FRAMEWORK FOR THE IMPLEMENTATION OF KNOWLEDGE SHARING BEHAVIOR IN GLOBAL SOFTWARE DEVELOPMENT ORGANIZATIONS

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By

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ABSTRACT

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Rayhab Anwar

Focus of world has shifted from industrialization (industrial economy) to knowledge-based economy. An economy becomes knowledge economy when use and creation of knowledge becomes its integral part. Based on the importance of knowledge, it is considered as an asset for competitive advantage. The competitive advantage which is based on knowledge is more likely to sustain for a longer period as compared to competitive advantage which relies on non-knowledge-based resources like latest technology. Knowledge which is vital for economic development and competitive advantage needs to be managed. This managing of knowledge is known as knowledge management. Knowledge management is a process through which knowledge is obtained, created, shared and stored. All these steps of knowledge management heavily rely on knowledge sharing. If there is no knowledge sharing, knowledge cannot be created, obtained or stored. One of the key issues in the execution of knowledge sharing is due to the mindset of prevailing culture of “knowledge is power". Such a culture, in organizations sturdily affects organization’s growth and progress.

Software industry is a highly competitive and innovative industry. In present era, software developers are globally distributed. Globally distributed software developers face cultural and geographic differences such as difference in language, traditions, values, norms of behavior and time zone difference which may cause misunderstanding and clashes. Knowledge sharing among distributed individuals is a complicated process; it involves many challenges and complications. The key focus of the existing literature has been on individuals working from same locations rather than globally distributed locations. The available literature focuses more on organizational aspects and neglects the geographic, cultural and psychological aspects of software developers working from globally distributed locations. Therefore, extensive research is required to understand the knowledge sharing process for globally distributed software development organizations. The purpose of this study is to fill this gap by identifying the problems being faced in the implementation of knowledge sharing behavior in global software development organizations. For this research "*positivist*" research philosophy was used, as the current framework was based upon utilization of existing theory. For data analysis structural equation modelling (SEM) has been adopted. The "measurement model" and the "structural model" is achieved by using "SmartPLS 3.0". Geographic distance, linguistic distance and time zone difference were introduced as barriers. The results showed that geographic distance had negative impact on knowledge sharing behavior, whereas time zone difference and linguistic distance had insignificant impact on the knowledge sharing behavior. Motivation, social interaction and trust were introduced as facilitators. The results showed that social interaction and trust had positive impact on

knowledge sharing behavior, whereas motivation had insignificant impact on knowledge sharing behavior. Two moderating factors were “organizational support” and “technological support” were introduced. organizational support emerged as a significant factor to support knowledge sharing behavior whereas “technological support” hypothesis was rejected. The study demonstrated a positive and strong relationship between “knowledge sharing behavior” and “job performance”.

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APPROVAL SHEET

This dissertation **"FRAMEWORK FOR THE IMPLEMENTATION OF KNOWLEDGE SHARING BEHAVIOR IN GLOBAL SOFTWARE DEVELOPMENT ORGANIZATIONS"** was prepared by RAYHAB ANWAR and submitted as partial fulfillment of the requirements for the degree of Master of Computer Science at Universiti Tunku Abdul Rahman.

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SUBMISSION OF DISSERTATION

It is hereby certified that **RAYHAB ANWAR** (ID No: **16ACM06211**) has completed this dissertation entitled "*FRAMEWORK FOR THE IMPLEMENTATION OF KNOWLEDGE SHARING BEHAVIOR IN GLOBAL SOFTWARE DEVELOPMENT ORGANIZATIONS"* under the supervision of Dr. Mobashar Rehman (Supervisor) from the Department of Information Systems, Faculty of Information and Communication Technology, and Dr. Khor Siak Wang (Co-Supervisor) from the Department of Information Systems, Faculty of Information and Communication Technology.

I understand that University will upload softcopy of my dissertation in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

_____

(*Rayhab Anwar*)

DECLARATION

I hereby declare that the dissertation is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

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LIST OF ABBREVIATIONS

ATT	Attitude
DTPB	Decomposed Theory of Planned Behavior
CMB	Common Method Bias
GD	Geographic Distance
GSD	Global Software Development
GSDO	Global Software Development Organizations
JP	Job Performance
KM	Knowledge Managment
KS	Knowledge Sharing
KSB	Knowledge Sharing Behavior
KSBF	Knowledge Sharing Behavior Factors
KSI	Knowledge Sharing Intention
LD	Linguistic Distance
MOT	Motivation
OS	Organizational Support
PBC	Perceived Behavioral Control
PLS	Partial Least Squares
SCT	Social Cognitive Theory
SEM	Structural Equational Modeling
SI	Social Interaction
SLR	Systematic Literature Review

SNs	Subjective Norms
TAM	Technology Acceptance Model
TIB	Triandis theory of Interpersonal Behavior
TPB	Theory of Planned Behavior
TR	Trust
TS	Technological Support
TZD	Time Zone Difference
VIF	Variance Inflation Factor

CHAPTER 1

INTRODUCTION

1.1 Overview

Knowledge is a combination of information, experience, values and norms (Koriat & Gelbard, 2014). Knowledge is classified into two main categories: “tacit” and “explicit”. Explicit knowledge can be codified and digitized in books, documents, reports, memos, etc. whereas, tacit knowledge is embedded in minds and relies largely upon “personal experiences” and “observation”. Tacit knowledge is difficult to define and is context dependent. Tacit knowledge and explicit knowledge are important pillars of any software organization (Nonaka, et al. 2000). Knowledge management (KM) is comprised of steps to determine, capture and share knowledge (Becerra-Fernandez, González, & Sabherwal, 2004). Knowledge sharing (KS) has become an essential element for the strategic operation of any organization in this digital information society (Liebowitz & Megbolugbe, 2003). Irrespective of the constant advancements in KS approaches, shared knowledge is seldom utilized properly in software development (Choi, Lee, & Yoo, 2010). Sharing of knowledge has become a complex activity as it faces various complications.

1.2 Knowledge Sharing Behavior (KSB) in Global Software Development Organizations (GSDO)

In today's dynamic and aggressively competitive era, the success of any software organization depends on the ability to leverage knowledge that will help in the development of new software products and processes which outperform those of competitors. Knowledge is considered as the most significant resource in software development (Aurum, Jeffery, Wohlin, & Handzic, 2013). Sharing of expert knowledge acts as the key process in the development of a software product (Kucharska & Kowalczyk, 2016). The efficacious development of any software is dependent upon the integration of knowledge spread across various domains (Patnayakuni, Rai, & Tiwana, 2007; Robillard, 1999).

Global Software Development (GSD) is defined as "*software work undertaken at geographically separated locations across national boundaries in a coordinated fashion involving real time synchronous and asynchronous interaction*" (Sahay, Nicholson, & Krishna, 2003, p. 1). GSD is a "knowledge intensive activity" that is dependent upon the KSB of individuals working across the globe (Zahedi & Babar, 2016). In GSD the individuals continue to work on the same project goals while working from different geographic locations (Oshri, Van Fenema, & Kotlarsky, 2008). The shift from an industrial economy towards a decentralized knowledge-based economy has given knowledge more value and importance for organizations which operate globally (Hustad, 2004). Knowledge is no longer considered as competitive advantage,

but it is considered as a backbone of how organizations meet the requirements of global competitive environment (Kroll et al. 2016).

In all stages of software development, knowledge needs to be shared and managed. This includes knowledge from all stages including requirement gathering, designing, development, testing, installation and maintenance (Desouza, Awazu, & Baloh, 2006). In order to minimize the challenges and complications involved in KSB process, it has become fundamental to get an understanding of the "factors" which impact KSB and propose a KSB framework to ease KSB among software developers.

1.3 Research Motivation

Many firms across the globe have opted for GSD because of cost effective solutions for software development, increased product quality (Niazi et al., 2016) and significant return on investment (A. A. Khan, Keung, Niazi, Hussain, & Ahmad, 2017). GSD has brought many advantages to the software industry such as cheap resource utilization, follow the sun approach, opportunities for merger, utilization of expert talent from various regions (Zahedi, Shahin, & Babar, 2016). But at the same time GSD faces many challenges (Betz, Oberweis, & Stephan, 2014; Zahedi et al., 2016). In GSDO's communication challenges arise due to absence of "*face-to-face communication*" in distributed projects (Razzak & Ahmed, 2014). Similarly, the geographic distance acts a barrier and causes communication issues which eventually hinder KSB (Yaseen, Baseer, & Sherin, 2015). Delays in overall project execution and

delivery occur due to absence of synchronous collaboration due to time zone differences (Aranda, Vizcaíno, & Piattini, 2010). Domain knowledge also varies from country to country. This leads to critical situation in which onsite members assume that the project specifications have been understood whereas individuals on other locations did not provide a valid feedback because of lack of understanding (Betz et al., 2014). In globally distributed projects, individuals working in different contexts usually neglect to share the relevant information which may be beneficial to offshore workers. The reason for this behavior is the non-awareness of identification of information (Kroll et al. 2016). required by the remote workers and ambiguous nature of project (Alam et al., 2012). This factor influences the capability to share knowledge and develop a common understanding with workers who are in different contexts (Zahedi et al., 2016). Additionally, when the native language is not same, the diversity in terms of a common language (usually English) also leads to various problems and misunderstandings (Aranda et al., 2010) When individuals share knowledge, they not only exchange valuable ideas but also learn new things from co-workers. In this way "learning capabilities" of individuals are improved, which in return enhances individual's job performance (JP) (Kang, Kim, & Chang, 2008). Though the factors which influence KSB of software developers needs to be identified, it is also vital that we carefully inspect the impact of KSB on JP. The motivation behind this study is to deepen our understanding regarding KSB, to identify the factors which influence KSB of software developers and how KSB impacts JP.

1.4 Problem Statement

Software development is a highly competitive and "knowledge-intensive activity" (Zahedi et al., 2016) which involves rapid changes (Kukko, 2013). Due to high competition, software organization needs to launch highly competitive and innovative products. The development of innovative software products depends upon specific knowledge within numerous technical fields. As per human limitation, it is not possible for one individual to become master of all technical fields. Hence, the expertise and knowledge of software professionals within the software organization have significant worth if shared properly (Berends, Bij, Debackere, & Weggeman, 2006).

