missing. The verbatim quote below shows how a disagreement arose between NESPAK and Chinese engineers:

> After visiting the site, the Chinese were annoyed, asking, "Why are there no connections in the construction for earthing arrangements?" We replied: "The contractor has to follow the drawing exactly and there were no connections in the drawing, that is why they are missing in the site work." Then they told us: "In China, the contractor himself knows that such connections should be included in the construction work." We replied: "You are not in China, rather, you are working in Pakistan with a Pakistani contractor, so you have to work accordingly. If you want the contractor to include connections or anything else, you have to tell us so that we can include them in the drawings." They showed some reluctance initially but were finally convinced and promised to give us a revised drawing. [Aqeel]

When NESPAK and Chinese engineers work together, there are disagreements and differences of opinion on ways of working. In the above quoted disagreement, the drawing was corrected by the Chinese engineers after necessary deliberation over the initial disagreements. Adapting the ways of working of Pakistani consultants and contractors by their Chinese counterparts reflects that they addressed their disagreements. Seen in this way, it is argued that disagreements are inevitable between NESPAK and foreign partners, because their consultancy practices developed in different contexts. They address their disagreements through debate and discussion at an earlier and modifiable stage of construction. Failure to do so at an earlier stage can lead to project abandonment or wrong construction work, as happened in the aforementioned Munda Dam project. However, in LOLMTP, Chinese consultants made a commitment to provide a revised drawing with earthing connections, while the contractor promised to add earthing connections to the existing construction work. In this way, not only was the project work was corrected but extra knowledge was also shared about Chinese ways of developing a drawing without earthing connections (which are to be provided by the contractor even though not included in the drawing).

In the same project, a drawing of the construction depot[28] was sent by the Chinese partner, however, it was not considered by NESPAK for construction work. As reported by the respondent and personally observed during a site visit, the site where the depot was to be built was a water pond and slush and sewerage water from a nearby village were poured into it. The drawing sent by the Chinese partner suggested building piles underneath the surface/floor of the depot. This would require a huge budget because the number of piles proposed for the depot was more than the total number of piles for the

[28] A depot is being built at one corner of the train track for washing and maintenance of trains.

overall train track. This led NESPAK to explore and consider alternative ways. NESPAK's Building Infrastructure Division (BID) analysed the site and suggested changing its soil. To this end, initially, new sand was poured into the water, which formed a thick slush. The slush was removed and the site was filled with river sand[29] to develop the base of the depot. As NESPAK engineers did not consider the drawing sent by Chinese, there was a disagreement between them. Majid told how they faced the disagreement with the Chinese engineers over this issue:

> They [Chinese engineers) had serious objections to rejecting their drawing, followed by heated arguments with them. They also complained to their higher management in China. However, we started deliberations with them and made many attempts to convince them. We also told them that the client could not bear the cost of so many piles. They understood our point but did not show proper agreement. They just stopped the heated argument. Following this we had meetings with the client and communicated to them that the pile-construction method would involve huge cost relative to the method proposed by us. The client approved our soil-changing method. Now we do not bother the Chinese on this issue anymore. [Majid]

The incompatible drawing sent by the Chinese partners led to an innovative and better solution because it prompted NESPAK engineers to think of new ways specific to the project site. NESPAK's engineers ignored the drawing sent by the Chinese engineers due to budgetary constraints and developed their own solution. Had they not disagreed with and rejected the Chinese drawing, they would not have learnt about a novel method for

[29] River sand was dredged from river beds. Relative to other sands, it is ranked highly for construction work because its grains are more or less round and smooth due to years of washing and abrasion. The sand has very low silt and clay content.

developing such a critical site. Learning this novel method only happened because of their disagreement with the Chinese engineers. Had they started work on the drawing sent by the Chinese partner without any disagreement, huge costs would have incurred and an innovative cost-efficient engineering method to build on such a site would not have been explored. This is indeed a significant value addition to existing engineering knowledge.

As mentioned in section 5.4, tunnel technology is being used for the first time in Pakistan in NJHPP, so the project offered substantial learning for the engineers involved in it. The project work is highly innovative and attractive, but requires extensive debates, discussions and disagreements between local and foreign engineers working on it. In discussions with the participants working on this project, local engineers learnt a lot through joint working with Swiss professors/ consultants because of their openness to disagreements, criticisms, debates, discussions, out-of-the-box thinking and innovativeness. As the quote below reflects, the engineers working on it value such disagreements and consider them part of their lifetime learning experience.

> The outcome of disagreement is lifetime experience, as you remember the outcome of a disagreement throughout your life. For instance, we have worked on the concept design for two years and there are many issues over which we had disagreements with Swiss professors. They are very open to disagreements and debates, so a number of decisions were finalized after intense disagreements followed by extensive debates and experimentation. As a result, we reached optimal decisions. That is lifetime learning for me as I learnt about a process, technology or model after going through into an intense process of reading, testing using different software, cross-checking through manual calculations, developing arguments to convince Swiss professors and validating their arguments with respect to local conditions. [Mohsin]

This is similar to what von Krogh (1998) argues, i.e. that workplace disagreements turn into positive learning experiences for individuals in a knowledge-oriented community. Seeing the reported openness of Swiss professors, they seemed to understand the disadvantages of uncritical agreement and premature consensus. On the other hand, if NESPAK engineers had agreed with them prematurely without any disagreement or debate, they would not have got a true picture of the site's characteristics from NESPAK's engineers, which could result in incompatible design for the dam. Further, they did not completely rely upon foreign consultants but also performed simulation and experimental work to cross-check the engineering methods in parallel with consulting Swiss professors. Had they accepted the foreign input without any arguments, endorsed the outcomes of simulations guided by the Swiss professors and not run further simulations by changing the input regarding site conditions, a specific concept design would not have been developed. So, while being highly critical, they performed further experiments, studied more, consulted further literature, did more calculations, rechecked those calculations manually and with other software, and finally came up with a concept design for the dam that was compatible with the site conditions. Mohsin sees it as a lifetime learning experience and can capitalize on this knowledge in other projects, too. This prompted the creation and sharing of extra knowledge, and this in turn became a lifetime learning experience.

Summary of Findings

The above category of constructive disagreements involves various contextual and project-related entities factors (located in the domain of real) causing them, as reflected in

Table 5.4. The key underlying real entity is that foreign firms are superior in knowledge of state-of-the-art engineering methods and technologies which are to be applied/ installed in a project. On the other hand, NESPAK's engineers are superior in their knowledge of local conditions, such as geological and geographical conditions of the project site and other broader environmental conditions that can affect the project. Thus, while developing engineering methods and technologies compatible with local on-the-ground conditions, both partners usually have differences of opinion because no partner fully knows the other side of the coin. These context related entities are shown in the first two columns of the table under the heading of domain of real reality.

Since, project team needs to successfully complete the project, they resolve and bridge the disagreements through issue-based debate, discussion and deliberation. Disagreements result in the formulation and sharing of extra knowledge, because engineers from both sides do more study and experimentation, listen to more logic and knowledge about methods proposed by other partners and get involved in further discussion, debate and deliberation to convince each other. This would not be possible with uncritical and facile agreement. These actual events and activities are reported in the third column of the table which subsequently cause the empirical reality of extra sharing of knowledge between local and foreign engineers.

If disagreements are not addressed through debate and discussion, NESPAK involves the client, or sometimes ignores disagreements because of being in the lead and decision-making position of the alliance.

Table 5.4: Critical Realist Analytical Framework for the category of Constructive Disagreements

Direction of Effects/Causal Explanation (From Cause-to-Effects – From Real-to-Actual-to-Empirical)

Domain of Real		Domain of Actual	Domain of Empirical
Reported and observed influencing contextual factors (including entities, processes and relations)	**Reported and observed features of consultancy projects (including entities, processes and relations)**	**Inferred composite mechanisms underlying features**	**Reported and observed outcomes of mechanisms (and ensuing strategies)**
- NESPAK's responsibility for surveying and analysing site conditions and preparing comprehensive input/ information according to which engineering methods and technologies are customized -NESPAK's better knowledge of project sites and local contexts -Foreign partners' better knowledge of state-of-the-art engineering methods and technologies which are to be applied/ installed in projects -Objective of ensuring the compatibility of engineering methods and technologies with project site conditions and contextual conditions	-Disagreements over the transformation of engineering methods and technologies according to specific geological and geographical site conditions, budgetary conditions of projects and overall environmental conditions	-Debate and discussion over issues raised -Studying more and preparing further arguments -Attempting to explore alternative options	-Sharing extra knowledge in the form of extra logic, arguments, theories and models shared in debate and discussion to convince each other -Learning further theories, models, and logics -Learning new/ alternative engineering solutions/ options **Reported and observed strategies for when a mechanism encounters a barrier** -Ignoring disagreements, being in the lead position -Getting the client involved

Direction of Exploration (Retroduction: From Effects-to-Cause – From Empirical-to-Actual-to-Real)

5.6 Conclusion

The above-presented categories merged together constitute the core category of Symbiotic Learning Alliances. The focus of this research is on studying engineers' learning in the practice of engineering consultancy, which is performed by NESPAK and its foreign partners in the context of international consultancy alliances, where sharing knowledge and consultancy practices is of key importance in such consultancy work. However, such sharing is facilitated/ hindered by different aspects which are categories of this core category. These categories are: Symbiotic Alliance Relationship, Developing Cultural Harmony, Intention to Learn and Share Knowledge, Constructive Disagreements. These factors are found to have a significant influence on the sharing of knowledge and consultancy practices during joint consultancy work done by NESPAK and foreign partners. Each section of the chapter has presented and analyzed one category, with comprehensive details about the context of the subject factor that influences the sharing of knowledge and practices, ways to influence others, problems encountered, ways to address those problems, and outcomes of the influence of factors. The findings of each category are also presented in a table at the end of the category.

The next chapter presents a comprehensive learning model in **Figure 6.1,** being drawn from the findings of this research presented and analyzed in this and previous chapters.

The next chapter also discusses the research findings in relation to the literature, theories and models informing this research.

CHAPTER 6: LEARNING MODEL AT NESPAK AND DISCUSSION OF FINDINGS

6.1 Introduction

On the basis of the research findings presented in Chapters 4 and 5, **section 6.2** of this chapter presents a research model, shown in **Figure 6.1,** that reflects the process of engineers' learning at NESPAK in the context of international consultancy alliances. The model is based upon the findings presented in the analytical frameworks presented at the end of each category (three and four categories of Learning in Engineering Consultancy Practice and Symbiotic Learning Alliance respectively) in Chapters 4 and 5. The model reflects different account of engineers learning at NESPAK and processes of sharing of required knowledge and working practices between NESPAK and its foreign partners in international consultancy alliances. The model also reflects different factors that influence such cross-borders sharing of knowledge and practices. The details of the processes of sharing, problems encountered and ways to address those problems are comprehensively discussed in the model explanation.

Section 6.3 discusses the findings of this research in relation to the literature, theories and models reviewed in Chapter 2. First, **sub-section 6.3.1** discusses all three categories of the core categories of Learning in Engineering Consultancy Practice in relation to the perspectives of cognitive learning and knowing in practice. Further, the rapprochement and combination of cognitive learning and knowing in practice is developed through the concepts of distributed cognition and the collective mind. Then, the second **sub-section, 6.3.2,** discusses four categories of the core category of Symbiotic Learning Alliance separately, in relation to relevant theories and models, because of their respective independent influence on sharing knowledge and working practices in an international consultancy alliance.

Finally, **section 6.4** concludes the chapter with a summary of the findings presented and discussed in this chapter.

6.2 Model of Engineers' Learning at NESPAK, Pakistan

The current research explores engineers' learning in doing engineering consultancy at NESPAK, Pakistan, in the context of international consultancy alliances. An engineering consultancy is performed in an international consultancy alliance with foreign partners who can fulfil the technological requirements of projects. The preceding chapters have covered Learning in an Engineering Consultancy Practice and Symbiotic Learning Alliance, which are the core categories of the current research. The former comprises three categories: Self-directed Learning, Managerially Influenced Learning and Partner-influenced Learning. While, the latter comprises four categories: Symbiotic Alliance

Relationship, Developing Cultural Harmony, Intention to Learn and Share Knowledge and Constructive Disagreements.

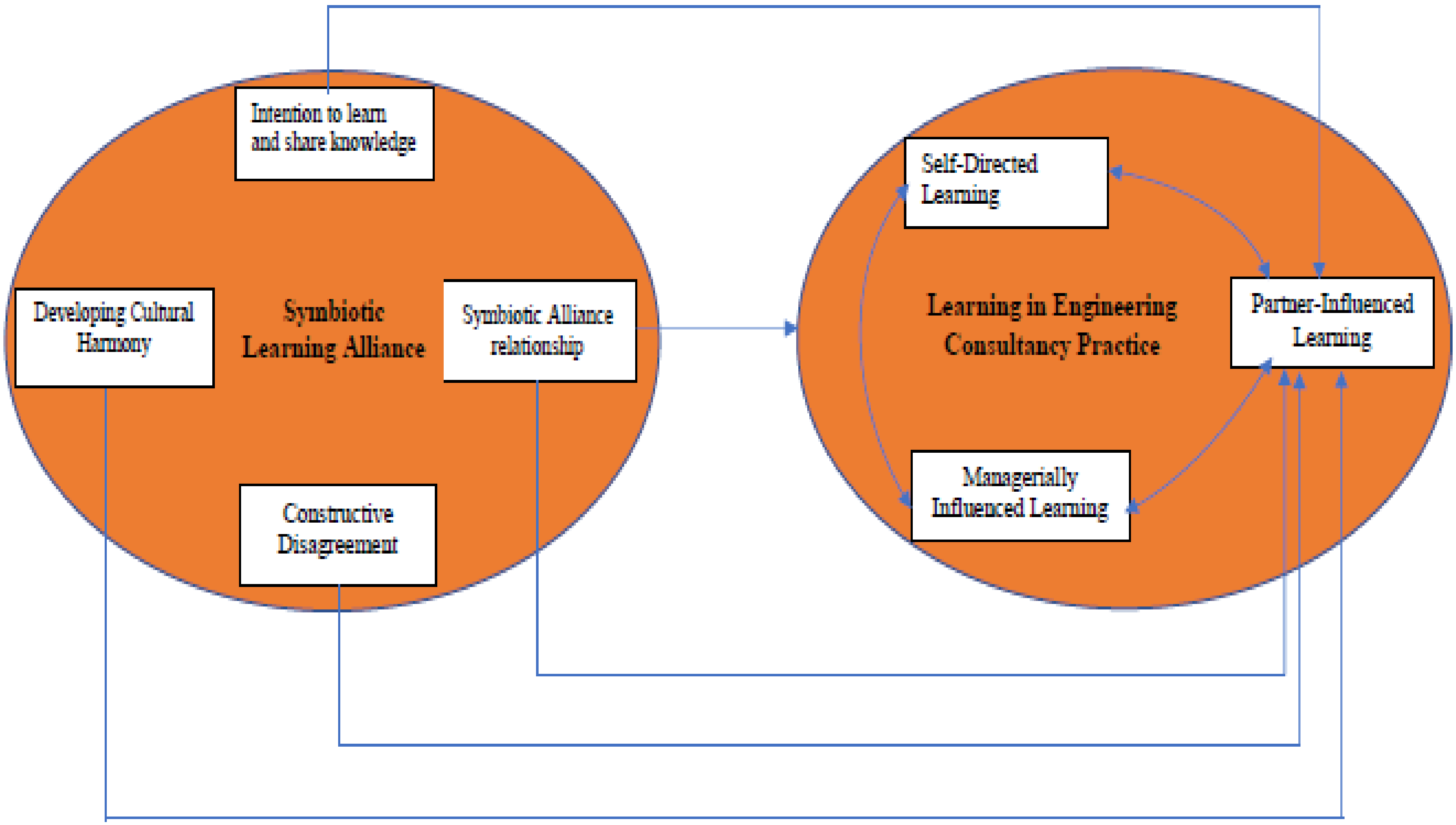
The accumulated findings of each category are also presented through a critical realist analytical framework (in table form) at the end of each section. The learning model presented in **Figure 6.1** is drawn from the analytical frameworks of the findings. The model answers research questions of this study:

- How do engineers' view their learning of engineering consultancy in the context of an international consultancy alliance?

- What factors influence the cross-border sharing of knowledge and consultancy practices between local and foreign engineers, and in what ways?

The model, through its first core category, answers the first research question and presents engineers' different accounts of learning of engineering consultancy while working locally at NESPAK and with foreign partners in the context of a consultancy alliance. The second core category answers the second research question through presenting different aspects influencing the sharing of knowledge and working practices during joint working with foreign partners. An explanation of the model is given after **Figure 6.1.**

Figure 6.1: Learning Model at NESPAK Pakistan



Though explanation of the model starts with an explanation of the core category of **Learning in Engineering Consultancy Practice,** it seems necessary to first explain one of the categories of core category of **Symbiotic Alliance Relationship** (reflected on the left side of the orange oval). This category covers defining Terms of Reference (ToR) of an alliance, which sets the stage for consultancy work performed by NESPAK's and foreign engineers in independent as well as in inter-dependent and symbiotic manners. Engineers' learning takes place differently in consultancy work performed differently.

According to the ToR of an alliance, NESPAK usually completes civil work and develops input regarding local conditions while foreign partners are usually responsible for using state-of-the-art engineering methods and technologies in a project. These responsibilities are, however, not performed independently by both partners but instead in a symbiotic, inter-related and inter-dependent manner, particularly at advanced stages of a project. If an alliance relationship is clearly defined, both partners clearly understand their respective roles, responsibilities and required contribution to the project. In the results, engineers from both sides extend their cooperation and share knowledge and working practices that are necessary to complete a project. Further, cordial personal relationships between local and foreign engineers also enhance their cooperation to manage the client as well as sharing knowledge and working practices in joint working. In almost all projects, the ToR and working relationships of partner consultants are clearly defined and the partners clearly understand their roles and responsibilities. However, personal cordial relationships between local and foreign engineers do not exist in some projects, such as in the Lahore Orange Line Metro Train Project (LOLMTP).

Poor personal relationships lead to poor cooperation and sharing of knowledge and working practices between consultant partners.

Being informed by the ToR of an alliance, NESPAK starts consultancy work. A significant portion of the consultancy work is done by NESPAK independently, without any support from foreign partners. Engineers learn in studying relevant literature and doing these activities independently, which is why this category is labelled as **Self-directed Learning,** one of the categories of the core category of **Learning in Engineering Consultancy Practice** reflected in the **Right Side of the Orange Oval Shape**. The activities performed in this category include studying and understanding relevant theories, theoretical models, engineering methods and technologies. Engineers develop a basic understanding through studying academic literature, project manuals, experimenting and using trial-and-error methods to understand the reports of previous projects and information available on the Internet, as well as watching videos on the application of relevant engineering methods and technologies. They also survey the geological and geographical conditions of a project site and other conditions affecting the project and prepare information/input to be used in the customization of engineering methods and technologies according to those conditions. In addition to that, they also analyze the concerns of external stakeholders and prepare answers to those concerns. Their learning takes place through cognitive learning in studying literature and project reports and watching videos (e.g. storing information in their cognitive memory and physical artefacts (computer information sheets)) and through learning in doing such as surveying sites, experimenting and using trial-and-error methods. Their learning takes place in studying text and doing performing those activities independently, and hence it is labelled Self-directed Learning.

NESPAK’s engineers complete as much work independently as possible. However, there is still a large proportion of consultancy work that is done by the local project team and foreign partners collectively. Learning in doing such activities is reflected in the category of **Managerially Influenced Learning, the** second category of the core category of **Learning in Engineering Consultancy Practice.** These activities include studying text identified/arranged by the managers and analysing information regarding local conditions and completing some parts of civil work in local teamwork that can be done locally at NESPAK. Senior engineers such as project team leaders/ project managers, Vice Presidents of divisions or immediate senior engineers facilitate/ direct the learning of their junior engineers. This facilitation takes place through:

- presenting work by junior engineers to their senior engineers or colleagues one-on-one and in meetings and getting feedback
- sharing pictures and videos of a technology installed by senior engineers
- sharing, arranging, developing and suggesting resources, such as books, journal articles, reports of previous projects, project manuals and the like by senior engineers
- evaluations of junior engineers’ work by senior engineers; assisting junior engineers in problem-based learning; and doing consultancy work collectively.

NESPAK's engineers' learning takes place through both cognitive learning, such as studying and analyzing text/ resources arranged by their senior engineers, and storing meaningful information in their cognitive memory and physical artefacts. They also learn in preparing and doing consultancy work, presenting it to seniors and colleagues, experimentation and junior engineers doing consultancy work under the close supervision of their seniors.

Once consultancy work is done which needs to be done locally, NESPAK's project team starts joint working with foreign partners to transform engineering methods and technologies to complete engineering consultancy. Engineers' learning taking place in joint working with foreign partners is reflected through the category of **Partner-influenced Learning**. This is the most practical stage of consultancy work in which concepts developed through studying academic and project-related texts and input, prepared through surveying and analyzing information (done in the previous two stages), are put into practice. Modern engineering methods and technologies are transformed according to input related to the conditions of a project. NESPAK's engineers' learning takes place through facilitation/direction by foreign experts who are supposed to guide NESPAK's engineers in the application/ installation of state-of-the-art engineering methods and technologies. Such guidance and support facilitate the learning of both explicit and tacit knowledge. Explicit knowledge is learnt through studying documents, project reports, Microsoft Excel spreadsheets, calculation formulas and the like, as well as through discussions, deliberations, reviewing each other's work, presentation of work, application of modern calculation and engineering methods and feedback on project work. These resources are shared and facilitation is provided in joint working. While tacit knowledge is learnt through collectively developing the concept designs and drawings of a project, finalizing the design of scientific instruments and their installation, collectively running simulation models, the configuration and schematization of computer software and models according to project conditions, observing foreign partners' working while assisting them on project work and the like. **Self-directed Learning** and **Managerially Influenced Learning** also take place in tandem with joint working with foreign engineers at this stage, because even during joint working, NESPAK's engineers do some work independently at the individual level, as well as at the local project-team level.

As NESPAK's engineers learn both explicit and tacit knowledge in this joint working, which is shared and facilitated by foreign engineers, the current research also studies various aspects influencing the sharing of such knowledge in joint consultancy work. The core category presenting such influencing aspects is labelled **Symbiotic Learning Alliance** (presented on the right of the orange oval shape), given that an alliance is formed with the core purpose of learning state-of-the-art engineering methods and technologies which are applied/ installed in a symbiotic and shared manner. The first category of this core category is labelled **Intention to Learn and Share Knowledge** and reflected in the orange oval shape of **Symbiotic Learning Alliance.** The category covers the intention of local engineers to learn state-of-the-art engineering methods and technologies and the willingness of foreign engineers to share relevant knowledge.

Though NESPAK's engineers also share knowledge about local conditions, their intention to learn modern engineering methods and technologies does matter, mainly for the sharing of knowledge by foreign engineers. The data indicate that NESPAK's engineers are quite willing to share knowledge about local conditions, project site conditions and engineering methods and technologies which they are already using. The underlying reasons for their willingness are: 1) NESPAK's organizational philosophy is always to learn state-of-the-art engineering methods and technologies from foreign partners to gain self-reliance for similar projects in the future; 2) organizational financial objectives (i.e. earning consultancy fees as a result of successful completion of projects); 3) personal and organizational reputations; and 4) personal career growth as a result of learning modern engineering methods and technologies. For the same reasons, they are always willing to share knowledge related to work done and information/input regarding local geological, geographical and general environmental conditions prepared in the earlier stages of projects. Their higher willingness to share knowledge on their hands is reinforced by their learning modern engineering methods and technologies by foreign partners. Hence, high willingness of NESPAK's engineers to share their knowledge and to learn state-of-the-art engineering methods and technologies, result in enhanced sharing of knowledge and working practices in alliances, not only by themselves but also by foreign engineers. Foreign engineers tend to share more knowledge with such learning-oriented engineers.

The key underlying reason for their willingness is equity ties/organizational financial objectives, i.e. earning consultancy fees after successful completion of a project. This research reports that most of the foreign engineers from Australia, the Netherlands, the United States, Germany, Switzerland, Norway and Canada are quite willing to share knowledge and working practices agreed upon in Terms of Reference (ToR) of consultancy alliances to successfully complete projects. Further, foreign engineers are also keen to learn about the application/ installation of engineering methods and technologies in the context of Pakistan, so their willingness to share knowledge is also reinforced by their own intention to learn of application of modern technologies in the unique geological, geographical and infrastructural settings of Pakistan

The data also indicate that there are engineers (a single evidence) who are not very willing even to share agreed-upon knowledge and working practices while many of them are not willing to share more than the agreed-upon knowledge and practices in the alliances. In such cases, NESPAK's engineers develop personal associations and friendships with foreign engineers, which makes foreign engineers more willing to share knowledge which they might withhold in normal circumstances. This also makes foreign engineers to share even more knowledge of competing engineering methods and technologies, their comparative evaluation and the selection of the most compatible engineering methods and technologies in alignment with a project's technical requirements and a site's geological and geographical conditions. Then they also share the rationales and logics of selected engineering methods to perform certain tasks. However, foreign engineers do not share knowledge about their core competencies in order to maintain their supremacy and secure business for themselves in similar projects in the future and such knowledge is not agreed-upon in the alliances to be shared. Besides, one engineer reported that he sometimes performs a task in the wrong way and/or disagrees unnecessarily. In return, the foreign engineer will correct him and tell him the right way to perform the task. In the case of unnecessary disagreement by a local engineer, a foreign engineer shares more knowledge, logic and methods to convince him. This ultimately causes more sharing of knowledge and working practices.

In contrast to engineers from the aforementioned countries, Chinese engineers are found to be highly unwilling and non-cooperative in sharing knowledge and working practices. They are found to be very possessive of their knowledge and more concerned with their supremacy in an alliance. They are not willing to share documents or work done before a deadline, even if it is ready to be shared. Almost all the participants reported that they faced huge problems in working with Chinese engineers, which resulted in poor sharing of knowledge and working practices. In such cases, local engineers learnt required engineering methods on their own using reverse engineering and trial-and-error methods. However, there was one instance reported in section **5.4** where a Chinese engineer supported him, shared extra documents and resources and helped the local engineer beyond what was necessary because the local engineer favoured him personally. This reflects that even Chinese engineers tend to honour personal associations, however this is one piece of evidence. Other Chinese engineers did not respond to the friendship initiatives of local engineers and did not support and provide required guidance throughout the project. Such absence of friendships and personal associations between Chinese and Pakistani engineers might also be attributed to the language barrier between them.

The second influencing aspect is both the professional and personal relationships constituting the category of **Symbiotic Working Relationships.** The professional relationship between two partners reflects alliance ToR that have already been covered at the start of the explanation of **Figure 6.1,** as such agreed-upon ToR sets the stage for overall consultancy work and sharing of knowledge and working practices between local and foreign engineers. However, personal cordial relationships between local and foreign engineers are developed during joint working and significantly influence the sharing of knowledge and working practices between both partners. Such cordial relationships exist in almost every project with engineers from Western companies. Such personal-level relationships support good cooperation, sharing of work, working practices and knowledge, understanding partners' problems and managing the client collectively. Foreign engineers then understand the problems of local engineers and the pressures put on them by the client and may manage the client directly on behalf of local engineers. However, NESPAK's engineers could not develop personal cordial relationships with Chinese engineers, which led to poor cooperation and sharing of work, working practices and knowledge. This subsequently adversely affected the learning of local engineers and overall project work.

The third important aspect that influences the sharing of knowledge and working practices between local and foreign engineers is cultural harmony, which was not there initially but was developed by local and foreign engineers as the joint working proceeds. That is why this category is termed **Developing Cultural Harmony.** As the model reflects, there are two main aspects of cultural harmony. The first of those is related to the varied working styles of both local and foreign engineers. These include different ways of performing managerial and technical tasks, interacting with or managing the client, time management, managing subordinates, openness to discuss issues, status orientation, differences in priorities and assertiveness. These differences raise severe hurdles to developing working integration and subsequent knowledge-sharing. However, as both partners are driven by equity ties (i.e. earning of consultancy fee in result of successful project completion), they cooperate with each other and adjust their working styles in order to develop integration between them. In this regard, local engineers are more inclined to adjust their working styles because they are on the receiving end and seek knowledge about modern engineering methods and technologies from foreign engineers. Foreign engineers also understand the problems of NESPAK, such as short deadlines for projects and working at the weekend so they respond by sharing knowledge, documents or any other resources as and when requested by local engineers. Due to such cultural harmony, required knowledge and working practices are shared sufficiently in a consultancy alliance and the outcome of consultancy work is not compromised.

The second key aspect in developing cultural harmony is the language barrier. Most local engineers do not have any problem in communicating in English with foreign engineers. This is because NESPAK's engineers have graduate, post-graduate and PhD qualifications from local and foreign universities, while the medium of instruction at their alma maters is English. However, there are a few engineers who are not very proficient in English and cannot have detailed deliberations with foreign engineers in English and face language barriers. Such language barriers hinder the sharing of knowledge and working practices. However, there is a severe language barrier while working with Chinese engineers as most of them do not know English at all. Chinese engineers are so restrictive in their language that they do not even write names, telephone numbers and email IDs in English. In such situations, interpreters are used but not proved to be very helpful because of their non-engineering background and no understanding of engineering terminology. Online resources such as Google translator also do not work well because they change the context of a communication. So, due to such language barriers, the communication of knowledge and working practices as well as collective working are seriously compromised.

The final aspect influencing the sharing of knowledge and working practices in an alliance relationship is **Constructive Disagreements.** Disagreements over compatibility of engineering methods and technologies with local on-ground conditions. Local engineers are more knowledgeable about local conditions and project dynamics while foreign engineers are more knowledgeable in modern engineering methods and technologies. For successful completion of the project, the engineering methods and technologies are customized/transformed according to the project specific condition. On one hand, local engineers want complete customization of the engineering methods and technologies for successful project completion and its efficient functioning. This customization increases the work of foreign engineers. This situation often causes disagreements between local and foreign engineers. However, disagreements are settled and addressed through debate and discussion. As a result of disagreements, even more knowledge is shared. Engineers involved in a disagreement do more study and experimentation to make the necessary preparations to prove their point of view, as well as having more logic and knowledge about a method proposed by other partners. They also get involved in further discussion, debate and deliberation to convince each other. So not only is more knowledge created (engineers of both sides have to do more study and experiments to prepare well to convince others) but it is shared as well in such constructive disagreements (as they give more logics, arguments and methods to convince each other). In addition to that, these disagreements are constructive because faults/errors in concept designs and drawings are identified at an earlier stage of a project. This subsequently prevents the construction of a project with a faulty concept design and prevents the failure of a project and/or a delay in its completion. This is not possible with uncritical and facile agreement.

To conclude explanation of the learning model existing at NESPAK, it is reported that engineers' Learning in Engineering Consultancy Practice takes place at three levels or through three methods. These are Self-directed Learning, Managerially Influenced Learning and Partner-influenced Learning. In Partner-influenced Learning, a great deal of sharing of knowledge and working practices takes place between local and foreign engineers in the context of international consultancy alliances. Such sharing is first influenced by the other two categories because understanding basics of the relevant engineering theories and models and completing basic work and required information enable NESPAK engineers to come at par with foreign engineers, understanding their work and have knowledgeable debate, discussion and deliberation with them. Further, such sharing of knowledge and practices is influenced by four key aspects: Symbiotic Alliance Relationships, Intention to Learn (of local engineers) and Willingness to Share Knowledge (of foreign engineers), Developing Cultural Harmony and Constructive

Disagreements. As these aspects are found in the alliance relationships of NESPAK with its foreign consultant partners as well as in engineering consultancy done in a collective, symbiotic and shared manner by local and foreign engineers, a consultancy alliance is termed a Symbiotic Learning Alliance.