The success of software development is largely dependent upon effective KSB among software developers (Zahedi et al., 2016). KSB factors can be classified in to two main categories "barriers" and "facilitators". KSB barriers (or challenges) specifically refer to the "*factors which discourage the knowledge sharing behavior of members*" (Akgün et al., 2017). KSB facilitators (or solutions) refer to the *"factors which drive the exchange of task-related information, ideas, know-hows, and feedback regarding products and processes*" (Ghobadi, 2015). Several challenges may complicate KSB of software developers in GSDOs such as managing diverse social and cultural identities, overcoming coordination challenges, creating shared understanding, motivating individuals to share knowledge (Ghobadi, 2015), overcoming problems to communicate because of differences in technical terminologies (Zahedi et al., 2016), managing trust between employees (Kukko, 2013) and re-

transferring of knowledge to the newly hired employees (Zahedi et al., 2016). GSD lacks sufficient opportunities for frequent communication exchange among distributed individuals because of geographic distance (Zahedi & Babar, 2016). Regardless of the significance of these issues, less work has been done to integrate the existing findings into a comprehensive framework for managing KSB (facilitators and barriers) in GSDOs. Some authors have developed frameworks to determine the KSB of software developers but the existing KSB frameworks have mainly focused on one or two categories such as "individual" and "organizational" (Chen, Zhou, Probert, & Su, 2016; Safa & Von Solms, 2016; Tamjidyamcholo, Baba, Shuib, & Rohani, 2014). To fill this gap, the emphasis of this research is to propose a comprehensive KSB framework which can cater to the needs of GSDOs by integrating "individual", "organizational", "technical", "geographic" and "cultural" categories along with KSB factors by integrating "psychological theories" including "theory of planned behavior", "social cognitive theory" and "Triandis theory of interpersonal behavior" in one comprehensive framework. Moreover, KSB impact on JP will be explored. This research tends to investigate how these factors influence KSB of software developers working in GSDOs and how KSB impacts JP.

1.5 Research Questions

The proposed study will answer the following research questions:

1. What are the facilitators which support KSB of software developers working in GSDOs?

2. What are the barriers which hinder KSB of software developers working in GSDOs?
3. What framework can support KSB of software developers working in GSDOs?
4. What is the impact of KSB on the software developer's JP working in GSDOs?

1.6 Research Objectives

The proposed study will meet the following objectives:

1. To identify the facilitators which support KSB of software developers working in GSDOs.
2. To identify the barriers which hinder KSB of software developers working in GSDOs.
3. To develop and validate a model for KSB of software developers working in GSDOs.
4. To analyse the impact of KSB on the JP of software developers working in in GSDOs.

1.7 Research Phases

Figure 1.1 describes the phases of the current research. In phase 1, initially literature was studied. Based on relevant literature, the problem was identified, and KSB factors were also determined. Using the identified factors, a KSB framework was developed through hypothesis formulation. In phase 2,

suitable research methodology was selected. Sample size was identified, and questionnaire development was done. Data was collected through surveys. In the third phase, data was tested for reliability and the analysis was done. The proposed framework was validated through data analysis. Finally, the results were discussed, and the research was concluded in thesis writing.

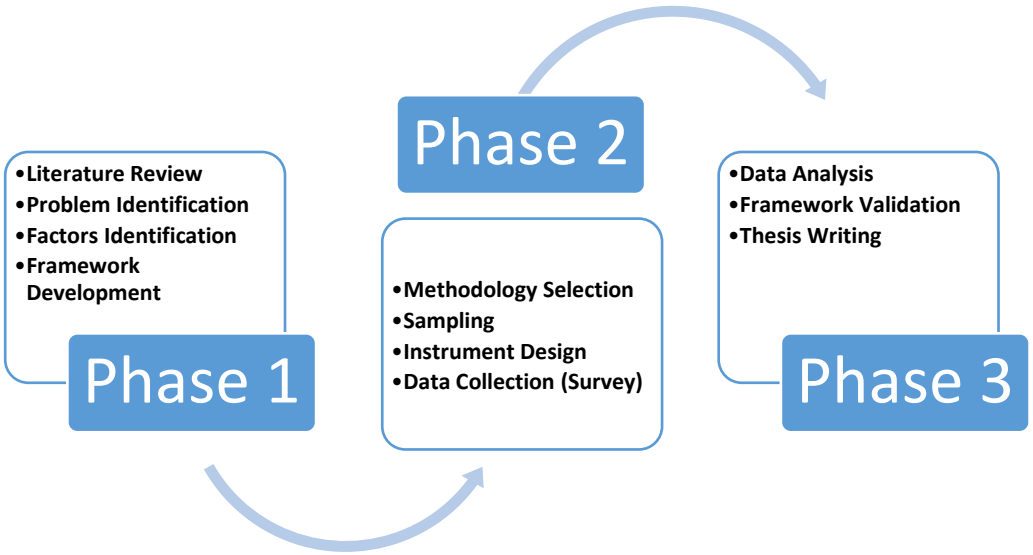

Figure 1.1: Research Phases

1.8 Unit of Analysis

The present study examines how KSB factors (facilitators and barriers) impact KSB of software developers working in GSDOs. It also explores the relationship between KSB and software developers Job Performance (JP).

1.9 Scope of Research

The scope is based on the objectives defined in the previous section 1.6 (page number 27). The research shall mainly focus on KSB of software

developers working in GSDOs of Malaysia. The result of this study is applicable only to GSDOs and may not be generalizable with respect to other industries. The research adopted mono approach (quantitative).

1.10 Thesis Formation

Chapter 1: This chapter explains importance of KSB in GSDOs. Research motivation and problem area are also discussed along with the research questions and objectives. This chapter also discusses the research phases and contributions of research work.

Chapter 2: Chapter 2 discusses previous literature and research work. This chapter discusses the facilitators and barriers identified from the previous literature. Chapter 2 also discusses about the theories used to develop the framework along with hypothesis formulation.

Chapter 3: In this chapter, the research methodology is discussed. This chapter majorly includes research philosophy, research approach, research strategy, research choice and research technique. Questionnaire development and the measurement items have also been discussed in detail. In addition, the results of pilot study are also part of this chapter.

Chapter 4: In this chapter the results of the study are presented. In the first stage the assessment of the adequacy of the "measurement model" is presented. In the second stage assessment and evaluation of the "structural

mode" is presented. Chapter 4 presents the results which include the significant and non-significant findings.

Chapter 5: This chapter provides answers to the research questions. It discusses how objectives were met. Chapter 5 also discusses the limitations of current study, implications and the possibilities of future work.

1.11 Chapter Summary

This chapter discussed the background of the research area and highlighted how KSB is significant in GSDOs. After defining the motivation of the research, problem statement, the research questions and objectives were discussed. At the end, thesis formation is also discussed as a part of this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter will focus on the previous literature. Topics include knowledge sharing, knowledge types and factors related to knowledge sharing behavior. Theory of planned behavior, social cognitive theory and Triandis theory of interpersonal behavior which have been used to formulate the research framework are also discussed. Additionally, this chapter also discusses research framework development.

2.2 Knowledge Sharing and Knowledge Sharing Behavior – Conceptualization

Topic conceptualization provides in depth information of the topic under study in order to get a *"a broad conception of what is known about the topic and potential areas where knowledge may be needed"* (Torraco, 2005), conceptualization is required. To achieve this, table 2.1 formulates the working definitions of KS and KSB proposed by various authors.

Table 2.1: Overview of selected KS Definitions

Definition of KS	**Source**
The term *"KS implies the giving and receiving of information framed within a context by the knowledge of the source."*	Sharratt & Usoro (2003) p 188
KS is the *"deliberate act in which knowledge is made reusable through its transfer from one party to another."*	Lee & Al-Hawamdeh (2002) P.49
KS is the *"provision of task information and know-how to collaborate with others to solve problems, develop new ideas, or implement policies or procedures."*	Cummings (2004, p. 352)
KSB is *"viewed as the degree to which employees share their knowledge with their colleagues for organisational tasks and goals."*	(Sugashwarprashanth & Thenmozh, p. 70)
KSB "is more about „share" manner from everybody to share what they know."	(Ain Zuraini binti Zin Aris, 2013, P. 519)
KSB is "a set of behaviors that involve the exchange of information or assistance to other".	*Connelly & Kevin Kelloway (2003, p. 4)*

Derived from previous literature, table 2.2 presents the significance of knowledge in software industry.

Table 2.2: Significance of Knowledge in Software Industry

Significance of Knowledge in Software Industry	**Source**
"Software engineering involves a multitude of knowledge-intensive tasks."	Birk, Surmann & Althoff (1999, p. 2)
"Software development is a collaborative and knowledge-intensive process."	(Ghobadi, 2015, p 82)

2.2.1 Knowledge Types

Knowledge is categorized into two types: "explicit" and "tacit". Explicit knowledge can be "*formalized, documented, archived and codified*". It includes "business documents", "plans", 'guidelines" and "process models" etc. (Koriat & Gelbard, 2014). Tacit knowledge is gathered by "experience", "personal ideas" and "values". It is hard to write and formalize (Koriat & Gelbard, 2014). Nonaka (1994) described knowledge into two main components: technical and cognitive. Cognitive knowledge refers to the "*individual's beliefs, values and mental models*". The technical knowledge refers to the "*know-how or informal skills*". Cognitive component forms the way individual's visualize the world (Nonaka, 1994). Knowledge can also be viewed from "individual" and

"collective" perspective. Collective knowledge refers to the knowledge that exists in groups or organization, whereas individual knowledge resides in the minds of the people (Nonaka, 1994).

2.2.2 Knowledge Sharing Behavior Factors (KSBF)

KSBF are broadly classified into two types: facilitators and barriers, which are shown in figure 2.1.