6.3 Discussion of Findings in relation to the Literature Review

Section 6.3 discusses the findings of this research in relation to the literature, theories and model reviewed in Chapter 2. First, sub-section 6.3.1 discusses all three categories of the core categories of Learning in Engineering Consultancy Practice in relation to cognitive learning and knowing in practice. The combination and rapprochement of cognitive learning and knowing in practice is discussed in relation to the Marshall’s (2008) proposal of the rapprochement between cognitive learning and knowing in practice in relation to the theories of distributed cognition and the collective mind. These categories are discussed in a *collective and integrated manner* due to their interrelationship and interdependence. Then, the second sub-section, 6.3.2, discusses the four categories of the core categories of Symbiotic Learning Alliance *separately* due to the distinct nature of their influence on the sharing of knowledge and working practices in joint working between NESPAK and its foreign partners.

6.3.1 Learning in Engineering Consultancy Practice

Practice is defined as socially organized doing of routine work (recursive) by knowledgeable agents informed by the historical and emerging context (Gherardi 2006, 2009a, Giddens 1984, Nicolini et al. 2003, Orlikowski 1996, 2002). The engineering consultancy in this research is considered to be a practice because: the consultancy work and its activities are recursively performed in every project but is transformed/ emerges according to the different contexts of different projects (Giddens 1984). The same activities, such as site analysis, concept design and drawings development, site supervision etc., are performed in every project; however, these activities are transformed according to the specific nature of projects, site dynamics, technological requirements and foreign partners.

Further, performing engineering consultancy work is knowledgeable doing because engineers are knowledgeable actors who have the power to do otherwise and give rise to transformations of practice according to the emerging context of a project (Giddens 1984). A consultancy practice is shared and distributed among human actors (local and foreign engineers working in a project team) and non-human actors (social rules and processes to perform an activity/ practice, scientific instruments, software, computers etc.) through a rich fabric of connectivity. Thus, consultancy practice is argued to be a socially organized communicative practice (Gherardi 2013). Lastly, engineers/ participants engage themselves both mentally and physically to perform engineering consultancy practice and its activities (Gherardi 2006, 2009a, Nicolini et al. 2003, Orlikowski 2002). They do not only work through bodies but also learn through them and their senses and develop aesthetic knowledge (Gherardi 2009a, Strati 2007). Such consultancy practice is considered a learning practice because engineers learn in doing this routine work of consultancy activities for a project (Gherardi 2006, 2009a, Nicolini et al. 2003, Orlikowski 2002). Their learning takes place in doing consultancy work locally as well as in consultancy alliances with foreign engineers.

In doing the practice of engineering consultancy, engineers' learning can be seen to have elements that are interpreted from a different learning perspective. For instance, they learn cognitively through cognitive learning processes, as presented by Ausubel (1960). For instance, they learn through cognitive rote receptive learning while studying relevant engineering theories, methods and technologies individualistically in the earlier stages of a project. They consult books, journal articles, online literature, videos, pictures, project reports and survey information and memorize information such as formulas, codes, theories, the content of pictures and videos, new technologies etc. through cognitive rote learning (Ausubel 1961). In addition to rote learning, they subsume information such as theories and engineering models, the installation of scientific instruments and technologies, consultancy work done for previous projects, construction codes, etc. into their existing cognitive structures (already having cognitive knowledge). In this way, they draw some meaningful information (insights and understandings) related to the application of new engineering methods and the installation of new technologies in a project, the relevance of previous projects to the current one, rules of calculation etc. Such meaningful information is used in overall consultancy work. Further, engineers learn through *cognitive discovery learning* as they analyze the principal content of such information regarding: engineering methods and technologies, relevant knowledge in the form of engineering theories, models, calculations and construction codes, previous projects, site conditions etc., and they relate it to existing cognitive structures (cognitive knowledge they have already gained through their academic and professional careers) and discover optimum solutions for the compatible application and installation of engineering methods and technology in a project. Overall, such a cognitive learning process involves engineers' acquisition of external information, storing it is in their cognitive memories and/or processing it in relation to existing cognitive knowledge they have gained during their educational and professional careers.

Engineers' learning is also influenced by the support, facilitation and supervision of senior local engineers, such as team leaders, divisional heads, project managers and the like (Managerially Influenced Learning). They assist their juniors' learning through identifying and suggesting resources of explicit knowledge, analyzing their work, giving them feedback on work done or presented, identifying their mistakes and sharing their explicit knowledge (through communication and document-sharing) and tacit insights (through socialization, on-the-job training and collectively working with them) (Nonaka & Takeuchi 1995). In this teamwork, consultancy work done by individuals is further analyzed to finalize information and work which are supposed to be done at the NESPAK level. Such learning can be interpreted via an amalgamation of the cognitive learning perspective and PBS's aspect of learning in practice perspective (Gherardi 2006, 2009a, 2011, Nicolini et al. 2003, Orlikowski 2002). Engineers do not only consult resources of external information and learn through cognitive rote and meaningful and discovery learning as discussed in the last paragraph, they also utilize such knowledge in doing consultancy work, such as experimentation, analysis of the project site, doing civil work and developing concept design and drawings. Consultancy work takes the form of a practice in which networked members of NESPAK’s project team work on interrelated and interdependent tasks collectively through the precise division of labour and maintain a common orientation regarding project targets and the rules and processes of consultancy work (Gherardi 2013).

Engineers’ learning is also influenced by foreign partners through collectively doing consultancy work for a project. For instance, it is influenced through practical demonstrations by foreign partners, supervision and assistance in collective work, reviews of each other’s work and giving feedback, discussion, deliberation and socialization. In fact, NESPAK’s project team independently surveys and analyzes project sites and develops basic input and information according to which the application of state-of-the-art engineering methods and the installation of technologies are transformed. This transformation is done in joint working with foreign partners. So, the boundaries of the practice of engineering consultancy are widened from NESPAK to the foreign engineers in the context of an international consultancy alliance. It is thus redistributed among local and foreign engineers. NESPAK’s engineers learn new engineering methods and technologies from their foreign counterparts in doing consultancy work collectively. In this joint working, explicit knowledge (such as documents, project reports, calculation methods and formulas) is shared through the sharing of documents, face-to-face and online communication, discussion and deliberation. While tacit knowledge (such as expertise, skills and methods for doing a task) is shared through collective working, assisting/ supervising, observation, on-the-job training and socialization. Engineers do not only study these resources of explicit knowledge and learn through cognitive rote and meaningful and discovery learning but also utilize such knowledge in working on concept design, drawings and feasibility reports for a project – learning in practice (Gherardi 2009a, Orlikowski 2002). So, understanding engineers' learning can be informed by the amalgamation of cognitive learning and knowing in practice perspectives.

Engineers, as participants of consultancy practice, learn in doing different activities of consultancy work with or without their awareness of working with and learning new technologies and engineering methods that are co-present (Gherardi 2013). A consultancy practice comprises 'topos' (Gherardi 2008) of learning in doing consultancy work involving the application of state-of-the-art engineering methods and technologies in every project of NESPAK. They engage in consultancy activities both mentally and physically through union of the mind and body, thoughts and actions (Gherardi 2009a), while their learning and doing consultancy work are co-constituents. They do not only use their thinking but also deploy their bodies and senses in consultancy activities, such as surveying sites, doing drawings, assessing mechanical instruments, using software, supervising sites etc. This is what argued by Strati (2007, p.65), i.e. that participants of a practice use their bodies *"to feel and judge, to sense and to act",* and this is knowledge engineers learn through their senses. Such knowledge is not only referred to as somatic tacit knowledge but social tacit knowledge (Collins 2010) as well, because engineers learn such bodily knowledge while responding to a situation, as consultancy activities and practices are performed in a situation involving the dynamics of a project site, engineering methods, technologies and consultancy alliances. Engineers learn such aesthetic knowledge while being in such situations, understanding those dynamics and responding accordingly. Engineers being in such situations acknowledge the 'Dasein' concept of practice (Gherardi 2009a).

Moreover, the practice of engineering consultancy is seen as a 'socially organized communicative practice' (Gherardi 2013). It is performed in a coordination centre comprising local and foreign project teams. It is distributed among social agents (local and foreign engineers) and material agents (analysis tools and software, technological equipment, ICT tools, Internet, intranet, offices, board room, project sites, etc.). This acknowledges that consultancy practice is a sociomaterial practice, as it is shaped by connection-in-action between social and material agents (Orlikowski 2002). PBS gives no privilege to either social or material agents in a practice (Orlikowski 2002). However, the current research takes a compromised position of privileging social agents (engineers) due to the rapprochement between cognitive learning and PBS, given that cognitive learning gives primacy to mental processing of learner for learning and knowledge creation (Easterby-Smith et al. 1998).

The practice of engineering consultancy is found to be informed by its context (Cook & Brown 1999). Its context comprises the structure of the project team, the ToR of the consultancy alliance, the learning orientation of the project managers and divisional heads, the history of similar previous projects, ways of performing consultancy activities, network/ connectivity of human and non-human actors, clients, project sites, technologies to be used or installed and scientific instruments which are organized in a relational arrangement. As suggested by Nicolini et al. (2003), the richness and depth of the context is given full consideration in the study of engineers' learning in the practice of engineering consultancy. Such Learning in Engineering Consultancy Practice is hard to generalize to another context due to its situatedness in a context. However, it can be somewhat resituated and reproduced in another project, subject to context similarity but it will emerge differently according to the context to hand.

The findings of this research also argue that existing explicit and tacit knowledge are used in performing the activities and practices of engineering consultancy. This results in new explicit knowledge, such as project reports and manuals (with codified knowledge of engineering methods and technologies) and tacit knowledge (skills and expertise in the application of those engineering methods and technologies). For instance, engineers consult theories and models of engineering and relevant calculation formulas and use/ apply them in their situated doing of consultancy activities. So, they use their existing knowledge learnt during project work as well as during their academic and professional careers in knowing and doing the practices and activities of engineering consultancy. This is what Cook and Brown (1999, p.383) argue, i.e. that *"the source of new knowledge and knowing lies in the use of knowledge as a tool of knowing within situated interaction with the social and physical world. It is this that we call generative dance"* (Cook & Brown, 1999, p.383). In this way, the findings of this research support Sole and

Edmondson's (2002) acknowledgement of the application of both explicit and tacit knowledge in performing a practice.

The key theoretical contribution made by this research is that Learning in Engineering Consultancy Practice is found to be somewhat different from conventional PBS (Corradi et al. 2010, Gherardi 2011) and its aspect of learning in practice (Gherardi 2006, 2009a, b, Nicolini et al. 2003, Orlikowski 2002), which is specially dismissive of cognitive learning (Marshall 2008). Whilst it is found that engineers equally learn through cognitive learning (Ausubel 1961) and knowing in practice while doing engineering consultancy practice, there is acknowledgement of the rapprochement between cognitive learning and knowing in practice while performing the overall practice of engineering consultancy. This research not only empirically substantiates the **rapprochement** of cognitive learning and knowing in practice, as argued by Marshall (2008), but also uses the theories of 'distributed cognition' (Hutchins 1995) and the 'collective mind' (Weick & Roberts 1993) to develop this rapprochement.

Thus, this rapprochement is informed by the concept of 'distributed cognition' (Hutchins 1995). In the initial stages of a project, cognitive processing takes place in an engineer's mind individualistically in terms of consulting theories, models and calculation formulas regarding engineering methods (in case of Self-directed Learning). In such cognitive processing, engineers learn through cognitive rote, meaningful and discovery learning, as argued by Ausubel (1961). They not only store such information in their minds but also relate it to existing cognitive structures, have meaningful insights and discover solutions for problems related to consultancy work. Such cognitive learning is similar to the internal representational framework of distributed cognition, which is *"in the mind, as propositions, productions, schemas, mental images, connectionist networks, or other forms"* (Zhang & Norman 1994, p.89). These propositions, mental schemas and the production of knowledge are the result of engineers receiving information from the external world and memorizing it, distilling meaningful information and discovering solutions to consultancy-related problems. Distributing cognition helps by externalizing such cognition and objective knowledge to other participants of the consultancy practice when engineers become involved in performing consultancy activities and practice – indicating a rapprochement between the perspectives of cognitive learning and knowing in practice through the concept of distributed cognition.

However, cognitive learning is different from distributed cognition (Hutchins 1995) and the collective mind (Weick & Roberts 1993) because it happens in the individualistic mental processing of an individual. The concepts of distributed cognition and the collective minds argue for cognitive learning occurring through the mental processing of an individual that happens in connection with the mental processing of other individuals (team members) in the context of teamwork (Hutchins 1995, Weick & Roberts 1993). So, the locus of learning is not only individual cognition but its connection with the cognitions of other networked members as well. However, this research argues that such individualistic cognitive learning does not remain limited to the individual mind, although it takes places individualistically. Instead, it is shared with other engineers (members of the project team) involved in consultancy work at advanced stages of project work through social and technological artefacts (during Managerially Influenced Learning and Partner-Influenced Learning).

Such sharing aspect of cognition through technological artefacts is similar to what is argued by distributed cognition (Hutchins 1995). Participants performing socially organized and communicative engineering consultancy practice are connected through a rich fabric of connectivity and the precise division of labour (Gherardi 2013). They need to share their cognitive learning (learnt through individualistic mental processing through rote, meaningful and discovery learning) in collective work in order to maintain a common orientation of consultancy work and activities, such as analyzing the project site, developing concept designs and drawings, assessing scientific/ mechanical instruments, supervising project sites etc. Thus, they share and off-load their cognition and already learnt objective knowledge to others when they become participants of socially organized engineering consultancy practice. Such sharing of cognition is informed by one of the predominant features of distributed cognition (Zhang & Norman 1994). Knowledge, that is an objective commodity according to cognitive learning (Burgoyne 1997, Fox 1997), can be made public and available to other participants when required (Heylighen, Heath and Overwalle 2003). Such knowledge can help ensure the common orientation among all engineers, which is necessary to perform socially organized communicative practices (Gherardi 2013). It can thus be argued that distributed cognition helps combine the contending perspectives of cognitive learning and knowing in practice.

In the case of Managerially Influenced Learning and Partner-Influenced Learning, engineers consult various resources identified/ suggested by managers, such as published texts, videos, pictures etc. in performing engineering consultancy activities. Their minds are also connected with each other's because they perform the same and/or interrelated consultancy activities collectively, whilst being relationally arranged through the precise division of labour in the coordination centre of consultancy practice (Gherardi 2013). Thus, their cognitive structures and knowledge occur in a collective, shared and distributed manner while being connected with other participants of the practice, as well as the material artefacts involved in consultancy work. This is what Hutchins (1995) argues, i.e. that cognitive thinking takes place in individuals' minds, some of it in parallel and some in coordination with other members of a team and with technological artefacts. The learning of engineers is supported/ facilitated/ assisted by local managers and foreign engineers who share their cognitive knowledge as well as practical skills and expertise to perform consultancy work. They share their cognitive knowledge about engineering methods and technologies through reviewing consultancy work, discussion and presentations, while share tacit knowledge through collective working, close supervision, assistance and practical demonstrations in performing consultancy practice. Thus, performing consultancy practice not only requires the coordinated mental processing of different engineers but also coordination between engineers' mental processing and material artefacts, because engineers not only learn through these material artefacts but extend and convey their cognition to other participants of the practice. They use their interactional competence (Cicourel 1974) to interact with material artefacts (Information and Communication Tools (ICTs) used in consultancy work) and social artefacts (norms and values of NESPAK and project team), not only to learn through them but also to extend their cognitive structures to other participants of the practice.