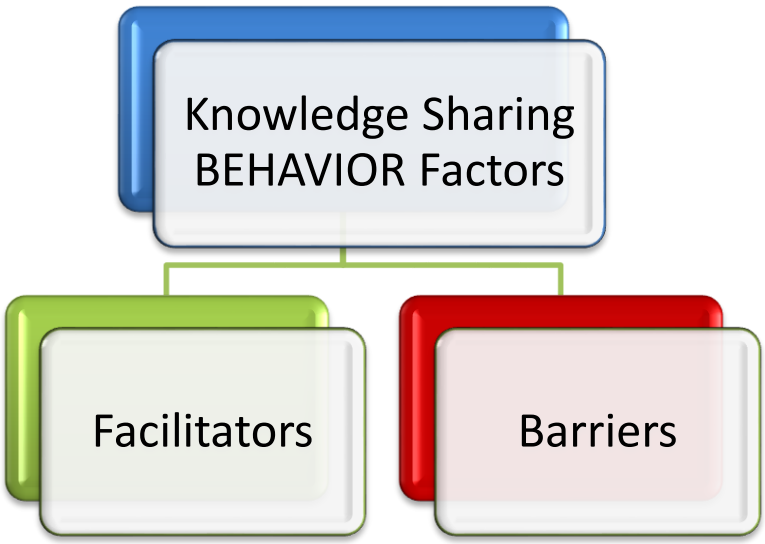

Figure 2.1: Types of Knowledge Sharing Behavior Factors

KSB barriers (or challenges) specifically refer to the "*factors which discourage the knowledge sharing behavior of team members*" (Akgün et al., 2017, p .3). KSB facilitators (or solutions) refer to the "*factors that drive the exchange of task-related information, ideas, know-hows, and feedback regarding products and processes*" (Ghobadi, 2015, p. 4). Various authors have classified these factors in different categories such as Zahedi (2016) identified six main themes: "management", "team structure", "work

processes/practices", "team cognition", "social attributes" and "technology". Ghobadi, (2015) identified four main themes "task", "technology", "people and structure" (Ghobadi, 2015). Wendling (2013) identified four themes "technology", "professional skills", "cost" and "methodology of software development" (Wendling, Oliveira, & Carlos Gastaud Maçada, 2013). Previous researches identified three categories "coordination", "communication" and "cultural" (Kroll et al. 2016).). However, the existing work done by various authors did not explicitly determine the actual KSB of software developers. In this research five categories namely "individual", "organizational", "technological", "cultural" and "geographic" are discussed. Individual's category "*refers to the degree of dispersion in individuals in terms of their skills, experience, characteristics, values* (Ghobadi & Mathiassen, 2016), *personal motivation* (Chen et al., 2016) *and social networks"* (Kukko, 2013) *which may impact knowledge sharing behavior"*. Organizational category "*refers to the overall organizational culture with regard to sharing knowledge, ideas and thoughts which may impact knowledge sharing behavior*" (Ghobadi, 2015). Technological category "*refers to the technological influences such templates, tools* (Ghobadi, 2015), *methodologies and issues* (Ghobadi & Mathiassen, 2016) *which may impact knowledge sharing behavior*". Cultural category "*refers to the cultural practices and norms which vary from region to region and impact knowledge sharing behavior"* (Zahedi et al., 2016). Geographic category "*refers to the diversity of the individuals in*

terms of being located at different physical locations" (Ghobadi, 2015) KSB categories used in this study are presented in figure 2.2.

Figure 2.2 Knowledge Sharing Behavior Categories

2.3 Previous Studies on Knowledge Sharing Behavior

Previous KSB factors (facilitators and barriers) and knowledge sharing frameworks will be discussed in sections 2.3.1 and 2.3.2 respectively.

2.3.1 Knowledge Sharing Behavior Barriers and Facilitators

Systematic Literature Review (SLR) has been used for reviewing the studies published from 2010 to 2016. The search string used in this SLR is given below:

TITLE-ABS-KEY (‘‘knowledge sharing’’ OR ‘‘knowledge transfer’’ OR ‘‘knowledge exchange’’ OR ‘‘knowledge distribution’’ OR ‘‘tacit knowledge’’ OR ‘‘explicit knowledge’’ OR ‘‘knowledge sharing process’’) AND

(‘‘software’’ or ‘‘software organization’’ OR ‘‘software development’’ OR ‘‘software engineering’’ OR ‘‘global software organization’’ R ‘‘global software teams’’) AND (‘‘factors’’ OR ‘‘facilitators’’ OR ‘‘enablers’’ OR ‘‘methods’’ OR technique∗ OR strategy∗ OR approach∗ OR process∗ OR practice∗).

The search was conducted in December 2016 using an advanced search in the electronic databases such as Scopus, Emerald Insight, Wiley Online Library, Academic Search Complete, ACM and Science Direct. Figure 2.3 presents the data sources for each selected study from 2010 to 2016.

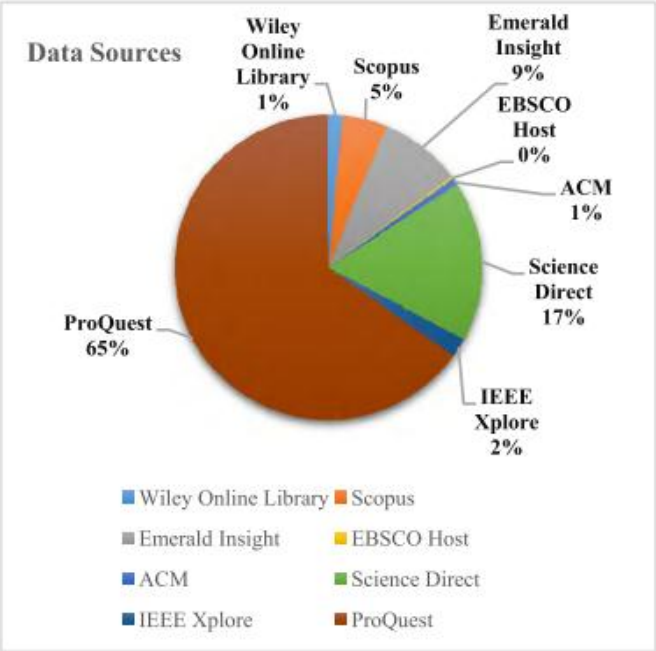

Figure 2.3 Data Sources

2.3.1.1 Inclusion Criteria

The inclusion criteria for the studies is given below:

1. Studies should have been published between January 2010 and December 2016 (including these dates).
2. Studies should be related to GSDOs.
3. Studies should discuss the importance of KSB in software organizations.
4. The main objective of the study should have been investigating and exploring KSB factors (in the form of facilitators or barriers) within GSDOs.

2.3.1.2 5) Exclusion Criteria

Studies were excluded on the basis of the following criteria:

1. Studies which were published in language other than English
2. Keynotes, lab reports, tutorial summaries and presentations.
3. Duplicated studies were detected and removed.
4. Studies which were not relevant to KSB in context of GSDOs were removed.

   The shortlisted studies published for each year along with their distribution over public venues are presented in Fig. 2.4.

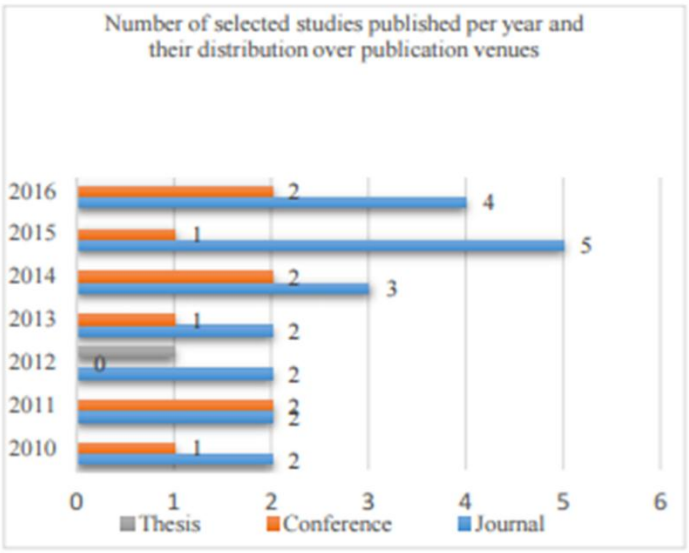

Figure 2.4 Data Sources

Table 2.3 presents KSB barriers for each category from the year 2010 to 2016, along with the frequency of each barrier. The blue highlighted boxes show the barriers with highest frequency in each category. In the "individual" category, the factor "lack of trust", "lack of social networks", "personal fear" and "incompatible professional qualification" were citied 4 times each. These three factors had the highest frequencies in the "individual" category. In the "organizational" category, the factor "poor organizational culture" had the highest frequency and was cited 12 times. "Lack and improper utilization of KS tools" had the highest frequency "technological" category and was citied 8 times. Cultural category had, "linguistic distance" as the highest frequency factor and was cited 12 times. In the "geographic" category two factors namely "geographic distance" and "time zone difference" had the highest frequencies (8).

Table 2.3: Knowledge Sharing Behavior Barriers

Identified Barriers	Studies	Frequency	Identified Barriers	Studies	Frequency
Individual Barriers			**Organizational Barriers**		
Lack of Trust	Amin, et al., (2011), Ghobadi & Mathiassen, (2016), Zahedi et al., (2016), Kukko (2013)	4	Poor Organizational Culture	Alam et al., (2012), Ali et al., (2010), Balaji (2011), Ghobadi & Mathiassen, (2016), Noll et al., (2010), Razzak & Ahmed, (2014), Yaseen et al., (2015), Zahedi et al., (2016), Kukko, (2013), Amin et al., (2011), Kroll et al., (2016)	11
Lack of Social Networks	Wendling et al., (2013), Zahedi et al., (2016), Kukko, (2013), Ghobadi & Mathiassen, (2016)	4	Poor Project Handling	(Razzak, Ahmed, & Mite, (2013), Betz et al., (2014)	2
Personal Fear	Noll et al., (2010), Zahedi et al., (2016), Ghobadi & Mathiassen, (2016), Zahedi & Babar (2014).	4	Budget	(Betz et al., (2014, Nguyen et al., (2014), Zahedi et al., (2016)	3
Incompatible Professional Qualification	Wendling et al., (2013), Alam et al., (2012), Kroll et al., (2016), Ghobadi & Mathiassen, (2016)	4	Employee Turn Over	(Balaji, (2011), Zahedi et al., (2016)	2
Lack of Motivation	Zahedi et al., (2016)	1	Team Growth and Competition	Kukko (2013)	1
Lack of Time	(Amin et al., (2011), Kukko (2013)	2	Lack of Rewards and Recognition	Kroll et al., (2016), Kukko (2013)	2
Low Awareness of Self-Possessed Knowledge	Kukko, (2013)	1			

Table 2.3: Knowledge Sharing Behavior Barriers (Cont'd...)

Identified Barriers	Studies	Frequency	Identified Barriers	Studies	Frequency
Technological Barriers			**Cultural Barriers**		
Lack and Improper Utilization of KS Tools	Ghobadi & Mathiassen, (2016), Kroll et al., (2016), Kukko (2013), Razzak & Ahmed, (2014), Zahedi et al., (2016), Ali et al., (2010)	7	Linguistic Distance	Ghobadi & Mathiassen (2016), Kroll et al., (2016), Kukko (2013); Noll et al., (2010), Razzak et al., (2013), Zahedi et al., (2016), Wendling et al., (2013), Zykov, 2015, Razzak & Ahmed (2014), Betz et al., (2014), Chen et al., (2016), Aranda et al., (2010)	12
Technological Knowledge Gap	Betz et al., (2010), Ghobadi & Mathiassen, (2016), Kroll et al., (2016), Razzak et al., (2013), Zahedi & Babar, (2014), Zahedi et al., (2016), Betz et al., (2014)	7	Cultural Norms Difference	Zykov (2015), Al Attar & Shaalan, (2016), Ali et al., (2010), Kroll et al., (2016), Moe et al., (2016), Noll et al., (2010), Razzak et al., (2013); Ulziit et al., 2015, Zahedi & Babar, 2014,. Zhang et al., (2014), Q. Zhang & Du, (2011)	11
Lack of Central Knowledge Repository and Standardized Templates	Balaji (2011); (2016), Al Attar & Shaalan, (2016), Zahedi et al.,(2016), Ghobadi & Mathiassen (2016)	4	**Geographic Barriers**		
Contextual Difference	Kroll et al., (2016), Zahedi et al., (2016), Alam et al., (2012), Zahedi & Babar (2014), Ghobadi & Mathiassen (2016)	5	Geographic Distance	Alam et al., (2012); Kroll et al., (2016); Yaseen et al., (2015)	8
Lack of Trainings	Alam et al., (2012, Kukko (2013)	2	Time Zone Difference	Ghobadi & Mathiassen, (2016), Moe et al., (2016), Noll et al., (2010), Razzak & Ahmed (2014), Wendling et al., (2013), Zahedi et al., (2016), Betz et al., (2014), Aranda et al., (2010)	8

The facilitators for each category from the year 2010 to 2016 are presented in table 2.4. The facilitators with the highest frequencies for each category are shown in a highlighted blue box. In the "individual" category, three factors namely "social interaction", "trust" and "motivation" had the highest frequencies (5). In the "organizational" category, the factor "organizational support" had the highest frequency and was cited 13 times. "Technological support" had the highest frequency in "technological" category and was citied 12 times. In the "cultural" category, "visits" had the highest frequency and was cited 6 times. In the "geographic" category the factor "Overlapping Hours/Shifts" was cited 2 times.

Table 2.4: Knowledge Sharing Behavior Facilitators

Individual Facilitators (IF)	**Studies**	**Frequency**	**Organizational Facilitators**	**Studies**	**Frequency**
Social Interaction	Boden et al., (2012), Wendling et al., (2013), Zahedi & Babar (2016), Chen et al., (2016), Wickramasinghe & Widyaratne (2012)	5	Organizational Support	Al Attar & Shaalan, (2016), Betz et al., (2014), Chen et al., (2016), Ghobadi (2015), Iskoujina & Roberts (2015), Moe et al., (2016), Kroll et al., (2016), Noll et al., (2010), Zahedi et al., (2016), Balaji, 2011, Zahedi & Babar (2014), Razzak & Ahmed, (2014)	12

Table 2.4: Knowledge Sharing Behavior Facilitators (Cont'd...)

Individual Facilitators (IF)	Studies	Frequency	Organizational Facilitators	Studies	Frequency
Trust	Ghobadi (2015), Kroll et al., (2016), Noll et al., (2010), Wickramasinghe & Widyaratne, (2012), Zahedi et al., 2016)	5	Team Communication	Kroll et al., (2016), Moe et al., (2016); Zahedi et al., (2016), Al Attar & Shaalan (2016), Ghobadi (2015), Razzak & Ahmed, (2014), Ali et al., 2010)	7
Motivation	Balaji (2011), Ghobadi (2015), Kroll et al., (2016), Chen et al., (2016), Zykov (2015)	5	Rewards, Incentives & Recognition	Balaji (2011), Wickramasinghe & Widyaratne (2012), Zahedi et al., (2016), Betz et al., (2014), Al Attar & Shaalan (2016)	5
Individual Participant's Satisfaction	Iskoujina & Roberts (2015)	1	Trainings and Workshops	Zahedi et al., (2016), Razzak & Ahmed (2014)	2
Manageable Workload	Zykov (2015)	1			
Professional Qualification	Wendling et al., (2013)	1			

Table 2.4: Knowledge Sharing Behavior Facilitators (Cont'd...)

I Technological Facilitators	Studies	Frequency	Cultural Facilitators	Studies	Frequency
Technological Support	Noll et al., (2010), Razzak & Ahmed, (2014), Kroll et al., (2016), Ali et al., (2010), Razzak & Ahmed (2014), Al Attar & Shaalan (2016), Yaseen et al., (2015), Noll et al., (2010), Razzak et al., (2013), Wendling et al., (2013), Betz et al., (2014), Zahedi et al., (2016)	12	Relocation of Members Between Remote sites	Ghobadi (2015), Noll et al., (2010), Razzak & Ahmed (2014), Al Attar & Shaalan (2016), Zahedi & Babar (2016)	5
Centralized Libraries, Knowledge Repositories and Maps	Razzak et al., (2013), Zahedi et al., (2016), Razzak & Ahmed (2014), Al Attar & Shaalan (2016), Betz et al., (2014), Kroll et al., (2016), Balaji (2011). Ghobadi (2015)	8	Cultural Exchange Programs and Workshops	Kroll et al., (2016), Razzak & Ahmed (2014)	3
Technical Infrastructure	Betz et al., (2014), Noll et al., (2010), Ghobad (2015)	3	Visits	Boden et al., (2012), Kroll et al., (2016); Noll et al., (2010), Zahedi et al., (2016), Razzak & Ahmed (2014), Betz et al., (2014).	6
User Innovation	Chen et al., (2016)	1	Intercultural Communication	Noll et al., (2010), Kroll et al., (2016), Nguyen et al., (2014), Nuwangi, Sedera, & Murphy (2012)	4
			Geographic Facilitators		
			Overlapping Hours/Shifts	Kroll et al., (2016), Razzak & Ahmed (2014)	2

2.3.2 Knowledge Sharing Behavior Frameworks

Previous researchers have proposed frameworks for KSB using psychological theories with regards to the software industry. Tsai & Cheng (2010) used social cognitive theory to determine knowledge sharing behavior (KSB) of programmers. Data was collected from software programmers and software workers in Taiwan (Tsai & Cheng, 2010). KS *"self-efficacy*", *"outcome expectancy"* and *"organizational climate"* had positive influence on individual's intentions to share knowledge (Tsai & Cheng, 2010). Zhang & Du (2011) conducted a study to determine impact of *"cultural difference"* on KS. Shorter *"cross cultural distance"* positively impacted KS in *"trust building".* Further, stronger *"relationship quality"* and knowledge sharing were found to improve *"outsourcing performance"* (Zhang & Du, 2011). Wickramasinghe and Widyaratne (2012) conducted quantitative study to analyse the impact of *"interpersonal trust", "rewards"* and *"team leader support"* on voluntary KS mechanism in software development project teams. 150 software developers were used as respondents. *"Interpersonal trust"* and *"rewards"* had significant impact on KS (Wickramasinghe and Widyaratne 2012). Olofsson (2012) conducted research to investigate how four factors "*individual motivation, social ties, virtual teams and the fit between the initiatives and the organizational context"* enhance KS in software development organizations (Olofsson, 2012). The data was collected using semi-structured interviews in Swedish case company named as *"Integrerad Företagsservice"* (in English: Integrated Enterprise Service). IFS had global presence in 33 countries with an employee count of 2700. Four major factors impacted KS on daily basis.

Individual level of was found as a *"precondition"* which could enhance knowledge sharing on a daily level. It was observed that *"low level of individual motivation"* hinders KS. It was suggested that organizations must develop strategies to enhance individual motivation to support knowledge sharing (Olofsson, 2012). Park & Lee (2014) conducted a study to determine the "*role of dependence"* and *"trust"* in KS of information systems projects from two large IT firms. Four constructs namely *"environmental complexity, domain expertise, similarity of project value, and communication frequency"* were included as the antecedents of trust. It was observed that *"trust"* impacts KS significantly which leads to a *"good team performance"* (Park & Lee, 2014). To determine KSB in virtual communities' authors utilized a subset of factors derived from Triandis theory. *"Perceived consequences", "affect"* and *"facilitating conditions"* impacted KSB. "*Social factors*" had no impact on KSB in information security communities (Tamjidyamcholo et al., 2014). Authors investigated the impact of *"participative motivation"*, *"social network" "organizational culture"* and "*user innovation"* on KSB in open source software projects. All of these factors were found to have a positive impact on KSB with respect to the Chinese context (Chen et al., 2016). Safa & Von Solms (2016) incorporated "theory of planned behavior", "motivation theory" and "Triandis theory" to investigate KSB in an information security department. It was observed that extrinsic motivational factors ("*earning a reputation"* and *"gaining promotion")* and intrinsic motivational factors ("*curiosity satisfaction")* had positive impact on employees' *"attitude"* towards information security KS. Furthermore, the study also found *"attitude",*

"perceived behavioral control", "subjective norms" and *"organizational support"* had positive influence on *"information security KS intention"* which effected "*information security KS behavior".* However, "*self-worth satisfaction"* had no influence *"information security KS attitude"* (Safa & Von Solms, 2016). Table 2.5 presents the knowledge sharing behavior frameworks. Each factor from the framework has been mapped to the corresponding category. The "+" and "-" signs indicates a "positive" and a "negative" impact of the factors respectively.

Table 2.5: Knowledge Sharing Behavior Frameworks

Framework - Author	**Individual**	**Organizational**	**Technological**	**Geographic**	**Cultural**	**KSB Relationship with Performance**
Tsai and Cheng (2010)	Self efficacy + Outcome expectancy +	Organizational Climate +				
Zhang and Du (2011)					Cultural Difference +	Outsourcing performance +
Wickramasinghe & Widyaratne (2012)	Interpersonal trust + Personal interactions +	Rewards + Team leader support -	Work-group communications+			
Olofsson (2012)	Individual motivation + Social ties +	Organizational match +	Agile project processes + (SCRUM process, Postmortem analysis)	Virtual teams -		

Table 2.5: Knowledge Sharing Behavior Frameworks (Cont'd...)