Such coordination between the cognitions of different engineers helps to develop a collective mind of all the engineers involved in a practice, which is *"a pattern of heedful interrelations of actions"* (Weick & Roberts 1993, p.357). Through this interrelationship of different actions, activities and tasks of engineering consultancy, not only is the 'doing' of engineers but also their mental contents (already learnt cognitive structures) and cognitive processing (currently going on cognitive learning) interlinked in performing the socially organized/ distributed/ relationally arranged and communicative practice of engineering consultancy (Gherardi 2009a, 2013, Kemmis 2009). This takes the form of a collective mind of all the participants of the practice. For instance, a local engineer working on the civil part of a project has not only to connect his mental processing with that of other participants of consultancy work but also with that of foreign engineers (who work on the technological side of the project) in order to develop compatibility between different interrelated consultancy activities as well as between civil work and the installation of technology.

Further, the resources of explicit knowledge, such as published academic and online material, previous projects' reports, project manuals etc. consulted by engineers, are similar to Hutchins' (1995) notion of 'chart' or external memory. They also follow the same 'framing rules' (Hochschild 1979, Sewell 1992), i.e. rules and processes to perform consultancy activities, interacting with the client, supervising the site etc. This helps their distributed cognitions to occur, i.e. the cognitive learning of key engineering theories, models, calculations formulas and working norms and processes in a connected, relationally organized and distributed manner. Thus, their cognitive structures are informed by the same social structures that surround consultancy work, such as rules, processes and working styles of NESPAK and foreign engineers and the technological infrastructure available for consultancy work. This helps to develop a 'common orientation' (Gherardi 2013) to perform the socially organized practice of engineering consultancy. This is what argued by Marshall (2008), i.e. situationally appropriate actions informed by cognitive structures which are subsequently shaped by the same social structures that exist in the coordination centre of a practice. Thus, the same external memory for all engineers helps to develop coordination and inter-linkage among their cognitions and the utilization of cognitive structures in their collective doing of consultancy activities.

In addition to distributed cognition and the collective mind, this rapprochement is also supported by the 'recursiveness' and 'knowledgeable doing' characteristics of a practice (Gherardi 2009a). For instance, the practice and activities of engineering consultancy are recursively performed in every project. However, these activities are not 'pattern-in-variety' (Cohen 207). Instead, these activities are intelligently transformed and resituated in the specific context of a project. For such a transformation, engineers act like knowledgeable actors (Giddens 1984), having cognitive structures and explicit knowledge that are already learnt through cognitive learning and practice-based learning. Distributed cognition plays its role here when an individual off-loads his/her cognition to other participants during collectively performing the consultancy practice (Zhang &

Norman 1994). An individual also transfers his/her cognition from mind to hands in doing the practice of engineering consultancy (Fenwick 2008).

Even while doing consultancy work, they study advances in relevant theories, models and other resources and adapt their activities according to such learning. This is in line with Fenwick's (2008, p.232) recognition of the role of cognitive learning in practice-based learning by stating that *"much workplace learning research also employs the assumption that individuals acquire knowledge cognitively, for example, by listening to information presentation, then applying it to practice, in a sort of 'transfer' process from mind to hands".* In addition, they consult manuals and reports of previous projects to maintain the relationship between the past and present of consultancy practice (Orlikowski 1996). Such cognitive learning of explicit knowledge further enhances engineers' knowledgeability and power, thus giving rise to the transformation of consultancy practice. Engineers apply such knowledge in doing consultancy practice and activities according to the project context. This transformation involves 'sustained adjustment' (Orlikowski 1996) to accommodate the variability within a specific context, while being informed by the history of practice. This transformation and the emergence of consultancy practice causes engineers to learn *new* engineering methods and technologies, otherwise they would be repeating the same consultancy activities.

Further, distributed cognition and collective minds are found to be similar to the perspective of knowing in practice in some respects. For instance, these perspectives argue that learning takes place through interaction with the tools and members/ participants of a team/ practice situated in a specific context. This interaction takes place among members who are socially organized, distributed and relationally arranged through the precise division of labour and working on the same or interrelated tasks in a collective manner. However, they are different in the way that the theories of distributed cognition and the collective minds give primacy to individual minds and consider these as a locus of learning. On the other hand, a learning in doing perspective considers interaction in a socially organized communicative practice to be a locus of learning (Gherardi 2011). This is why the current research is informed by the unit of analysis, i.e. individuals learning in a socially organized communicative practice to accommodate both perspectives of learning.

Both contending perspectives of learning maintain their respective key assumptions despite a rapprochement between them. For instance, cognitive learning gives ontological primacy to mental processing for learning and knowledge creation and it works through the dichotomies of mind and body, and thoughts and actions (Gherardi 2006). Further, knowledge is an objective commodity according to the cognitive learning perspective that can be transferred and made public when required (Burgoyne 2002, Fox 1997). On the other hand, practice-based perspective of learning and its theme of knowing in practice gives primacy to social interaction, discourse and performing the socially organized communicative practice in which learning and doing are co-constituents (Gherardi 2006, 2013). Further, the practice perspective considers knowledge as a situated, embedded, emergent and negotiated act of knowing (Blackler 1995, Gherardi 2009a). The practice perspective stresses the union of mind/body, and thought/action instead of seeing them from a distance, and that connectedness instead of separation are powerful tools to learn and create knowledge.

However, these contending perspectives are found interacting and integrating with each other in performing engineering consultancy practice and its activities. Previous knowledge and learning which has involved cognitive processes, is found being utilized in practically performing consultancy activities. The engineers share their cognition and objective knowledge with other participants through social and technological means, as argued by distributed cognition (Hutchins 1995, Zhang & Norman 1991), in the course of performing a practice to ensure a common orientation of the practice. The engineers' cognition also takes place while being connected with the cognitions of other participants of the practice in addition to their practical, recursive, knowledgeable doing of the consultancy practice and activities.

In this way, learning in the practice of engineering consultancy can be understood as the rapprochement of cognitive learning and practice-based learning perspectives, as proposed by Marshall (2008). However, this research extends this proposal and makes a significant contribution to existing knowledge *through developing this rapprochement using the theories of 'distributed cognition'* (Hutchins 1995) *and the 'collective mind'* (Weick & Roberts 1993). This is a theoretical discussion of the learning accounts of NESPAK engineers in doing the practice of engineering consultancy in relation to relevant theories and models. The next section discusses different aspects influencing the sharing of working practices and knowledge between local and foreign partners theoretically, in the context of an international consultancy alliance.

6.3.2 Symbiotic Learning Alliance

This section discusses the categories of the second core category of the research findings. Being distinct in nature, all of these categories have been discussed separately (independent of each other) as opposed to the discussion style of section 6.3.1 for the first core category. There is a logical sequence among the categories of the core category of Learning in Engineering Consultancy Practice. However, the categories of the core category of Symbiotic Learning Alliance are not interrelated and interdependent. Instead, they separately influence the sharing of knowledge in joint working between NESPAK and foreign partners. Below is a discussion of these categories in relation to their relevant literature, theories and models.

Every form of strategic alliance has its unique dimensions (Hagedoorn and Narula 1996) that predict knowledge-sharing among an alliance's partners. Consultancy alliances in general, and at NESPAK in specific, have a loosely-coupled alliance form (Steiner 2006) because of the 'networked-like' nature of consultancy companies in which a few highly specialized experts work together to provide consultancy to a third party, i.e. the client (Boussebaa et al. 2014). NESPAK enjoys a **Symbiotic Working Relationship** as both partners work together in a shared and symbiotic manner in a mutually-beneficial alliance to successfully complete a project and earn their respective portions of consultancy fees. According to the ToR of NESPAK's consultancy alliances, it is necessary for partners to share required knowledge and working practices for a project's successful completion. The equity-based form of consultancy alliances (Mowery et al. 1996) also motivates partners to share required knowledge and working practices. Apart from the organization level, there are cordial relationships between NESPAK's and foreign engineers. Being knowledge-seekers, NESPAK's engineers develop personal associations and friendships that in turn cause greater sharing of knowledge in an alliance (Ingram & Roberts 2000).

Second, NESPAK's engineers report different cultural barriers hindering knowledge-sharing between them and foreign partners and ways to **Develop Cultural Harmony**. First, they face language barriers, particularly when working with Chinese engineers. To address this, NESPAK uses external language resources and machine translation for communication with Chinese engineers, as suggested by Joshi and Lahiri (2015). However, these methods do not work well for knowledge-sharing as the exchange of information cannot be take place due to the unfamiliarity of interpreters with engineering terminology. This is what is argued by Clarke-Hill, Li and Davies (2003) that poor communication and language barriers can severely influence the operational tasks of international alliances.

Further, working practices and people learning in doing those practices are situated in social and cultural settings (Hong et al. 2006, Rooney et al. 2012). Ways of doing things by individuals, groups and organization are informed by a common culture, behavioural dispositions or 'habitus' (Bourdieu 1977), which are difficult to share across national and cultural boundaries. For instance, the working style of Western engineers is more formal in terms of managing working hours while it is less formal in Pakistan. This is because of extra socialization during working hours in Pakistan relative to Western countries. As a result, they have to stay late and work at the weekend to complete their tasks.

In addition, Western engineers can confront an assertive client due to their low power-distance cultural dimension, while NESPAK's engineers do not do so due to the high power-distance culture and the potential threat to their careers (Hofstede 2010). Thus, they do not challenge the unrealistic demands of assertive clients but become pleasing and flatter. However, they understand that their foreign counterparts are doing good by confronting clients boldly. In this way, an atmosphere of mutual understanding and a cordial relationship between local and foreign engineers are developed, which is essential for the sharing of not only technical knowledge and practices but also knowledge of managing assertive clients (Lyles & Salk 1996). Apart from that, Pakistani society is socially stratified and local people value such stratification and maintain the protocols of their positions due to 'status-centric orientation' (Hafeez 1985). Where foreign engineers are more concerned with high-quality ICT and scientific instruments, NESPAK's engineers are more concerned with the office furniture and fixtures and protocol. This indicates how much Pakistani people are status-centric, even 32 years after Hafeez's (1985) findings. This is the reason why they view working with their own hands as alien to their positions' protocol, they believe that they are meant to give orders only. On the other hand, foreign engineers do not feel any hesitation in working with their own hands.

Such culturally different working styles are managed by both local and foreign engineers. They follow Berry's (1997) cultural integration strategy and adapt to the working styles of each other. For instance, foreign engineers understand the fast pace and short deadlines of projects and respond to Pakistani engineers as and when required, irrespective of their working hours and weekends. This is likely to be because of the aforementioned equity-based form of consultancy alliances, as suggested by previous literature (Mowery et al. 1996, Salk & Simonin 2011). In this regard, local engineers modify their working style more than their foreign counterparts, perhaps because of being in the position of knowledge-seekers (Salk & Simonin 2011). They also develop personal associations and friendships with foreign engineers, particularly during site work. Foreign engineers, particularly Western ones, are also reported to be quite supportive as they are open to accepting cultural differences. For instance, Western engineers confronted a client on behalf of local engineers, given their weaker position vis-à-vis top management and government (the client). Such cordial relationships and mutual adjustment and adopting each other's practices result in cultural integration (Berry 1997), which subsequently supports a harmonious working relationship for the sharing of knowledge and working practices (Lyles & Salk 1996).

Third, the intention of local engineers to learn and the willingness of foreign engineers to share knowledge are found to be other predominant aspects influencing the sharing of knowledge and working practices. Local engineers are keen to learn state-of-the-art engineering methods and technologies that are informed by different theoretical assumptions. First, the Knowledge-Based-View (KBV) of the firm (Grant 1991) informs NESPAK's core philosophy (i.e. always learning state-of-the-art engineering methods and technologies to address weak areas and maintain a competitive advantage in the local market through international alliances). This subsequently encourages engineers' intention to learn (e.g. Easterby-Smith et al. 2008, Lane et al. 2001, Salk & Simonin 2011). Their intention is also directly influenced by KBV and their view of specialist knowledge as a source of competitive advantage (Foray & Lundvall 1998). They view such knowledge as unique, valuable and rare (Salk & Simonin 2011) and a significant contributor to their personal career growth and organizational competitive advantage (Godshalk & Sosik 2003). That is why they start learning on their own in case of unwillingness of foreign engineers, through trial-and-error methods and reverse engineering (Maedche & Staab 2001, Young 2009). In addition, their intention to learn is also influenced by their baseline qualifications and basic understanding of particular engineering methods and technologies because having basic knowledge is expected to increase their curiosity to learn higher level/ next order complex knowledge, as suggested by Hong et al. (2006). Such high intentions of local engineers increase the quantity, quality and depth of knowledge they learn independently, as well as from foreign partners (Salk & Simonin 2011, Steensma, Tihanyi, Lyles & Dhanaraj 2005).

Further, knowledge-sharing between partners in an alliance is affected by the position and power of partners, according to earlier studies (e.g. Easterby-Smith et al. 2008, Inkpen 2008, Kale & Singh 2009). However, as discussed above, NESPAK’s consultancy alliances are symbiotic, mutually beneficial and equity-based and formed to serve the client. This structure and nature of NESPAK’s alliances increase the intention of local engineers to learn and the willingness of foreign engineers to share knowledge. So, despite the superior position of foreign partners in terms of having high-tech knowledge, most of them are found to be quite willing to share the required knowledge and working practices.

However, foreign partners do not share knowledge of their core competences if this is not agreed in alliance agreements in order to maintain their supremacy and competitive edge (Becerra et al. 2008) in the long run and due to fear of losing privileges (Hau & Evangelista 1996). Apart from that, few Western engineers, but all Chinese engineers, are found to be unwilling to share knowledge due to their individual and organizational approaches, respectively.

In such situations, NESPAK's engineers use different methods to make foreign engineers willing to share knowledge. For instance, they develop personal associations and friendships, as suggested by previous literature (e.g. Hasnen & Lovas 2004, Ingram & Roberts 2000, Krackhardt & Kilduff 1990). Informal associations and friendships increase trust, liking and affection between local and foreign engineers and so they start supporting and taking more care of each other (Argyle & Henderson 1985). Increased knowledge-sharing as a result of informal relationships is also informed by Social Exchange Theory (SET) (Blau 1964) and its notion of reciprocity (Gouldner 1960). Being informed by this, foreign engineers normally reciprocate to such informal associations and friendships with feelings of warmth and extra cooperation and share extra knowledge and engineering methods (DeLamater 2006). The same should apply to Chinese engineers who seem to be informed by Confucianism and believe in personal connections or *guanxi* (Xin & Pearce 1996) which is characterized by shared psychological meanings and mutual obligations and expectations (Tsui & Farh 1997). However, only in ten engineers valued the initiative of personal friendship by NESPAK's engineers and offered extra support and shared extra knowledge.

Further, the findings also indicate that performing a task in the wrong way in front of a foreign engineer may lead him to correct it and share the right engineering methods. This indicates that intentionally doing wrong in front of an expert can make him share knowledge about correct methods. The same local engineer also disagrees, sometimes unnecessarily, with foreign engineers who in turn give more logic, reasons and arguments to convince local engineers, with greater sharing of knowledge. This supports the findings of van Woerkom and Sanders (2010) that disagreements increase knowledge-sharing in teamwork. However, this technique should be used carefully because if a knowledge donor understands that the knowledge seeker intentionally performs a task in a wrong way and unnecessarily disagrees, the knowledge donor may get offend and will likely to withhold even the necessary knowledge.

While working together, there are disagreements between local and foreign engineers, particularly over the compatibility of engineering methods and technologies with project site conditions. Finally, the existing literature also reports on the influence of disagreements on knowledge-sharing, innovativeness and learning in teamwork, with some mixed findings. The findings of this research align with those favouring greater knowledge-sharing as a result of disagreements. Thus, these are **Constructive Disagreements.** For instance, the findings acknowledge the significance of ‘constructive controversy’, a term used by Ellis et al. (2003), which is found to be inevitable to refine concept designs and address errors in earlier stages of development. On the other hand, ‘premature consensus, facile and uncritical agreement’ (Aldag & Fuller 1993) in such collective work can lead to an ill-refined concept design and wrong drawings, which are not tenable at all. Further, disagreements in NESPAK's consultancy work also increase the innovativeness and creativity of its engineers, as argued by previous studies (e.g. De Dreu 1997, Turner & Pratkanis 1997), as engineers find novel solutions to unique problems in every project. Thus, the findings are consistent with those of van Woerkom and Sanders (2010), who argue that disagreements increase the openness to sharing suggestions and ideas. NESPAK engineers, once they face disagreements, become more open, do more study and experiments, criticize each other and come up with more ideas and solutions to correct errors in concept design and drawings to avoid costly project failures.

The current findings also endorse ways to increase knowledge-sharing in case of disagreement, as identified by previous literature (e.g. Ramasamy & Yeung 2016, Tjosvold & Deemer 1980, 1986, van Offenbeek 2001). In disagreements, both local and foreign engineers come up with divergent ideas, logic, arguments and solutions to reach a consensus and find common ground that can best serve the client's interests. The preparation of divergent solutions with ideas from NESPAK engineers themselves and understanding those of foreign engineers results in greater learning, which is not possible in the case of uncritical facile agreement. Such divergence of ideas holds a key place in today's workplaces to develop innovative solutions (van Beer & Zand 2014, Ramasamy & Yeung 2016).

Disagreements also arise due to the different working styles of local and foreign partners. They may deliberate with each other and synchronize their work according to project requirements. This is what is suggested by an integration acculturation strategy (IAS)

(Berry, Kim, Power, Young, & Bujaki, 1989) to achieve integration. Such disagreement-led deliberation is key to developing acculturation while working in international alliances (Elsass & Veiga 1994). Adapting to each other's ways of working reflects that the project team has achieved a certain level of acculturation (Berry et al. 1989) to the respective core working practices of local and foreign engineers, which are merged into a common practice (Damanpour, Devece, Chen & Pothukuchi 2012).

Finally, the findings acknowledge the notion of von Krogh (1998), that workplace disagreements turn into positive learning experiences for individuals in a knowledge-oriented community. With disagreement-led deliberation and critical evaluation of a method from different aspects, NESPAK's engineers refine the concept design and drawings of a project and find novel solutions to complex engineering problems and the best methods for the application of certain engineering methods and technologies. Such learning is a life-long learning experience and they become able to contribute towards the self-reliance of NESPAK to complete similar projects in the future, the core purpose of NESPAK's alliances.

6.4 Conclusion

This chapter aimed to present a data-driven research model and discuss the findings in relation to a critical realist philosophical perspective and previous literature, theories and models informing this research. **Section 6.2** presented the research model in **Figure 6.1**, which derives from the findings of this research. The model presents the ways in which

NESPAK's engineers learn in doing their routine work of engineering consultancy through presenting two core categories of this research. The first category, i.e. Learning in Engineering Consultancy Practice, presented three accounts of engineers' learning (categories), i.e. Self-directed Learning, Managerially Influenced Learning and Partner-influenced Learning. Further, as NESPAK largely relies upon knowledge and working practices related to state-of-the-art engineering methods and technologies being shared by foreign partners, the second core category, i.e. Symbiotic Learning Alliance, presented four aspects influencing this sharing process in the context of NESPAK's consultancy alliances. Thus, these aspects, i.e. Symbiotic Alliance Relationships, Developing Cultural Harmony, Intention and Willingness to Learn and Share Knowledge, and Constructive Disagreements, are presented in the model. The model also presented the ways in which these aspects influence the sharing of knowledge and working practices during joint working with foreign partners. The model is comprehensively explained in this section as well.

Section 6.3 discusses the research findings in relation to the literature, theories and model reviewed in Chapter 2. The section is divided into two sections according to the two core categories of this research. The first **sub-section 6.3.1** discussed the findings of three categories of the first core category i.e. Learning in Engineering Consultancy Practice. The research found that engineers learn by doing engineering consultancy practice, informed by PBS's aspect of knowing in practice (Gherardi 2006, 2009a, Nicolini et al. 2003, Orlikowski 2002). However, within their learning in practice, they equally learn through cognitive learning (Ausubel 1961, Burgoyne 2002) and create and utilize explicit knowledge equally. These aspects have been negated and overlooked, respectively, by learning in practice; however, the current research found a rapprochement between PBS and cognitive learning, as argued by Marshall (2008). It is worth mentioning here that this research significantly extends this debate by using, *for the first time*, theories of distributed cognition (Hutchins 1995) and the collective mind (Weick & Roberts 1993). This is a significant addition to Marshall's proposal and overall in the field of learning. Further, this research found an equal role for explicit knowledge in addition to tacit knowledge, which was previously overlooked by the core conception of learning in practice.

As NESPAK's engineers' key learning of modern engineering methods and technologires takes place in joint working with foreign partners, which is a technological requirement of almost in every project of NESPAK, the sharing of knowledge and working practices by foreign partners in international consultancy alliances is of great value. Thus, the second **sub-section, 6.3.2**, discussed the second core category, i.e. Symbiotic Learning Alliance, and its four categories/ aspects (mentioned above in the first paragraph of this section), which are found to be influential (facilitating/ hindering) in this sharing process, in relation to the existing literature and theories reviewed in Chapter 2.

The next chapter concludes the thesis by presenting answers to the research questions, the contribution of this research, its limitations and potential areas for further research in this domain.

CHAPTER 7: CONCLUSION

7.1 Introduction

Chapter 7 concludes the study and presents its main findings and key contributions. First, the chapter recaps Chapters 1–6 in order to give a brief summary of the study. Second, the chapter discusses how the two research questions are answered through presenting key research findings. Further, I present the key theoretical and methodological contributions of this research, i.e. how this research contributes to the existing body of knowledge.

Then, I present practical implications that could be useful not only for NESPAK but also for other organizations' and individuals' learning in the context of international alliances. The problems faced to access the research organization and participants and not being part of a research organization, such as an employee or internee, are considered as limitations of this research. It is suggested that future researchers can validate the research model by studying it in another context, and/or with a quantitative research approach, as well as studying the same phenomenon while being an employee/ Internee of a research organization.

7.2 Recap of Chapters

Before concluding the research, it is important to review earlier chapters to understand what is covered by each chapter and how they contribute to this thesis. This will also remind the reader about the aims and focus of this research and how the research questions are answered. This section is thus dedicated to a recap of all the chapters.

The thesis starts with an introduction, in Chapter 1, which sets the stage for the current research. The chapter starts with my background and personal motivation to conduct this research, followed by the aims and focus of the research and a brief overview of the research organization. In the following section on research gaps, I found that there are only five empirical studies exploring learning in practice that are informed by the perspective of practice-based-studies (PBS). However, these studies are situated in a single organizational context. On the other hand, I could not find any studies exploring learning in practice where practice which involves the sharing of knowledge or joint practices between local and foreign partners in the context of an international alliance. Given that cross-border sharing of knowledge and practices takes place in performing consultancy practice, this phenomenon holds key importance in this research. There is voluminous literature on the influence of a large variety of aspects of inter-organizational knowledge sharing. However, the current research, being informed by 'systematic combining' (Dubois & Gadde 2002), only studies those factors which are later found to influence the cross-border sharing of knowledge and practices in this research. To address these gaps, the following section presents two research questions focusing on engineers' view of Learning in Engineering Consultancy Practice in the context of an international consultancy alliance and the cross-border sharing of knowledge and working practices. The chapter highlights how this research adds value by being conducted in the relatively overlooked context of Pakistan. Finally, key concepts and terminology that are used in this thesis are introduced briefly.

Given the aims and focus of the research, Chapter 2 comprises a review of literature, theories and models informing the research questions. The first part of the chapter critically reviews two contrasting perspectives of learning, i.e. cognitive learning (Ausubel 1961, Burgoyne 2002) and one of the themes of PBS, i.e. learning in practice (Gherardi 2006, 2009a, Nicolini et al. 2003, Orlikowski 2002, Strati 2003, 2007), as this research is not completely informed by either of the perspectives but by a combination and amalgamation of the two. Thus, following the proposal of Marshall (2008), a rapprochement between cognitive learning and knowing in practice is developed through the concepts of distributed cognition (Hutchins 1995) and the collective mind (Weick & Roberts 1995). Further, engineering consultancy practice seems to involve both explicit and tacit knowledge equally, thus the interaction of both types of knowledge in the course of performing consultancy practice is considered. The next section reviews existing relevant literature, identifies research gaps (e.g. studying engineers' learning in practice being informed by a rapprochement between cognitive learning and knowing in practice in the context of an international consultancy alliance, and qualitatively exploring the cross-border sharing of knowledge and practices between local and foreign partners in this specific context) and ways to address those gaps in this research.

To conduct this research, a qualitative research approach with a single case study design based on systematic combining is followed on the basis of its potential to answer ‘how’ questions in this research. Chapter 3 also presents the research organization, with different stories reflecting its potential to study learning in practice and cross-border sharing of working practices and knowledge. In alignment with the qualitative approach, it is explained that the research participants were approached using purposive and snowball sampling techniques, while qualitative data were collected through semi-structured interviews, field observation and document collection. The next section discusses operationalising critical realist grounded theory to analyze qualitative data and the emergence of two core-categories, i.e. Learning in Engineering Consultancy Practice and Symbiotic Learning Alliance as the main findings of this research. The chapter ends with a section on each of research evaluation and the ethical issues considered in this research.

Chapter 4 presents the first finding/ core category, i.e. Learning in Engineering Consultancy Practice. Its categories, including Self-directed Learning, Managerially Influenced Learning and Partner-influenced Learning, are presented with relevant quotes and analyses. At the end of the data analysis for each category, findings are given in respective critical realist analytical frameworks.

Chapter 5 presents the second finding/ core category, i.e. Symbiotic Learning Alliance, with its four categories of Symbiotic Alliance Relationship, Developing Cultural Harmony, Intention to Learn and Share Knowledge, and Constructive Disagreements. Each category is presented with relevant findings (quotes), followed by analysis. Similar to Chapter 4, the findings of each category are also presented in respective critical realist analytical frameworks at the end of each section.

Chapter 6 presented a comprehensive learning model being in place at NESPAK with its details and discussion. Finally, the findings of this research are discussed in relation to the literature, theories and models reviewed in Chapter 2. In the first part of this section, the first core category, i.e. Learning in Engineering Consultancy Practice, is discussed in relation to cognitive learning, knowing in practice and their amalgamation through the concepts of distributed cognition and the collective mind. In the second section, the second research finding, i.e. Symbiotic Learning Alliance, is discussed in relation to the literature, theories and models related to the aspects influencing the cross-border sharing of knowledge and practices in international strategic alliances.

7.3 Theoretical Contribution

The overall account of practice-based learning is in sharp contrast to and dismissive of cognitive learning (Gherardi 2009a, Marshall 2008). Further, existing texts on practice-based learning theories do not give much space to explicit knowledge. The current research contributes to existing learning theories through empirically substantiating the proposal of Marshall (2008) regarding the rapprochement between cognitive learning and practice-based learning. **A major contribution made by this research is going beyond Marshall's proposal and using the concepts of distributed cognition (Hutchins 1995) and the collective mind (Weick & Roberts 1993) to develop this rapprochement and**

combine these contrasting learning perspectives. These methods have neither been proposed nor empirically substantiated by earlier studies to combine these perspectives. It is found empirically in the current research that engineers' learning in the practice of engineering consultancy involves a combination of both cognitive learning and knowing in practice.

For instance, in performing the practice of engineering consultancy, engineers learn through cognitive rote, meaningful and discovery learning, and they collect and store information, considering it as an objective commodity related to the project site, relevant engineering theories and models and calculation methods and formulas. They analyze such information in relation to their existing cognitive structures and knowledge, draw meaningful insights and find solutions to consultancy-related problems. In coordination with such cognitive learning, they learn while doing different activities of engineering consultancy, such as experimentation, operating analysis software, assessing scientific/ mechanical equipment, developing scientific models and their schematization, and the installation of scientific equipment. Thus, engineers' learning takes place via the interaction and combination of contrasting perspectives of cognitive learning and learning in the practice of performing engineering consultancy activities.

Engineering consultancy is found to be a learning practice, because it is performed in a recursive manner as the routine job of engineers. They perform similar activities in every project, but these activities emerge differently in different projects according to the nature of the project, its technological requirements and site-specific geological conditions (Gherardi 2009a, Giddens 1984, Kemmis 2009). This recursive and emergent nature of practice results in engineers' learning because it involves new engineering methods and technologies. Engineers perform such consultancy work by employing their minds and bodies in these activities, as argued by the notion of 'being-there' (Dreyfus 1991, Giddens 1984). They not only work with their bodies but also learn through them, by using their senses such as sight, hearing, smell and touch, and as a result they construct sensory knowledge and make aesthetic judgements (Strati 2007). In this doing, engineers utilize existing explicit knowledge they learn through cognitive learning, and tacit knowledge they learn through working on different projects throughout their professional careers. In this doing, they learn new knowledge as they codify new explicit knowledge in the form of project reports and manuals, as well as new tacit skills of doing consultancy work involving new engineering methods and technologies for different projects. Seen in this way, the current research empirically finds a strong interaction between explicit and tacit knowledge in performing the practice of engineering consultancy.

To develop the rapprochement between cognitive learning and knowing in practice, the current research took a step beyond the proposal of Marshall (2008), who argues that this rapprochement is on the basis of 'framing rules' (Hochschild 1979), interactional competence (Cicourel 1973) and cognitive knowledge of rules and processes to perform a practice (Sewell 1992). Taking this proposal forward, the current research uses the concepts of distributed cognition (Hutchins 1995) and the collective mind (Weick & Roberts 1993) to combine cognitive learning and knowing in practice. It is argued that engineers learn engineering theories, models and calculation formulas, and project-site dynamics through storing such information in their memories and processing their cognitive structures to develop their understandings individualistically (Self-directed Learning), as argued by Ausubel (1961). This is equivalent to the internal framework of distributed cognition (Zhang & Norman 1994), cognitive structures that remain within the mind. However, the current research argues that an engineer offloads such cognition into his/her doing and utilizes it in performing different consultancy activities, such as site analysis and developing input to be used in projects.

Such existing cognitive structures and knowledge of engineers are also shared and offloaded to other engineers in collectively performing the practice of engineering consultancy at either the local NESPAK level or with foreign partners in which Managerially Influenced Learning and Partner-Influenced Learning occur, respectively.

In this collective work, engineers' further cognitive processing and learning takes place in connection with the cognitive processing of other participants of a networked consultancy practice, distributed cognition (Hutchins 1995), because they work collectively on interrelated and integrated consultancy tasks through the precise division of labour in the coordination centre (project office) of the consultancy practice (Gherardi 2013). Their cognition is also distributed and shared because they consult the same engineering theories, models, calculation formulas etc. and utilize them collectively in their doing of consultancy activities. The mental processing of different participants of a practice thus occurs and they work together in parallel as well as in coordination, as argued by Hutchins (1995). This aligns with the concept of the collective mind (Weick & Roberts 1993), which is heedful of the mental processing of different engineers. This collective mind of all the networked engineers in project consultancy work develops a common orientation among the engineers, which is required to perform the socially organized/ communicative/ collective practice of engineering consultancy (Gherardi 2009a, 2013).