Framework - Author	Individual	Organizational		Technological	Geographic	Cultural	KSB Relationship with Performance
Park & Lee (2014)	Trust + Dependence + Expertise+ Similarity of project value +		Project Complexity	Communication frequency + Similarity of project value +			Project performance +
Tamjidyamcholo, Baba et al. (2014)	Social interaction + Reputation + Usefulness + Affect(motivation) + Social factors -		Community Support +				
Chen, Zhou et al. (2016)	Motivation + Trust+		Organizational Culture +			Shared Language +	Performance of open source software project +
Safa and Von Solms (2016)	Motivation + Trust +		Organizational Support +				

2.4 Conceptual Framework Development

The conceptual framework proposed in this study is based upon theory of planned behavior (TPB) as baseline and supplements it with constructs derived from social cognitive theory (SCT) and Triandis theory of interpersonal behavior (TIB). Next sections: 2.4.1, 2.4.2 and 2.4.3 discuss in detail the relationship between KSB and the selected theories.

2.4.1 Knowledge Sharing Behavior and Theory of Planned Behavior (TPB) in GSDOs

Ever since the introduction of TPB around 23 years ago (Ajzen, 1985), this theory is recognized as one of the prominent model used to predict of human social behavior. Its popularity can be revealed by conducting a "Google Scholar" search for the keyword "*theory of planned behavior*" or "*theory of planned behavior*". From 22 citations in 1985, (Ajzen, 2011) the number of citations per year has increased progressively to a total of 20,970 in 2018. The screenshot provides the evidence for the citations of TPB in the year 2018 (refer to Appendix A).

TPB considers individual's attitude (ATT) which can either be "positive" or "negative" and subjective norms (SNs) as the main forecasters of behavioral "intention" along with (PBC) (Ajzen, 1991). TPB is considered superior as compared to other competing models in predicting and human behavior, because it provides more information to explain behavior (Taylor & Todd, 1995). Figure 2.3 presents TPB.

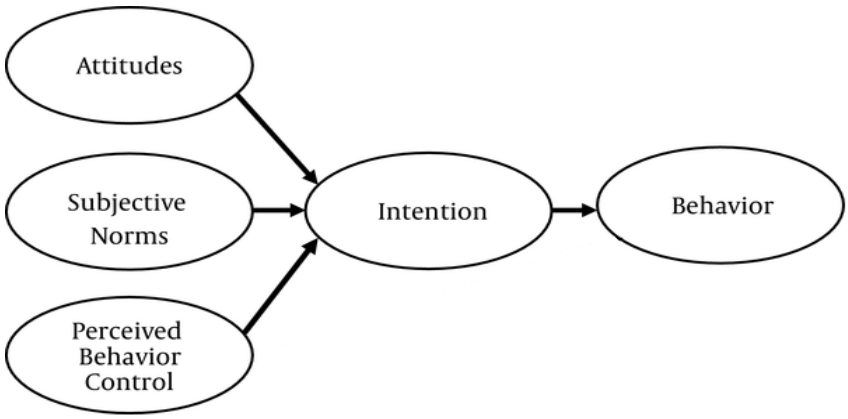

Figure 2.5: Theory of Planned Behavior

TPB is a widely accepted model for predicting behavior in the IT arena (Riemenschneider, Harrison, & Mykytyn, 2003). TPB has been used in many different studies in the information systems literature (Taylor & Todd, 1995). Ifinede (2012) used TPB to investigate information systems security policy (ISSP) compliance. Data was collected via survey of 124 business managers and information system professionals. The study investigated "information system's ethical behaviors" and individual's *"decision to adopt acceptable computer security measures"* with information systems security policy*"*(Ifinedo, 2012). Safa and Solms (2016) incorporated TPB, to determine KSB in information security department. Data was collected from online survey comprising 482 information security professionals. It was concluded that "*attitude", "perceived behavioral control"*, "*subjective norms*" positively influenced "*Information Security KS intention"* which effected "*Information Security KSB"* (Safa & Von Solms, 2016). TPB was used to examine professional's intention to share and reuse knowledge in information technology service operations context. The data was collected from 40 IT professionals using an online survey. The results showed that all direct determinants of intention to share knowledge, excluding subjective norms regarding "service operations KS" and "intention to reuse knowledge were significant" (So & Bolloju, 2005). Taylor and Todd (2005) used technology acceptance model (TAM), TPB and a DTPB to asses which of these models best understands usage of information technology. The data was collected from 786 students from a computer resource centre. It was found that DTPB provides a fuller understanding of behavioral intention (Taylor & Todd, 1995). Harrison et. al (1997) used TPB to determine small business executive's

behavior in adoption of Information Technology (IT). The data was collected from a filed study of 96 business firms. Numerous ITs were identified by respondent's including *"relational databases, inventory control, graphical oriented tools*" etc. Strong support was found for decision process based on attitude, subjective norm and perceived control regarding IT adoption"(Harrison, et.al, 1997). Morris and Ventakash (2000) used TPB to determine the impact of "age" on software usage by young and old. 118 responses were obtained via a virtual community of customer service representatives. "*Windows95*" based organization-wide system was introduced for data and information retrieval. It was observed that young employees were more driven by attitude whereas older workers were more influenced by subjective norms and perceived behavioral control (Morris & Venkatesh, 2000). Mathieson (1991) compared TAM and TPB to measure behavioral intention to use an information system. The TAM model was used by 149 subjects and the TPB model by 113 subjects which comprised of juniors and seniors in an introductory management course at university. The result found both TAM and TPB predicted intention to use an information system quite well. It was also concluded that TPB provided more specific information which better guided development (Mathieson, 1991). Jeon et al. (2011) used TPB to identify factors and relationships which influenced "community of practice (CoP) members KS attitudes", "intentions" and "behavior". *The study collected* 282 responses from four Korean companies. It was observed that intrinsic motivational factors "*enjoyment*" and "*need for affiliation*" and extrinsic motivational factors *"image"* and *"reciprocity"* had positive impact on attitude

towards KS (Jeon, Kim, & Koh, 2011). Appendix B (adopted) provides an overview of TPB usage within the Information Technology /Information Systems domain (Al-Lozi & Papazafeiropoulou, 2012) .

Ajzen (1991) defines ATT as "*the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behavior in question"* (Ajzen, 1991, p. 188). Previous researchers suggested that if KS creates a favourable impact on individual's only than they will prefer to share knowledge (So & Bolloju, 2005). Pavlou and Chai (2004) observed that ATT is a significant predictor of electronic commerce intention in two countries, Greece and USA (Pavlou & Chai, 2002). Several researches have laid emphasis on the positive impact of ATT towards KSI while sharing knowledge (So & Bolloju, 2005, Safa, 2016 ; Taylor & Todd, 1995; Morris & Venkatesh, 2000). Accordingly, following hypothesis is proposed:

H1a: Positive ATT towards KSB has a positive relationship with KSI of software developers working in GSDOs.

In accordance with TPB, SNs *"represent the influence of social pressure as perceived by the individual to either perform or not to perform a certain behavior*" (Ajzen, 1985, p. 188). This can be explained by an example of a software programmer. A software programmer might show more intention to share specific debugging knowledge to some colleagues because his/her boss

thinks that this kind of knowledge should be shared among other programmers (So & Bolloju, 2005). Previous researches have shown SNs to be significant antecedent towards behavioral intention (Bock, Zmud, Kim, & Lee, 2005; Mathieson, 1991; Morris & Venkatesh, 2000; Pavlou & Chai, 2002; Taylor & Todd, 1995). Hence, the following hypothesis is proposed:

H1b: Positive SNs regarding KSB have a positive relationship with KSI of software developers working in GSDOs.

According to TPB, PBC refers to "one's perceived ease or difficulty of performing the behavior" (Ajzen, 1985, p. 188). PBC directly increases intention, as individual's choose to perform an activity only when they get fruitful outcomes (Ajzen, 1991). This can be explained with the example of a "system administrator", who might have a strong intention to share knowledge on "tuning system performance" only because he feels that he has the desired ability to share his knowledge (So & Bolloju, 2005). Taylor and Todd (1995) found PBC to be an important predictor of intention. Matheison (1991) also found significant impact on intention by PBC (Mathieson, 1991). Thus, the following hypothesis is proposed:

H1c: Lower PBC over KSB has a positive relationship with KSI of software developers working in GSDOs.

In accordance with TPB, the *"willingness to participate in a behavior*" is measured by the intention of an individual (Ajzen, 1991). A positive intention to share knowledge leads to a favourable situation of knowledge sharing behavior (Safa & Von Solms, 2016). Thus, the following hypothesis is proposed:

H1d: KSI is positively related to KSB of software developers working in GSDOs.

2.4.2 Knowledge Sharing Behavior and Social Cognitive Theory (SCT) in GSDOs

In social cognitive theory, "personal factors", "environmental factors" and "behavior" act as interrelating contributing elements which impact each other (Hsu, Ju, Yen, & Chang, 2007). Figure 2.4 presents the social cognitive theory:

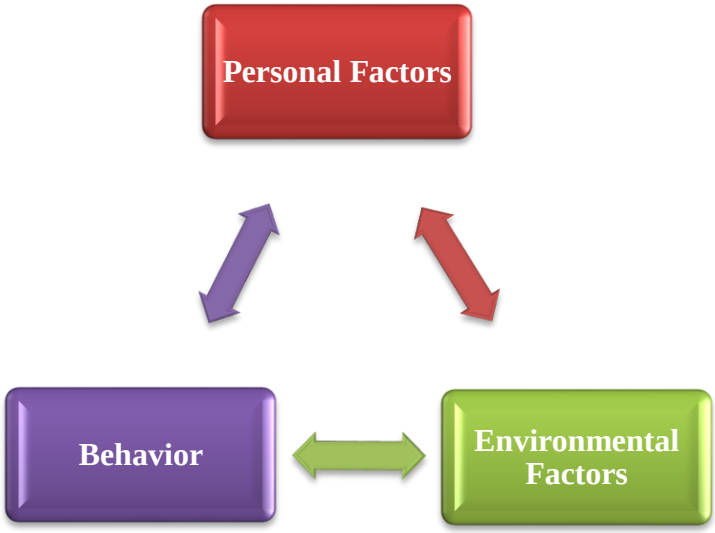

Figure 2.6: Social Cognitive Theory. (Bandura, A. 2002)

SCT states that individuals learn through their own experiences and by observing the "actions" and the "consequences of those actions" from other individuals (Stajkovic & Luthans, 1979). Appendix C summarizes the manner how previous studies have mapped various variables in SCT constructs "environmental", "personal" and "behavioral" (related to information technology and information systems).