Previous practice-based studies overlook the role and creation of explicit knowledge in performing a practice, but this research contributes to the existing knowledge debate by acknowledging the interaction of explicit and tacit knowledge in performing a practice. With the aforementioned utilization of explicit knowledge (available in the form of engineering theories, models and calculation formulas) in doing the consultancy activities, the current research also finds an equal role for explicit knowledge, in addition to tacit knowledge, in the course of performing the overall practice of engineering consultancy

Thus, contrary to the core conception of PBS and knowing in practice, which are especially dismissive of cognitive learning, the current research advances the conception of learning by combining cognitive learning and knowing in practice. Previous notable empirical studies are either informed by cognitive learning or practice-based learning. They neither acknowledge the theoretical conception of rapprochement between cognitive leaning and practice-based learning as argued by Marshall (2008) nor develop such a rapprochement and combination of these learning perspectives. The current research thus addresses the tension in learning perspectives by combining two contending learning perspectives using the concepts of distributed cognition and the collective mind. Further, this research disagrees with the core conception of practice-based studies regarding acknowledging explicit knowledge and presents a process of interaction between explicit and tacit knowledge in the course of performing engineering consultancy practice. With this integrated and holistic account of learning, which is developed by combining cognitive learning and knowing in practice and the interaction of explicit and tacit knowledge, research in this area will find a way forward to foreground the multidimensionality of learning, and combine its different accounts of learning through the concepts of distributed cognition and the collective mind. This is a significant contribution of this research to the existing knowledge debate on learning.

Second, previous empirical studies in this field (e.g. Gherardi 2010, Gomez et al. 2003, Nicolini 2009, Orlikowski 2002, Rooney et al. 2012) have explored learning in practice in the context of a single organization in which that practice is developed, historically and culturally situated and deeply embedded. Those studies did not study a practice that is distributed across organizational and national boundaries. In contrast to that, **the current research makes a contribution through studying knowing in practice in the context of international consultancy alliances involving more than one organization.** In a consultancy alliance, local and foreign partners share existing practices, working styles and relevant knowledge which has been previously developed and is deeply embedded in different sociocultural, historical, organizational and national settings. These practices and knowledge are integrated into a specific consultancy practice according to a project's specific requirements. Both local and foreign partners adapt their working styles and processes to perform the activities of each other. As a result, a consultancy practice emerges that is different. Participants of the practice learn new ways to apply new engineering methods and install new technologies while collectively performing consultancy practice.

The empirical evidence regarding sharing practices and knowledge across borders and their integration for a specific project is of great value in the current era of growing numbers of cross-border strategic alliances. Inter-dependence among countries is increasing and firms belonging to different countries form alliances to exploit the knowledge bases of each other. A significant volume of empirical literature is available on cross-border knowledge-sharing, however, the cross-border sharing of practices and their integration and transformation into new context-specific practices is a highly overlooked phenomenon. Further, the existing literature does not give much space to operationalization, i.e. ways and methods of cross-border sharing of practices and knowledge. Addressing this literature gap through empirically identifying different ways and methods of cross-border sharing and the integration of working practices and knowledge adds substantial value to the current literature. This takes forward the existing literature and can prompt future studies to look beyond the simple identification of influential factors for knowledge-sharing by exploring how and why those factors influence such cross-border knowledge-sharing processes.

The comprehensive learning model, presented in Figure 6.1, is another contribution of this research. The knowledge-sharing models presented by previous studies reflect different factors influencing knowledge-sharing in alliances. Meanwhile, Easterby-Smith et al. (2011) call for a comprehensive learning process in alliances. Similarly, Salk and Simonin (2011) stress that one of the biggest gaps in the existing literature is the lack of empirical findings on inter-organizational collaborative learning. These research calls are answered, and the research gap is addressed by **presenting a data-driven learning model** through digging deep into the phenomenon of engineers' learning in international consultancy alliances using critical realism and its retroduction mode of inference.

The learning model comprises the empirical findings of this research presented in Chapters 4 and 5. In the model, the novel findings from different accounts of engineers' learning in performing the overall practice of engineering consultancy are presented under the core category of Learning in Engineering Consultancy Practice. These accounts are:

- Self-directed Learning reflecting engineers' cognitive learning and knowing in practice but individualistically

- Managerially Influenced Learning reflecting engineers' cognitive learning and knowing in practice collectively locally at the NESPAK level

- Partner-influenced Learning mainly reflecting engineers' learning in the practice of engineering consultancy in joint working with foreign partners.

In such joint working, local and foreign practices and knowledge are brought into the application and performing of engineering consultancy. Comprehensive details of the processes underlying these accounts of engineers' learning are presented in **Figure 6.1**.

Further, as engineers' learning is studied in the context of international alliances in which existing practices and knowledge are shared by two partners, the model also presents different aspects/ factors influencing such a sharing process. Considering engineers' learning as an outcome that is enacted by its underlying actual events and realities (cause-and-effect relationship), as suggested by Easterby-Smith et al. (2012), as well as following the critical realist retroduction mode of inference (Danermark 2002), this research presents various deep-rooted realities causing engineers' learning in consultancy practices and the cross-border sharing of knowledge and working practices.

By digging deep into the phenomenon under study, **I make another contribution** through presenting comprehensive details about influential factors and the ways they influence the cross-border sharing of knowledge and working practices in alliances. For instance, the model reflects: reasons for the willingness/ unwillingness of foreign engineers to share knowledge; ways to convince unwilling engineers to share their knowledge; ways to develop professional and personal cordial relationships with foreign engineers; reasons for disagreements and how these disagreements contribute towards extra sharing of knowledge; cultural differences and language barriers, ways to address them and develop cultural harmony among local and foreign engineers.

In exploring these processes, the model makes some minor but novel contributions. For instance, what local engineers (knowledge-seekers) do in emerging situations during joint working to ensure necessary sharing of existing knowledge and working practices. Foreign engineers are sometimes not willing to share required knowledge and working practices. In such situations, local engineers develop informal associations and friendships to prompt/ convince foreign partners to engage in such sharing. Further, intentionally doing work in the wrong way in front of an expert engineer may persuade him/her to correct the working method and share knowledge which s/he withholds in normal circumstances. Similarly, unnecessary disagreements and the opposition of expert engineers' points of view leads to the sharing of extra knowledge to address disagreements. In such a situation, expert engineers give extra logic and reasoning behind a proposed method or demonstrate a complete method to convince the learner – thus an increase in knowledge-sharing. Besides, the ineffectiveness of interpreters to address the language barrier due to their unfamiliarity with the technicalities of the tasks is also identified and is another novel contribution of this study.

Such a comprehensive learning model of strategic alliances is absent from the existing literature. The current research thus advances this field of inter-organizational learning by presenting this model, which not only identifies the factors influencing the cross-border sharing of knowledge and working practices but also reflects how local engineers learn in the process of performing consultancy work while utilizing the knowledge and practices shared by foreign counterparts. This learning model can be further validated in different contexts.

In this way, the current research makes significant contribution to the existing literature. Although, the existing literature provides insights about factors influencing knowledge sharing in strategic alliances, there is a lack of the findings about how these factors influence cross-border and inter-organizational knowledge sharing (process)? what problems encounter? How to address those problems? In this regard, the findings of the current research contribute to the existing knowledge based by answering these unaddressed questions and provide significant insights about the processes of sharing of knowledge and practices in international alliances. This research reports the ways local engineers exploit the knowledge bases of their foreign counterparts and learn modern engineering methods and technologies and the ways to address the problems encountered in this process. Thus, this research moves beyond the simple identification of the influential factors and provides more comprehensive insights about the processes and operationalization of cross-border sharing of knowledge and practices in strategic alliances.

7.4 Methodological Contributions

The first methodological contribution of this research is the development/ refinement of critical realist grounded theory (GT). The current research first substantiates the suitability of critical realism with grounded theory, particularly with the Straussian version, given the symbolic interactionist background of the Straussian version and its retroduction mode of inference. In this way, the current research substantiates the connection of critical realism with GT developed by Oliver (2011) and Kempster and Parry (2011). Further, Easterby-Smith et al. (2012) present a table (**Table 3.2** in Chapter 3) contrasting the Straussian and Glaserian versions of GT. On analysing the table, it seems that the Straussian version is closer to critical realism; however, no single version alone serves the purposes of this critical realist research. For instance, the Glaserian version is mis-aligned with critical realism when considering three out of its four characteristics. However, its ontological assumption, i.e. 'the world is out there', does align with that of critical realism, but only for its intransitive dimension of knowledge, because underlying realities have enduring properties and continue to exist whether we observe them or not (Sayer 2000, Simm 2009). On the other hand, the ontological assumption of Straussian version, i.e. ‘reality and experience are constructed’, also aligns with that of critical realism, but only for its transitive dimension (actual events and empirical experiences) of knowledge, because these are theories and models of the world and are socially constructed indicating interpretivist epistemology (Sayer 2000, Simm 2009). This led me to **contribute methodologically** and add a third column to the table comprising a refined version of critical realist grounded theory by combining the ontological assumptions of both Glaserian and Straussian GT and consider both the transitive and intransitive dimensions of knowledge. Further, I have added another aspect to the rest of the characteristics of Straussian GT, i.e. extensive moving back and forth between data and theory to collect insights from many sources and create a fit for systematic combining (Dubois & Gadde 2002).

This research thus empirically validates the critical realist ground theory developed by Oliver (2011) and extends the classification of grounded theories presented by Easterby-Smith et al. (2012) by adding an ontologically specific critical realist grounded theory. Such a specific grounded theory will help researchers better foreground their critical realist enquiries.

The second methodological contribution is the exploration of Learning accounts in Engineering Consultancy Practice in an **international consultancy alliance** involving the cross-border sharing of working practices and knowledge. Previous studies have explored learning in working practice in the same organization or the transfer of working practices across borders from parent firm to a foreign subsidiary. But the current research is conducted in an engineering consultancy organization which is a ‘network-like organization’ (Boussebaa et al. 2014). Inter-organizational learning in a consultancy alliance is viewed as difficult because of the low willingness of foreign partners to share and not sharing organizational knowledge management systems, contrary to the case of the aforesaid foreign subsidiary alliance. The parent firm in a subsidiary alliance is more likely to be willing to share their existing knowledge and working practices because of the higher stakes involved. Further, international joint ventures have also been carefully studied for their cross-border sharing of knowledge while international consultancy alliances have been completely overlooked in this respect. Thus, this research adds value to the existing literature through studying this overlooked form of strategic alliance for the sharing of knowledge and inter-organizational learning. With this advance, learning theories can better foreground these phenomena in such a loosely-coupled form of strategic alliance.

7.5 Practical Implications

Grounded theory research was conducted to make sense of a set of data collected from engineers performing engineering consultancy at NESPAK. This was a significant attempt to gain insights into the world of engineers as they consciously or unconsciously develop it and provide a basis to develop a theory of leaning informed by the rapprochement and combination of cognitive learning and knowing in practice. Such a theory can be used as an explanatory basis in the future. Engineers from different divisions and hierarchal levels provided empirical data about their world and contributed to theory development. I aim to present some insights that can be used to improve engineers' knowing in practice in an engineering consultancy and the cross-border sharing of knowledge and practices. I believe that the learning model presented by this research offers various reasonable explanations of why the perspectives of cognitive learning and knowing in practice are so important for engineers' learning and should be taken into account. I also believe that engineers will see my research findings as logical and interesting.

Engineering knowledge involves both explicit and tacit knowledge and engineers are already following cognitive learning and knowing in practice. To improve it, managers, such as project leaders or divisional heads, can get insights from this research and promote such learning perspectives among their subordinates. With these findings, they can influence subordinates through identifying and arranging resources for their cognitive learning and facilitating their practice-based learning. By understanding the findings, they can further critically evaluate the nature of knowledge and identify ways to learn it. Similarly, they can understand the interaction of explicit and tacit knowledge in performing consultancy practice and subsequently facilitate engineers to learn such knowledge. Engineers can also understand their ways of learning different kinds of knowledge in performing consultancy practice. Besides this, senior management can devise a career path for engineers based upon their learning aptitude and innovative achievements by considering the reported role of learning in engineering consultancy companies. This could be a significant motivator for engineers to get involved in learning modern engineering methods and technologies.

Finally, NESPAK and other Pakistan-based engineering consultancy companies are involved with foreign companies on various Pakistan-based projects under the umbrella of the China Pak Economic Corridor (CPEC). Those projects include the Thar Engro Coal Power Project, the Hydro China Dawood Wind Power Project, Upgrading and doubling the Karachi-Peshawar train track, the UEP Wind Farm Project, the Sachal Wind Farm Project, the Kohala Hydropower Project and many more (CPEC 2018).

Considering the increase in foreign direct investment (FDI) across the world in general, and Pakistan-based projects under CPEC (which are being jointly done by local and foreign companies) in particular, cross-border sharing of knowledge and technology has become an issue of great interest. In this regard, the findings of the current research provide significant insights into: how local engineers exploit the knowledge bases of their foreign counterparts and learn modern engineering methods and technologies; what problems can be encountered? And how to address those problems? For instance, they can: use personal friendship and association, and disagreements to prompt foreign partners to share more knowledge and practices and ensure compatibility of technologies with the project sites; learn basics of relevant engineering theories and analyse project sites properly to become able to disagree with the foreign partners; use foreign partners to confront undue demands of the clients, etc. Further, by understanding the reported adverse effects of the language barrier on knowledge-sharing in alliances with Chinese companies, NESPAK should start a Chinese language training programme to address this barrier in future projects. They should also hire/ train some engineering-qualified Chinese translators, given the nature of the reported language barrier while working with Chinese partners. Lastly, it is direly needed that NESPAK should brief government of Pakistan and relevant departments about non-cooperative attitude of Chinese partners and their possessiveness of knowledge and technologies. The government should take prompt measures in this regard such as inclusion of certain clauses in the agreements with Chinese companies that can bind them not only to complete the projects but to share/transfer sufficient knowledge and technologies to their local allies. This can make local companies self-reliant for future projects and be a significant source of strategic and economic advantages for the country.

7.6 Limitations and Future Areas of Research

This research, like all other research, suffers from a number of limitations. First, the Human Resources Department of the research organization did not offer any support and did not refer me to potential participants of my research. I also requested a three-month internship but there was no such organizational policy to entertain academic researchers. Following that, I managed to make some initial contacts within NESPAK through personal referees who further referred me to other engineers for interviews. This took me six months from initial contact to first interview. Time constraints also increased my difficulty to conduct interviews because of the extra assertiveness of the client to complete projects in less than the due time. As a result, engineers worked extra hours, even at the weekend, and could not easily spare time for interviews. Every engineer was contacted five times (on average) before I could get an appointment. This caused further delays in the field work so I could only complete it within 14 months (from the first initial contact to the last interview).

Further, I observed various things related to engineers' learning; however, I was not allowed to participate in their meetings within the organization or with foreign counterparts, so I could not observe knowledge-sharing during their meetings or disagreements. I was also not allowed to observe them working, such as preparing concept designs, drawings, operating software and site work and supervision. This is why I could not conduct this research through ethnomethodology but instead had to rely on engineers' interviews. In addition, despite my requests, the participants did not give me any documents related to the phenomenon under study. Some of them just showed me some documents, such as drawings, on their computer screens, while some others just gave me pictures of project sites. The documents I used in this research for cross-validation were retrieved from newspapers, social websites etc.

Although I made every effort to do quality work, similar studies can be conducted by researchers who intend to study this phenomenon in the same organization where they are working or have worked. Then they would not face any access problems and could use ethnomethodology to observe the phenomenon under study during complete consultancy work while being part of the context. Such researchers might better know the context, people's learning orientation and methods, ways of working locally and with foreign counterparts, and the overall context which informs working practices. They can identify more hidden phenomena that can directly or indirectly enact learning.

Apart from this, future researchers can adapt the research models presented in **Figure 6.1** to examine the phenomenon understudy. They can use it as a reference point to devise initial research questions and start field work and include emerging phenomena and underlying causal structures, as suggested by systematic combining (Dubois & Gadde 2002). In this way, they can further validate the learning model or extend/ refine it with new relevant phenomena. This research model can also be used when following a quantitative deduction approach and its hypotheses can be examined through quantitative data from larger samples from other organizations or other fields of business. Finally, by following the methodology of this thesis, researchers can develop case studies of local organizations that can be included in universities' curricula and be consulted by practitioners.

I tried my best to conduct a qualitative research that meets combination of quality criteria as discussed in section 3.9. These include trustworthiness comprising creditability, transferability, dependability and confirmability and rich rigor (Lincoln & Guba 1985, Tracy 2010). Rest is left with the readers to assess whether and where I have been successful.

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APPENDICES

Appendix I: Project Details

A brief detail of each project about which the data is extracted to be presented in the thesis is given below. All of these projects fulfill the criteria of this research i.e. an involvement of foreign consultants for technological requirement of the project such as application and installation of new/state-of-the-art engineering methods and technologies for which NESPAK had not required expertise and skills.

1. HVDC Transmission Line

High Voltage Direct Current (HVDC) transmission line project involves installation of 1300 kilometers long HVDC transmission line from Karachi to up north of the country for dispersal of 2500-3000 Mega Watts (MW) power. HVDC transmission line is first time being installed in Pakistan so required expertise and capacity is not locally available in the country. In Pakistan, hydro power plants are in north while thermal power plants are in south. The HVDC transmission line will help to transmit the power from north to south in summer and from south to north in winter. The client in this project is Water and Power Development Authority (WAPDA), Government of Pakistan. NESPAK, as an associate partner, is providing engineering consultancy for this project in consultancy alliance with Surveyer, Nenniger and Chenevert Consulting Engineers (SNC) Canada which is lead partner. The project is funded by Asian Development Bank (ADB).

2. Supervisory Control and Data Acquisition

Supervisory Control and Data Acquisition (SCADA) project was completed in 1990s in Pakistan. The project involved installation of SCADA technology and software to automate the power distribution at major power distribution centers in Pakistan. The technology and software are customized according to the specific dimensions of local power stations and infrastructures. The client in this project was WAPDA, Government of Pakistan. NESPAK provided engineering consultancy in collaboration with EDF France.

3. Mangla Dam Raising Project

Mangla Dam raising project was completed during 2005-09. NESPAK had consultancy alliance with Montgomery Consulting Engineers, Watson Hawksley, Ltd., and Harza Engineering Company (MWH) International USA to provide the engineering consultancy in this project. MWH is a global water and natural resources firm, providing technical engineering, construction services and consulting services. The client was WAPDA Government of Pakistan. The real design of the dam, that was built in 1960, had option of being raised by 40 feet. NESPAK was unable to provide consultancy for such a complex dam raising project. The consultancy partners collective provided engineering consultancy for dam raising and its various functions. These functions include: analyzing the project site through new software; raising the bank of the dam and its spill ways, abutment bridge; building inclined core and redesigning its foundation; filling up cavit; modifying power house turbines; designing and installation of advanced measurement instruments such as pressure gauges and pesometers; configuring new software to operate the dam; and addressing the social issues.

4. Flood Early Warning Systems

Flood Early Warning Systems (FEWS) is another major project NESPAK has worked on involving designing a compatible system to be installed in Pakistan. FEWS Model employs two major analysis procedures for estimation and propagation of flood waves in the Indus River System. For this purpose, it consists of following two modules: 1) SAMO (Sacramento): Rainfall-Runoff Model; and 2) SOBEK: Routing Model. These procedures are Rainfall-Runoff and Routing models which estimate flood hydrographs from rainfall in the upper catchments of the rivers and their tributary streams and compute flood and stage hydrographs at various points of interest along the river reaches in the plain areas. There were many technologies of different era have been used in FEWS such as Geographic Information System (GIS) and satellite data for schematization, configuration and installation of the systems. The project also included installation of radars for weather forecasting caused by different geography such as Bay of Bengal, Kashmir and northern areas of Pakistan. Delph Hydraulics (DHI) Neither land remained consultant partner of NESPAK throughout different phases of the project. The client in this project was Pakistan Meteorology Department (PMD) while the project cost was $1Billion.

5. Lahore Orange Line Metro Train Project

Orange Line Metro Train Project is an automated rapid transit system which is going on at present. NESPAK is providing engineering consultancy in consultancy alliance with CR-NORINKO (a joint venture of China Railway and NORINCO China). The key reasons for taking Chinese company is that the required expertise are not available locally as well as the loan (amounting to $1.6Billion) for this project is provided by Exim Bank China under China Pakistan Economic Corridor (CPEC) plan. The client in this project is Government of Punjab. Orange Line train is the first phase of a mega rapid transit system to be developed in Lahore that comprises Green, Purple, Blue and Red line train. The train track is 27.1 kilometers long that has been developed from Dera Gujjran to Thokar Niaz Beg Lahore out of which 25.4 kilometers is elevated over ground while 1.7 kilometers underground track. The line will be served by 26 stations. The train will be completely electrically operated as there will be an operator, instead of a driver, to operate the train.

Such a metro train infrastructure is first time being developed in Pakistan so the required expertise are not available locally. As a result, the client had to involve CR-NORINKO to provide the required expertise. The project involves various new engineering methods and technologies such as: deciding routes of the train track and making required soil and vibration analysis; developing electro-mechanically equipped civil work; developing elevated over ground as well as underground railway track and train stations; and developing a depot for washing and maintenance of the train. NESPAK, in consultancy alliance with CR-NORINKO, conducted feasibility study and developed concept designs and drawings for different aforementioned parts of the project. The consultant partners are also responsible for site supervision to ensure that the construction is being made according to the concept design and drawings of the project.

6. Neelum Jhelum Hydro Power Project

NESPAK is working on Neelum Jhelum Hydro Power Project (NJHPP) with the capacity of 1450MW power generation. The client is WAPDA Pakistan while the project cost is $5.1 Billion. In this project, five consultant firms including MWH USA, NORPLAN Norway and NESPAK, ACE and NDC from Pakistan are providing engineering consultancy together. Two 27 kilometers long water tunnels were built to divert the water of Neelum river to a power station on Jhelum river. In the tunnels, a 430 meters long underground caveat and an underground power house have first time built/made in Pakistan through Tunnel Boring Machines (TBM). NJHPP is located on earth quake fault line so designing the project was quite challenging for NESPAK and required expertise were not available locally. Thus, MWH and NORPLAN were taken as co-consultant in the alliance because of their expertise of similar projects across the world.

However, the key contribution to design the project, its reservoirs, power house, tunnels and caveat was made by two Swiss professors. One of them was expert in hydropower while the other one was expert of civil engineering. NESPAK's engineers learnt various new engineering methods and technologies while working on such a project first time in their career. These include: analyzing such a complex project site, its soil and rock characteristics, reservoir dimensions and its absorptive capacity of earthquake shocks, potential storage of water and its flow and discharge. NESPAK's engineers learnt new analysis techniques such as pseudo static and response spectrum approach (for approximation and estimation of outcome in result of earthquake shocks), running simulation to understand the effects of earthquake shocks on the dam, and different analysis software such as SAP[30], ETAB[31] and Abacus[32] software to analyze the site conditions and developing an appropriate and workable concept design and drawings.

7. Murree Cable Car Project

Murree Cable Car Project is an ongoing project for which NESPAK is providing engineering consultancy. The project involves installation of a modern cable car in Murree and nearby areas to manage the congestion particularly in snowy season, summer, Eid and Independence Day. This is a complex project involving various engineering to install an advanced Ropeways cable car technology first time in Pakistan. The client is Tourism Development Corporation of Pakistan (TDCP). NESPAK is working in consultancy alliance with Snowy Mountain Engineering Consultant (SMEC) Australia (for the required analysis of geological and geographical conditions of the project site including analysis of land sliding such as its study, design, control and mitigation) and Cable Car Consultant (CC), Switzerland (for designing the cable car and gondolas

[30] SAP is a finite element software that can analyze stress in the body of dam and its foundations (Mughieda, Hazirbaba, Bani-Hani and Daoud 2017).
[31] ETAB is an integrated software package used for structural analysis (Computer & Structures Inc. 2017).
[32] Abacus software is used for thermal analysis of a dam (Gao, Cheng and Brebbia 2013).

through Ropeways technology, getting them manufactured with certain features suitable to the specific geological and geographical conditions of the project and its installation).

8. Bhikki Power Project

Bhikki Power Project involves developing of a new power plant of 1200MW capacity with the advanced combined cycle technology (CCT). The client is Government of Punjab while the cost of the project is $881Million. CCT is very old and major equipment of this technology is gas turbine. The technology has already been installed in other power stations of Pakistan. However, in this project, most advanced gas turbines with an expected efficiency ratio of 100:61 are being installed as only four developed countries including USA, Russia, Japan and France are working on its installation. The project also involves installation of a modern FM200 firefighting system. As NESPAK alone was unable to work on such a modern technology, it formed the consultancy alliance with Lehmeyer German to design the project. The consultant partners collectively analyzed the site and client’s requirements, developed the concept design and drawings of the project for installation of CCT and its turbines. The consultant partners also decided and suggested specific design of the turbines and its features to the manufacturer General Electrictic (GE) that will install the turbines in power plant.

9. Dasu Hydro Power Project

Dasu Hydro Power project is a dam project with maximum height of 233 meters and it will produce 4320MW power. The project is still in the design phase. The main task which was done so far was to conduct feasibility study and developing design of the project involving civil and electromechanical engineering. NESPAK is self-reliant in civil work but in this project, an advanced roller compacted concrete engineering method is used in which concrete is compacted through roller and is used on massive scale. As NESPAK had never used this technology in a dam project before, it formed consultancy alliance with MWH USA and COLINQO Switzerland. The consultant partners collectively designed the projects and developed its drawings according to the specific dam's site conditions. In addition to the compacted concrete technology, NESPAK's engineers learnt various new software such as Slope/W, SEEP/W, SLIDE to analyze the rock mechanics and hydraulic analysis from foreign partners in joint working.

10.Mangla Dam Turbine Refurbishment Projects

With the raising of Mangla Dam, NESPAK had completed another but relevant project of the refurbishment of Mangla Dam Power turbines to increase power generation by 200MW. WAPDA Pakistan was client in this project. Turbine refurbishment had never been done in Pakistan, so expertise did not exist in Pakistan that is why MWH USA was consultant partner in this project. MWH has been doing such projects since 1960s. In refurbishment of turbines, different parts were replaced or repaired. The turbines were working but due their usage of more than 50 years, their parts were not in proper working conditions and often had to be repaired that increased power losses. The consultant partners collectively assessed the turbines and their parts for replacement or repair and getting it done by the original manufacturers of these turbines from Czechoslovakia and

Japan. NESPAK's engineers worked on the project site in joint working with MWH's experts like assistants and learnt assessment of turbines and their parts and deciding about its replacement or repair. They learnt certain signs of a faulty part by having an on-the-job training and practical demonstration by foreign partner.

Appendix II: Call for Invitation/Sample Letter to the Research Organization for approval of Fieldwork

Lancaster University
Management School

Dated: January 01, 2015

[redacted]
NESPAK, Lahore Pakistan.

Subject: **<u>Collection of PhD Research Data from NESPAK</u>**

Dear Sir,

I am doing my PhD in Management Learning and Leadership at Lancaster University Management School (LUMS), United Kingdom. As a compulsory part of PhD program, I am working on my PhD dissertation titled ***Cross Border Transfer of Organizational Learning (OL) Practices: A Critical Realist Approach.*** The general working practices in any area such as management, engineering etc. are considered as OL practices in this research. In this regard, I intend to understand how your organization, while being in strategic collaboration with a multinational firm, applies working practices that were initially developed in your foreign partnering organization. It is believed that the working practices, developed anywhere in the world, are embedded in their socio-cultural milieu and they are hard to replicate in another workplace settings. The knowledge seeking firms need to understand both explicit and tacit knowledge about such practices to replicate them in the local settings. At times, local firm replicates foreign working practices in entirety however, on many instance, they are modified and developed according to the local requirement. Further, I am interested to know how cross-border transfer of working practices can be facilitated through transfer of relevant knowledge from foreign to local firm and local firm's learning environment.

To give a practical knowledge about the aforementioned research issue; NESPAK is the most appropriate organization as I came to know that the company is working on some projects with strategic collaboration of foreign companies. To collect the data, I need to conduct interviews of around 30 key personnel involved in such projects as they can give detailed insights about various contributors of cross-border transfer of working practices. Apart from these interviews, I need to observe internalization of foreign working practices and informal discussion with relevant employees reflecting insights and knowledge about the understudy research issues.

The participation of relevant employees will be voluntary. I assure that identities of the study participants, interview records and any form of collected data will be kept confidential and it will be used for my educational purposes only.

I will be obliged if you kindly allow me to conduct research in your organization. The findings of the study will not only contribute towards my PhD thesis but it will also offer detailed insights about how NESPAK seeks knowledge about foreign working practices and how the company deploys such working practices to develop its own culture.

Looking forward to your kind approval, please.

Kind Regards,

Muhammad Shakeel Aslam

Muhammad Shakeel Aslam
PhD Student, LUMS, United Kingdom
Email:s.aslam1@lancaster.ac.uk
Phone: +92 333 4376796

Appendix III: Recommendation Letter from Research Supervisor for Fieldwork

Lancaster University
MANAGEMENT SCHOOL

Dated: February 20, 2015

[redacted]
Human Resources Division
NESPAK, Lahore Pakistan

[redacted]

Subject: **Collection of PhD Research Data from National Engineering Services Pakistan (NESPAK)**

Dear Sir

I wish to inform you that Mr. Muhammad Shakeel Aslam is doing a PhD in Management Learning and Leadership at Lancaster University Management School (LUMS), United Kingdom. As a compulsory part of the PhD programme, he is working on a PhD dissertation titled ***Cross Border Transfer of Organizational Learning (OL) Practices: A Critical Realist Approach.*** The general working practices in any area such as management, engineering etc. are considered as OL practices in this research. In this regard, he intends to understand how your organization, while being in strategic collaboration with a multinational firm, applies working practices that were initially developed in your foreign partnering organization. It is believed that the working practices, developed anywhere in the world, are embedded in their socio-cultural milieu and they are hard to replicate in another workplace settings. The knowledge seeking firms need to understand both explicit and tacit knowledge about such practices to replicate in its local settings. At times, local firm replicates foreign working practices in entirety however, on many instance, they are modified and developed according to the local requirement. Further, he is interested to know how cross-border transfer of working practices can be facilitated through transfer of relevant knowledge from foreign to local firm and local firm's learning environment.

To give a practical knowledge about the aforementioned research issue; NESPAK is the most appropriate organization as your company is working on some projects with strategic collaboration of foreign companies. To collect the data, he needs to conduct interviews of around 30 key personnel involved in such projects as they can give detailed insights about various contributors of cross-border transfer of working practices. Apart from these interviews, he needs to observe internalization of foreign working practices, informal discussion with relevant employees, and documentary evidences reflecting insights and knowledge about the understudy research issues.

/contd.....

The participation of relevant employees will be voluntary. The interview will be tape recorded with the prior approval of the participants involved otherwise detailed notes will be taken. Further, it is assured that identities of the study participants, interview records and any form of collected data will be kept confidential and it will be used for his educational purposes only.

I will be obliged if you kindly allow him to conduct research in your organization. The findings of the study will not only contribute towards his PhD thesis but it will also offer detailed insights about how NESPAK seeks knowledge about foreign working practices and how the company deploys such working practices to develop its own culture.

Looking forward to your kind approval, please.