2.4.2.1 Antecedents of Personal Factors of Social Cognitive Theory

As per the analysis of KSB factors in section 2.2.1, the factors with the 33 from the individual category (facilitator and barriers) have been included in the "personal" factors of social cognitive theory. Three factors namely "motivation" "social interaction" and "trust" had the highest frequency.

A. Motivation and KSB in GSDOs

A person who has no urge to act for a particular action is characterized as "*unmotivated*" whereas as someone who is eager toward an action is considered as "*motivated*" (Ryan & Deci, 2000). Individual's motivation is the key factor which strongly influences KSB. Participative motivation is positively related to KSB. Self-motivation influences the KSB process positively (Balaji, 2011; Ghobadi, 2015). Zykov et al. (2015) found that individual's motivation impacted KSB process. Previous studies suggested that motivation is linked up with individuals needs which encourage people to involve in a specific behavior

(Ryan, Lynch, Vansteenkiste, & Deci, 2011). In *"Self-Determination Theory"* two types of motivations have been defined based upon different reasons or goals that give rise to an action. The division is between intrinsic motivation, "*which refers to doing something because it is inherently interesting or enjoyable*", and extrinsic motivation, "*which refers to doing something because it leads to a separable outcome*" (Ryan & Deci, 2000). Previous literature considers motivation as a "personal factor" (Safiullah, 2015). Motivation has been related to *"person's internal nature"* that accepts "positive incentives" and rejects "negative incentives" (Safiullah, 2015). Based on this literature the proposed framework includes "motivation" as a "personal factor", with the following hypothesis:

H2a: High motivation has a positive relationship with KSB of software developers working in GSDOs.

B. Social Interaction and KSB in GSDOs

Social interaction in the relationship which exists between *two or more individuals* (Andersen & Taylor, 2012). In previous researches KSB has been found to be strongly influenced by social interactions and relationships. Zahedi et al. (2016) suggested that stronger social interactions between individuals allowed faster information exchange. Furthermore, authors observed social interaction and relationships play an important role in KS (Wendling et al., 2013) and strongly affect KSB (Tamjidyamcholo et al., 2014). A survey comprising of 150 software developers was conducted to determine voluntary

KS mechanisms in software project teams in Sri Lanka. It was found that personal interactions positively impacted KSB (Wickramasinghe & Widyaratne, 2012). Thus, this study includes "*social interaction*" as a "personal factor" with the following hypothesis:

H2b: Social interaction has a positive relationship with KSB of software developers in GSDOs.

C. Trust and KSB in GSDOs

Trust significantly impacts both tacit and explicit KSB (Ghobadi, 2015). To facilitate KSB between globally distributed individuals, trust plays a significant role (Wickramasinghe & Widyaratne, 2012). Interpersonal trust positively effects KSB. Furthermore, trust between remote sites can be enhanced by promoting visits between globally distributed sites which can eventually build up trust (Kroll et al., 2016; Noll et al., 2010). Individuals with greater reliability, transfer knowledge frequently to their trusted peers (Zahedi et al., 2016). Therefore, in this study "trust" has been included as a "personal factor", leading to the following hypothesis:

H2c: Trust has a positive relationship with KSB of software developers working in GSDOs.

Figure 2.5 presents the antecedents of "personal factors" of SCT used in this research.

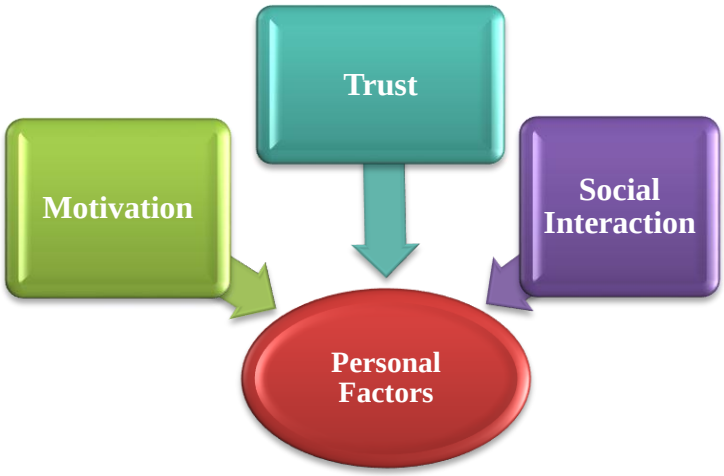

Figure 2.7: Antecedents of Personal Factors of Social Cognitive Theory

2.4.2.2 Antecedents of Environmental Factors of Social Cognitive Theory

Environmental factors of SCT includes the "social/physical" environment (Battle, 2009). The environment is composed of "physical" and "social" dimensions. The social environment is composed of the groups to which humans belong, the workplaces and the relevant strategies formed to direct lives (Yen & Syme, 1999). Social environment also comprises of cultural surroundings in which people interact with each other (Casper, 2001). As per the analysis of KSBF in section 2.3.1 (pages 35 - 43), "linguistic distance" had the highest frequency from the cultural category (facilitator and barriers). Therefore, "linguistic distance" has been added in the "social factors" of SCT. Physical environment constitutes of sum of all physical entities all over the organizations (Darrin & Krill, 2016). As per the analysis of KSBF in section 2.3.1 (pages 35 - 43), "geographic distance" and "time zone difference" had the

highest frequencies in the "geographic" category. Therefore, these factors have been included in the "physical" category of SCT. Figure 2.6 presents the antecedents of "environmental factors" of SCT.

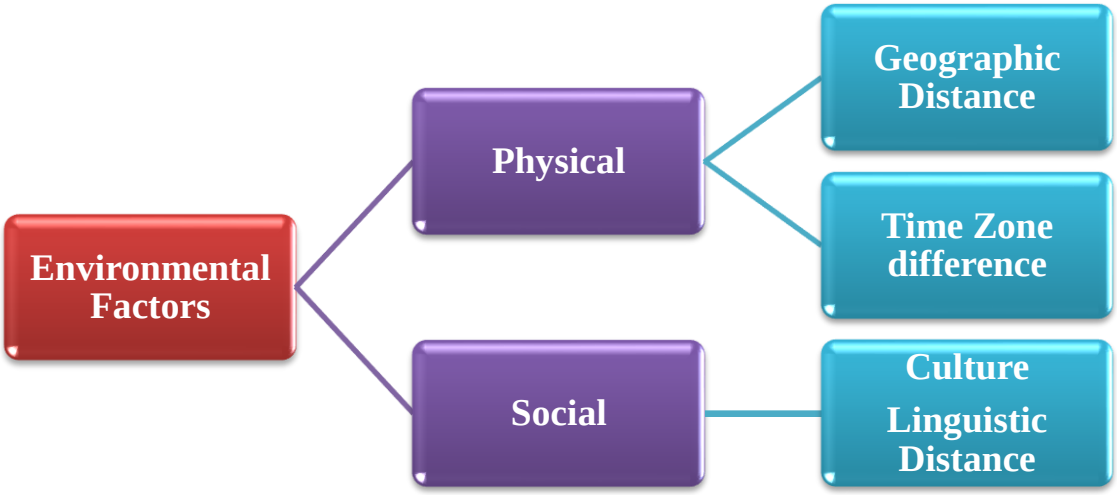

Figure 2.8: Antecedents of Environmental Factors of Social Cognitive Theory (SCT)

2.4.2.3 Antecedents of Physical Factors of Social Cognitive Theory

Previous literature suggest that the behavior of organizational members gets influenced by the physical layout of workplaces (Oldham & Rotchford, 1983). The outcome of constant interaction between social and physical environment contributes in the overall formation of any environment (Yen & Syme, 1999). To achieve mutual goals various professionals, work together from different geographic physical locations in GSDOs. Due to geographic distance individuals face communication issues as face to face communication is not easily not

possible. Similarly time zone difference creates obstacles in real time communication because of difference in working hours of distributed employees (Kotlarsky & Oshri, 2005). The antecedents of environmental factors of social cognitive theory are shown in Figure 2.7.

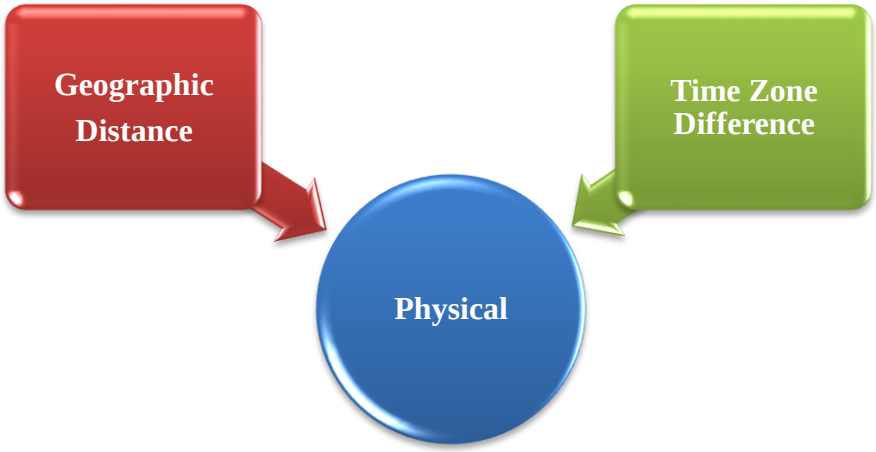

Figure 2.9: Antecedents of Environmental Factors of Social Cognitive Theory (SVT)

A. Geographic Distance and KSB in GSDOs

The distance between geographically dispersed members acts a barrier (Noll et al., 2010) and causes communication issues (Alam et al., 2012). Physical distance between subproject participants prevented informal communication (Ali, Beecham, & Mistrik, 2010). KS process becomes easier when individuals meet casually, which happens when the distance between individuals is not a concern. However in case of growing software development organizations, the growing distance between distant members hinders KSB (Kukko, 2013). Face to face communication is also difficult when large distance is involved, and hence communication becomes

difficult as compared to nearby employees (Alam et al., 2012; Betz et al., 2014). Distance was also mentioned as barrier by an interviewee as it limits the connectivity to the right resources (Wendling et al., 2013). Distanced members also face misunderstanding and project visualization challenges (Razzak & Ahmed, 2014). Therefore, "*geographic distance*" is found to negatively affect KSB of software developers working in GSDs, leading to the following hypothesizes:

H3a: Geographic distance is negatively related to KSB of software developers working in GSDOs.

B. Time Zone Difference and KSB in GSDOs

Time zone difference makes communication difficult and challenging between distributed employees (Ghobadi & Mathiassen, 2016; Moe, Fægri, Cruzes, & Faugstad, 2016; Noll et al., 2010; Razzak & Ahmed, 2014). Difference in time zone decreases the mechanisms of KSB and creates communication gaps between distant workers (Wendling et al., 2013; Zahedi et al., 2016). Time zone variance is found to negatively impact knowledge transfer and overall success of any project (Betz et al., 2014). Delays in overall project execution and delivery occur due to absence of synchronous collaboration because of difference in time zone (Aranda et al., 2010). Based on this literature "*time zone difference*" was included in the physical factor of the SCT, leading to the following hypothesis:

H3b: Time zone difference is negatively related to KSB of software developers working in GSDOs.

2.4.2.4 Antecedents for Social Factors of Social Cognitive Theory

The antecedent for social factors of social cognitive theory used in this study is shown in Figure 2.8.

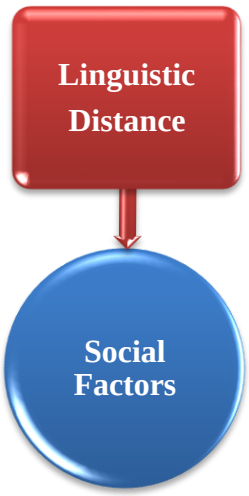

Figure 2.10: Antecedents of Social Factor of Social Cognitive Theory (SCT)

A. Linguistic Distance and KSB in GSDOs

In today's era GSDOs comprise of individuals with various cultural backgrounds and encounter cultural differences such as "Linguistic distance", "variations in traditions", "values" and "norms of behavior" which may lead to misinterpretation (Baumard, 1999; Zhang & Du, 2011). Linguistic distance creates communication issues between individuals (Zahedi et al., 2016). Many studies such as Ghobadi & Mathiassen (2016), Kroll et al., (2016), Kukko,

(2013), Noll et al., (2010), Razzak et al., (2013) and Zahedi et al., (2016) have reported difference in language as one of the top most barrier for KSB in GSDOs. Individuals working in globally distributed locations found it very problematic to share knowledge because of Linguistic distances (Zahedi et al., 2016). Having individuals with heavy accents also made communication very difficult (Betz et al., 2014; Wendling et al., 2013). Individuals whose native language was not English e.g. German (Betz et al., 2014) or Chinese (Chen et al., 2016) suffered from communication issues which resulted in improper flow of knowledge and information exchange. Additionally, when the native language is not same, the diversity in terms of a common language (usually English) also lead to various problems and misunderstandings (Aranda et al., 2010). Thus, following hypothesis is proposed:

H3c: Linguistic distance is negatively related to KSB of software developers working in GSDOs.

2.4.3 Knowledge Sharing Behavior and Triandis Model Facilitating Conditions

The Triandis model has been used widely to predict intentions and forecast behaviors (Tamjidyamcholo et al., 2014). In this research only one element namely "*facilitating conditions*" from the Triandis model was included in the proposed framework. According to Triandis, an individual may intend to do perform an action, but is incapable to achieve it because of hindrances resulting from "geographical barrier".

To surpass these types of hurdles, Triandis introduced "*facilitating conditions*" to forecast behavior (Tamjidyamcholo et al., 2014).

2.4.3.1 Antecedents of Facilitating Conditions of Triandis Model

"Facilitating conditions" are defined as the include *"objective factors within the environment to which observers agree will enable certain behaviors to be performed with ease*" (Robinson, 2010, p. 31). "Facilitating conditions*"* also refer to the extent to which "technological" and "organizational" infrastructure needed to use the desired system is essentially available (Ghalandari, 2012). As per the analysis of KSBF in section 2.3.1 (pages 35 - 41), "technological support" had the highest frequency in the "technological" category. Similarly, "organizational support" had the highest frequency in the "organizational" category. Therefore, in the context of this research, this research proposes that "*facilitating conditions*" include "*technological support*" and "*organizational support*" (Ghalandari 2012, Tamjidyamcholo, Baba et al. 2014, Safa and Von Solms 2016). Figure 2.9 presents the antecedents of facilitating conditions of Triandis model:

Figure 2.11: Antecedents of Facilitating Conditions of Triandis Model

A. Technological Support and KSB in GSDOs

Technological support plays a significant part in promoting KSB in GSDOs (Zahedi et al., 2016). Latest knowledge management tools like "wiki, pair-programming" and "video-conferencing" (Noll et al., 2010) facilitate KSB in distributed agile members (Razzak & Ahmed, 2014). Various enabling technologies (Kroll et al., 2016) and tools cater to the needs of distributed stakeholders in the decision making promote KSB (Ali et al., 2010). In order to facilitate KSB software organizations, make use of "*technical and electronic discussion boards"* (Razzak & Ahmed, 2014). The technical boards enable individuals to share information, experiences and technical skills for a specialized discipline. Electronic discussion boards allow individuals to share task lists, latest technical and business information. Additionally, visual prototypes are created to solve issues of miscommunication between onshore and distributed individuals (Razzak & Ahmed, 2014). KS tools act as a key success factor and enable necessary for KS culture among individuals (Al Attar

& Shaalan, 2016). In order to facilitate KS, both synchronous (instant messaging, video conferencing) and asynchronous (e-mailing) communication tools, are required depending upon needs for different purposes (Noll et al., 2010). Distributed members used synchronous communication method such as "*instant messaging*" to share knowledge (Razzak, Ahmed, & Mite, 2013). Geographically distributed individuals also make use of tools such as "intranets, groupware", "teleconferencing", "videoconferencing" and "online chats" *to* easily exchange information (Wendling et al., 2013). Furthermore, physical meetings can be substituted with communication tools (Betz et al., 2014) for example, spatial knowledge with remote members was shared using communication tools instead of doing physical meetings (Razzak et al., 2013). It was observed in a study that analysing individual's preferences (based upon their cognitive characteristics) can help in selecting the most suitable tool. This technique of selection of groupware tool in return improved stakeholders' satisfaction with requirement specifications shared between distributed members (Zahedi et al., 2016). The following hypothesis is therefore proposed:

H4a: Technological support has a positive moderating relationship with KSB of software developers working in GSDOs.

B. Organizational Support and KSB in GSDOs

Various studies have laid focus on the importance of proper organizational infrastructure which support KSB (Al Attar & Shaalan, 2016; Betz et al., 2014; Chen et al., 2016; Ghobadi, 2015; Iskoujina & Roberts, 2015; Kroll et al., 2016; Noll et al., 2010; Šmite et al., 2017; Zahedi et al., 2016). An autonomous team, where individuals have the freedom and independence, leads to frequent communication and thus permits knowledge transfer (Ghobadi, 2015). A proper organizational design facilitates KSB between individuals by defining clear roles and responsibilities for its members (Ghobadi, 2015; Zahedi et al., 2016). Razzak & Ahmed (2014) found that "*common chat rooms*" facilitated communication and enabled faster knowledge exchange (Razzak & Ahmed, 2014). Flexible communication and team hierarchy enables KS by facilitating communication at different stages in GSD (Zahedi et al., 2016). Proper documentation (Moe et al., 2016) such as business documents, systematic reviews, codification and artifacts serves as a reference point for communicating and sharing knowledge (Zahedi et al., 2016). Proper utilization of available infrastructural assets before commencing a project can help in streamlining the knowledge transfer process (Betz et al., 2014). Supportive organizational culture with tolerance to accept failures by mangers also leads to a constructive relationship with KS (Chen et al., 2016). Balaji (2011) suggested that by proper implementation of mechanism to retain knowledge of old employees for new employees can help in promoting KS culture. Moreover, onshore mangers may minimize the misinterpretations by reducing the need of complex domain knowledge with distributed employees e.g. the parts of the project which have

to go through legal rules (e.g., integrations and data migration) may not be assigned to individuals working at distributed site (Zahedi & Babar, 2014). This study proposes the following hypothesis:

H4b: Organizational support has a positive moderating relationship with KSB of software developers working in GSDOs.

2.4.4 Knowledge Sharing Behavior and Job Performance (JP) in GSDOs

JP refers to the *"overall expected value of employees' behavior's carried out over a set period of time"* (Motowildo, Borman, & Schmit, 1997, p. 229). The terms "job performance" and "work performance" have been used interchangeably in previous literature (Koopmans et al., 2011). JP is a multi-dimensional concept (Sonnentag, Volmer, & Spychala, 2008) and it is made up of multiple dimensions, which in turn, are made up of indicators which can be measured directly (Koopmans et al., 2011). By sharing knowledge individual not only exchanges ideas but also learn new things from co-workers. In this way "learning capabilities" of individual's are improved, which in return enhances individual's job performance (Kang et al., 2008). Park and Im, (2001) suggested that KSB improves JP of individuals (H. Park & Im, 2001). Furthermore, KSB improves performance by providing innovative solutions to business problems (M. T. Hansen, 2002). Hoopes & Postrel (1999) carried out in a study in software company, which focused on *"developing scientific software"* It was demonstrated that *"shared knowledge", "collegial cooperation,"* and *"project coordination"* influenced *"staff performance in product specifications"*

(Hoopes & Postrel, 1999). Park (2014) carried out a study to determine the impact role of dependence and trust in knowledge sharing in information systems projects. Data was collected from 135 project teams in two large IT firms. It was observed that dependence and trust had a strong impact on knowledge sharing, which to good team's project performance (Park & Lee, 2014). Zhang and Du (2011) conducted a study to determine impact of "cultural difference" on knowledge sharing in IT-based service outsourcing. The data was collected from the employees who involve in the outsourcing projects. It was found that shorter *"cross cultural distance"* positively impacted KS in *"trust building"*. Stronger *"relationship quality"* and KS were found to improve "outsourcing performance" (Zhang & Du, 2011). Chen et. al (2016) conducted a study to study analyze the impact of implicit and explicit knowledge sharing on the performance of open source service projects. The results showed that KS has a positive relationship with performance of OSS projects with respect to the Chinese context (Chen et al., 2016). Wang & Wang (2012) found that explicit KS had significant effect on *"innovation speed"* and *"financial performance"* while tacit knowledge sharing has more significant effects on *"innovation quality"* and *"operational performance"*.