Kind Regards,
Yours faithfully

Dr David Simm

Director of International Partnerships (LUMS)

Department of Management Learning and Leadership
Lancaster University Management School
Charles Carter Building
C36, Lancaster, LA1 4YX
T: +44 (0)1524 510931
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Appendix IV: Participant Information Sheet

Lancaster University
Management School

Dated:________________

To,
____
____
____

Subject: **Participant Information Sheet – Request for Participation in PhD Research Interview**

What is the study about?
The objective of this research is to investigate cross-border transfer of organizational learning/working practices. In this regard, the author intends to understand how a Pakistan based organization, while working in any form of strategic collaboration with a multinational firm, applies working practices that were initially developed in the foreign partnering organization. Further, the author is interested to know how cross-border transfer of working practices can be facilitated through transfer of relevant knowledge from foreign to local firm and local firm's learning environment.

Why have I been approached?
You have been approached because the study requires information from people who have been involved in any form of strategic collaboration in which they have contributed towards transfer of foreign working practices and their application and re-generation in the local context. Further, they have been involved in cross-border transfer of required knowledge and fostering local firm learning environment and/or have understanding how local firm's environment impact the whole process of application of foreign working practices in the local context.

Do I have to take part?
No. It's completely up to you to decide whether or not you take part as your participation in the study as an interviewee will be voluntary. The interview will be conducted at your convenience. You may withdraw at any stage, without giving a reason. If you wish to withdraw please contact me. If you withdraw within 2 weeks of participating in the research, then all data collected from you will be deleted and not used within the study. You may withdraw after this date, but it may not be possible to exclude your data from the study, as it may have been anonymised and/or analysed. Besides this, the interview will be audio recorded with your permission. If you do not want it to be recorded, detailed notes will be taken

Note for the Reviewers:

- During the interview, the participants may use different non-verbal gesture such as ‘Ummm’ ‘Aah’, ‘Sigh’ or remain silent while thinking about the answer or to give the impression that he/she is not willing to answer. On the other hand, the participants may show his/her disliking for any ongoing process with body language and facial expression. Such non-verbal gesture will be recorded through interview recording or field notes that will subsequently accompany the main data and will be used to support the results.

- Transcripts will be sent to the participants for any clarification or addition/deletion they wish to make. However, I will not send it to those who are not ready to review it thoroughly and consider it as a workload. So, this depends upon the willingness of the participants to review his/her interview transcripts.

What will I be asked to do if I take part?
If you decide to take part in the study, I would conduct your semi-structured interview in which I will ask questions about your work, experiences and knowledge and documentary source, if any, related to the aforementioned research phenomena. You will also be more than welcome to give information about any other issue that contributes towards cross-border transfer of working practices. The interview would take about for 45 to 60 minutes approximately.

Will my data be Identifiable?
It is assured that the interview record will be anonymous and encrypted. The data collected for this study will be stored securely and only the researchers conducting this study will have access to this data. To ensure security of data, following measures would be taken:

- Data will be encrypted (that is no-one other than the researcher will be able to access them) and the computer itself will be password protected.
- Audio recordings and video/photographs taken during observation will be transferred to password protected folders in my password protected personal laptop immediately after the interviews and the audio recordings and videos/photographs will be deleted from recorders and camera immediately.
- The field notes will be kept securely in the locked cabinet at my home during my stay in Pakistan (during data collection purpose). During my stay at Lancaster University, these will be kept in locked cabinet I have in my office at MLL Department LUMS. After completion of my PhD, I will bring these filed notes to my home country and keep them securely in the locked cabinet at my home. The purpose of keeping data even after completion of my study is to address the comments, if any, of publications’ reviewers.
- Data will be kept for a minimum of 10 years after the study has been completed, in accordance with Lancaster University requirements, and any data will then be securely destroyed.

- The interview transcripts will be encrypted (that is no-one other than the researcher will be able to access them) and the computer itself will be password protected.
- The hard copies of interview transcripts will be kept securely in the locked cabinet I have in my office at MLL department, LUMS. I will destroy these transcripts once I complete my study.
- The typed version of your interview will be made anonymous by removing any identifying information including your name. Any direct quotations from your interview will be used in the reports or publications anonymously, so your name will not be attached to them.
- All your personal data will be confidential and will be kept separately from your interview responses.

There are some limits to confidentiality: if what is said in the interview makes me think that whether you or someone else is at significant risk of harm, I will have to break confidentiality and speak to a member of staff about this. If possible, I will tell you if I have to do this.

What will happen to the results?

The results will be summarised and reported in my PhD dissertation and may be submitted for publication in an academic or professional journal.

Are there any risks?

There are no risks anticipated with participating in this study. However, if you experience any distress following participation you are encouraged to inform the researcher and contact the resources provided at the end of this sheet.

Are there any benefits to taking part?

Although you may find participating interesting, there are no direct benefits in taking part.

Who has reviewed the project?

This study has been reviewed and approved by the University Research Ethics Committee at Lancaster University.

Where can I obtain further information about the study if I need it?

If you have any questions about the study, please feel free to contact me. My contact detail is given at the end of this sheet.

Complaints

If you wish to make a complaint or raise concerns about any aspect of this study and do not want to speak to the researcher, you can contact:

Dr. David Simm
PhD Supervisor
Director of International Partnerships
Department of Management Learning and Leadership
Lancaster University Management School (LUMS)
Lancaster University, Lancaster, United Kingdom. LA1 4YX
Tel: +44 1524 510931, Email: d.simm@lancaster.ac.uk

If you wish to speak to Head of Management Learning and Leadership Department, you may contact:

Professor David Collinson
Head, Department of Management Learning and Leadership
Lancaster University Management School,
Lancaster University, Lancaster, United Kingdom. LA1 4YX
Tel: +44 (0)1524 510916, Email: d.collinson@lancaster.ac.uk

Kind Regards,

Muhammad Shakeel Aslam

Muhammad Shakeel Aslam
PhD: Management Learning and Leadership
Lancaster University Management School (LUMS)
Lancaster University, United Kingdom, LA1 4YX
Tel: +92 333 4376796, +44 (0) 7459 075945
Email: s.aslam1@lancaster.ac.uk

Appendix V: Participant Consent Form

Lancaster University
Management School

Detail of Researcher
Name: Muhammad Shakeel Aslam
Position: PhD Student
Department and University: Management Learning and Leadership, Lancaster University, UK

Detail of Participant
Name:____________________________ Identification Number:_______________
(to be marked by the researcher)

Position: __________________________ Department: _______________________

Please initial box

1. I confirm that I have read and understand the information given in the above letter for the above study. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason. ☐
3. I understand that any information given by me may be used in future reports, articles or presentations by the research team. ☐
4. I understand that my name will not appear in any reports, articles or presentations. ☐
5. I agree to take part in the above study. ☐

The researcher is advised to visit me for an interview at __________________________ (whether in your office or at any convenient place) on below time and date.

Time:_____________________ Date:____________________

Signature of Participant:______________ Date:____________________

Signature of Researcher: *Muhammad Shakeel Aslam* Date:____________________

Appendix VI: Preliminary Interview Guide

Cross-Border Transfer of Organizational Learning Practices: A Critical Realist Approach

Principal Investigator:

Muhammad Shakeel Aslam

PhD Student

Department of Management Learning and Leadership

Lancaster University Management School (LUMS)

United Kingdom

Question Sheet

Main Questions	**Additional Questions**	**Clarifying Questions**
Can you give me your brief introduction?	• From where you get education? • Since how long, you are in the company? • In which positions, you have previously served? • What do you know about organizational learning and knowledge creation?	• Can you please explain a little more? • Anything else you want to add?
With which foreign firm, your firm has strategic collaboration at present?	• Origin of that foreign firm? • Since how long, your company is working with that foreign company? • What is the nature of strategic collaboration? • Which firm is knowledge seeker and which is knowledge donor?	• Any other detail you would like to share.
Is your firm interested to adopt working practices of your foreign partner?	• Do you working practices of foreign counterpart more sophisticate than your own? • What sort of working practices do you intend to adopt? • Why you or your firm views those working practices more beneficial for your company? • Are these working practices are deeply rooted in their socio-culture and organizational settings and culture and situation specific? • Are these working practices are easy to transfer? • If difficult, then why? • Does your firm send you and/or your colleagues to your partnering firm? • Did you visit your foreign partner? • If yes, which working practices attracted you? • Did you adopt these working practices successfully in your local context? • If not, why? • What do you think your own working practices are superior	• Any further information, you want to share in this regard. • Any other question according to the situation

	that those of your foreign partner • Does your firm adopt working practices in entirety or modify and develop such foreign working practices according to local context	
How transfer of knowledge related to the working practices contribute towards successful transfer and re-production of these working practices	• Do you think sufficient knowledge about foreign working practices should be on-hand when to apply such practices in local context • If yes, then why? • Is it easy to gain knowledge from foreign context? • Is knowledge about foreign working practices tacit, specific and complex? • Is knowledge about foreign working practices are deeply rooted in their socio-cultural and situation specific? • Does such knowledge attract you? • Is that knowledge rare, valuable non-susceptible and inimitable? • What mechanisms such as visits, observation, being part of the foreign organization or any other your firm applied to gain such knowledge? • Did you visit your foreign partner? • If yes, how much time you spend there? • what knowledge you gained from there and how? • In which working practices, you were being part in your foreign partnering firm? • What type of knowledge you gain easily and what knowledge was difficult for you to attain? • Did you socialized and interacted with personnel of your foreign firm to get such knowledge? • Above all, you view that you gained sufficient knowledge about working practices you	Any other relevant information, experience or event that contributed towards transfer of required knowledge from foreign partner

	intend to replicate in local context? • Did you successfully utilize such knowledge in replication of foreign working practices in local context?	
Do organizational characteristics contribute towards successful replication of foreign working practices?	• Does your firm have sufficient absorptive capacity to learn and gain knowledge from foreign partner and absorb such knowledge? • Is your foreign partner completely motivated and willing to share the knowledge you require? • Is your firm fully interested to learn and gain knowledge from foreign partner? • Is your firm capable enough to transfer knowledge from your foreign partner? • Is there trust between two partners? • Is there cultural compatibility between two partners? • Is your partner willing to offer training to your staff, give required material and invited your personnel to visit? • Does your firm have required ICTs and infrastructure for knowledge transfer? • Is the speed of transfer of knowledge from foreign partner to your firm is good?	Would you please share any other relevant experiences and information about firm's characteristics contributing towards transfer of required knowledge
How inter-firm dynamics affect transfer and sharing of knowledge between two partners?	• Is your firm at par with your foreign partner? • If, No. which one is weak and why? • Does trust prevail in strategic relationship? • Is your foreign partner reluctant in knowledge sharing? • If, yes. Why? • Does your firm trust the knowledge offered by foreign partner? • Does your firm view credible sources of knowledge about foreign working practices? • Are both partners fully	Any relevant example, incidence, experiences you want to share in this regard.

	committed to the strategic collaboration? • Is there any conflict between two partners? • If yes, does it affect knowledge sharing?	
• Does local firm's learning environment contribute towards successful transfer of working practices?	• Is your firm ready to unlearn old working practices and ready to adopt new ones? • Is your firm keen to learn and encourage innovation and knowledge creation • Do your employees resist to change or always willing to adopt new methods • Is your top management very influenced from foreign working practices and intend to adopt by all means	Any relevant example, incidence, experiences you want to share in this regard.
• Does leadership style contribute towards successful transfer of working practices?	• Do your leaders frequently visit your foreign partner to gain insights about working practices? • Does your leadership speed up knowledge acquisition from foreign partner and distribute to the followers? • Does your leadership give seminars and trainings to followers to give them insights about foreign working practices? • Does your leadership become part of foreign working practices when applied in the local context? • Is your leadership always ready to share knowledge about foreign working practices and motivate followers to adopt them? • Does your leadership offer guidance when followers confront with any problem while applying foreign working practices? • Does your leadership motivate followers to accept change in form of new foreign working practices? • Does your leadership motivate followers to accept change and	Any relevant example, incidence, experiences you want to share in this regard.

	play as a change agent? • Does your leadership promote creativity, innovation and knowledge creation?	
How learning culture contribute towards application of foreign working practices in your local context?	• Does your culture support innovation, creativity and knowledge creation? • Does your culture empower and care for employees? • Is your culture characterized by open flow of communication, risk taking, idea-initiated activities? • Does your firm reward employees for learning and contributing in application of foreign practices? • Is your culture characterized by mutual trust, group discussion, recognition for taking initiatives and continuous search for opportunities? • Is your culture adaptable or consistent?	If yes, how these cultural traits contribute towards transfer of cross-border transfer of working practices?
Does strategic HRM contribute in transfer of foreign working practices into your organization? If yes, then how and why?	• Are employees are empowered in your organization? • Are employees given proper reward? • Are employees can communicate to any level of management about their issues? • Does your organization hire learning oriented and innovative employees? • Does your organization offer proper reward, training and development opportunities and career growth? • Is there fair appraisal system in your organization? • Is employees' performance link with reward?	If your organizational have all these characteristics related to strategic HRM, how and why they contribute into successful transfer of foreign working practices. Please give relevant examples, experiences and insights about the contribution of strategic HRM
Does organizational structure contribute towards cross-border transfer of working practices? If yes, then how?	• Is there matrix structure in your organization? • Your organizational structure is characterized many contact points or lesser? • Is your organizational structure is flexible? • Is your organizational	If yes, then how and why these characteristics of your organizational structures contribute in application of foreign working practices. Please also share relevant example, incident and experiences.

	structure is decentralized? • Does your organizational structure offer a balanced level of empowerment decentralization? • Does your organizational structure have lesser formal reporting? • Does your organizational structure offer free flow of information?	

At the end, the participants will be request to give a holistic overview about the understudy research issue and about any other issue which was not asked.

Appendix VII: Final Interview Guide

Learning in Engineering Consultancy Practice:

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The interview guide and its questions were evolved over time during field work. Following is the final list of questions with additional on-spot, repeat and probing questions which were asked to the research participants to conduct the field work and collect the required data. This interview guide is quite different from its initial/preliminary version.

- Can you please give me your brief introduction, qualification and work experience?
- Can you please brief me about a project you have worked or currently working on in which NESPAK worked in collaboration with foreign consultants?
- What are the key reasons of having foreign consultant in that project?
- What new/modern technology or engineering methods you have learnt or are learning from your foreign counterparts in doing the consultancy work in that project?
- Were you completely dependent upon foreign partners or you (NESPAK project team) completed some work independently?
- What parts of work you have completed with the support and assistance of foreign partners?
- How did you learn new engineering methods and technologies?
- Did you consult published literature/material to learn modern engineering methods and technologies? If yes, how do you learn from them?
- Is anybody in NESPAK supported you in such learning? If ye, how?
- Have you learnt some applied/practical knowledge such as expertise and skills to practically perform an engineering task? If yes, then what?
- How did you learn that?
- Was this a collective or individual work?
- If it was a collective work, how many engineers were involved in it?
- How information and communication technologies help to work collectively on a task?
- What technology and scientific instruments you are using to complete the work?
- What did you learn from your local NESPAK's colleagues? And how?
- What did you learn from your foreign partners? And how?
- Is the consultancy alliance sufficiently conducive for sharing of the required knowledge, skills and engineering activities with you? If yes, why? And how it is conducive?
- What problems you experienced in learning new engineering methods and technologies?
- How did you address them?
- What knowledge, skills, expertise, experience and activities are/were shared by your foreign partners?
- How did this sharing have had happened?
- How consultancy activities and practices were shared by foreign partners?

- What factors facilitated/hindered such sharing processes? And how?
- What problems this sharing process faced?
- Were these problems addressed? If yes, how?
- What did you do if these problems were not addressed and solved, and required consultancy practices and relevant knowledge were not shared by foreign partners?
- Please share any other information related to your learning of new engineering methods and technologies and knowledge sharing between you and foreign engineers.