With regards to GSD the relationship between KSB and JP has been rarely explored and most of the studies have focused on "project performance" (Chen et al., 2016), outsourcing performance (Zhang & Du, 2011) and *"operational performance"* (Wang & Wang, 2012). According to employee's opinion, JP is fundamentally the outcome of a series of behavior's. (Munisamy, 2013). As the

focus of current research is particularly on the KSB of software developers, so this research intends to investigate the impact of KSB on individual's (software developers) JP. Accordingly, the conceptual frameworks incorporate JP as an outcome of KSB. Hence, this following hypothesis is proposed:

H5: KSB is positively related to the job performance of software developers working in GSDOs.

Figure 2.10 presents the baseline used to create the conceptual framework.

Figure 2.12: Conceptual Framework Baseline

Figure 2.11 presents the conceptual framework. used in this study.

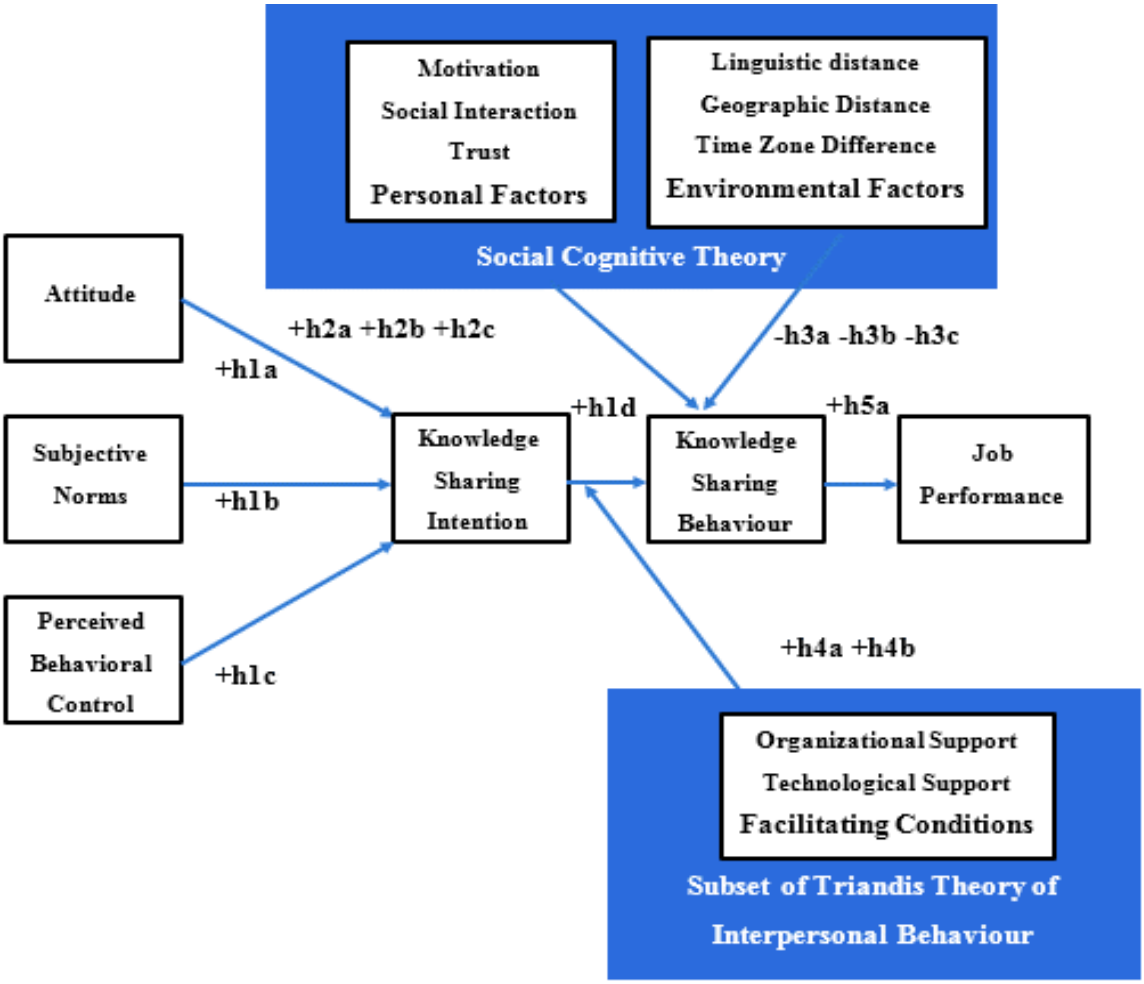

Figure 2.13: Conceptual Framework for Knowledge Sharing Behavior in Global Software Development Organizations

2.1 Chapter Summary

In this chapter previous literature regarding KSB factors have been discussed. This chapter also reviewed the literature about various theories including, theory of planned behavior, social cognitive theory and Triandis theory of interpersonal behavior. The findings from the literature review have been used as a base to develop the conceptual framework. At the end, chapter two presented the conceptual framework which served as a basis for the research model.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Overview

This chapter will focus on the research methodology used to conduct the study. Research process, data collection, questionnaire development and the measurement items shall be discussed in detail. In the last section the research quality and ethics shall be discussed

3.2 Research Process

The research onion proposed by Saunders et. al (2011) has been followed in this research. The research onion presented in Figure 3.1 demonstrates the stages which shall be covered while proposing a research strategy. Each single layer of the research onion describes a more comprehensive stage of the research process.

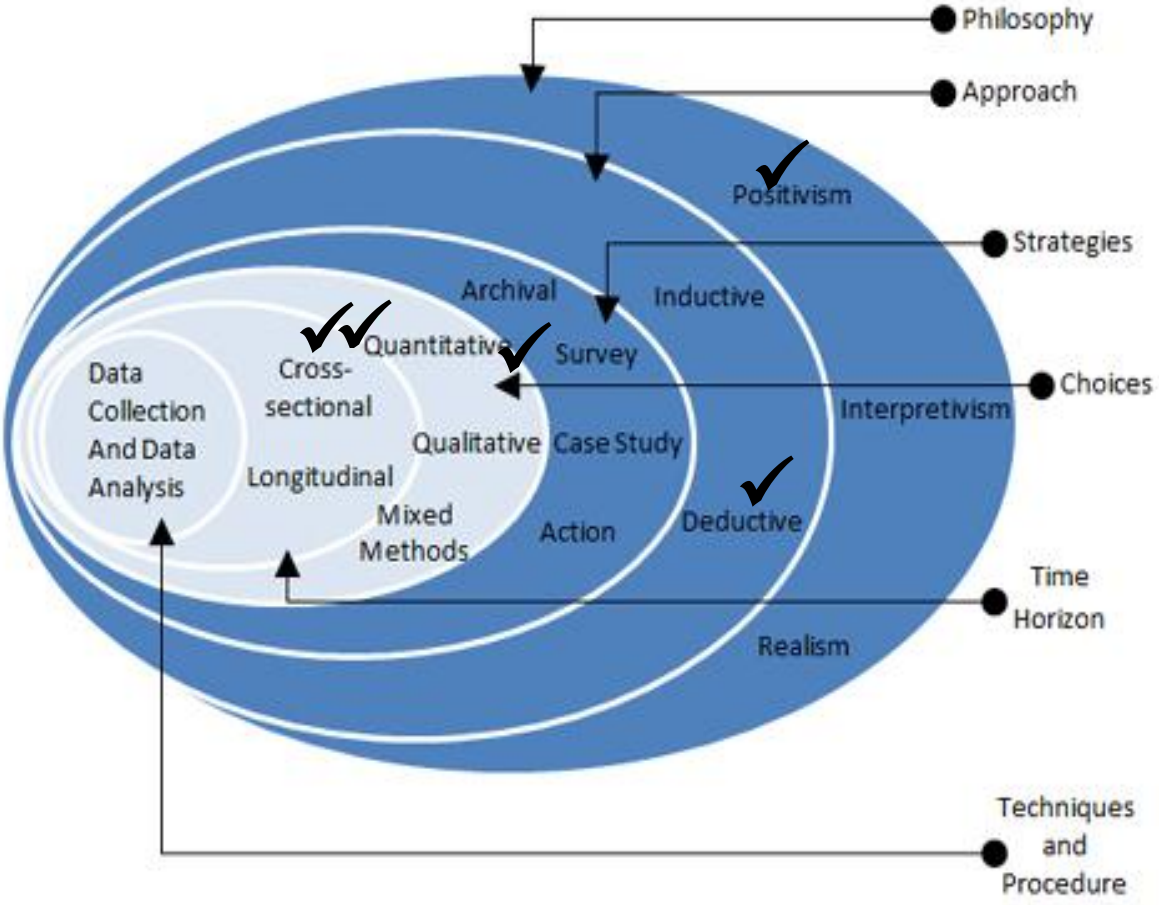

Figure 3.1: Saunders Research Onion (Saunders, 2011)

3.3 Research Philosophy

Research philosophy term precisely "*relates to the development of knowledge and the nature of that knowledge*" (Saunders, 2011, p. 128). Research philosophy is related to the development of knowledge in a field. The development of knowledge might not necessarily be a new theory, but even with a minor purpose of a specific problem it is nonetheless development of new knowledge (Saunders, 2011). There are three dimensions of research philosophy namely "positivism", "interpretivism" and "realism". In interpretivism knowledge is considered as

"*subjective"* in nature, which is "*socially constructed*" and may change multiple times. In interpretivism, knowledge is not considered "objective" but is transmitted to us through ideas and experiences. On the other hand, positivists discover the world from a "unidirectional" viewpoint and knowledge is considered "*objective and independent of social factors*" (Saunders, 2011). Hence, logical questioning is applied to the research (Hussey & Hussey, 1997). Hypothesis are deducted from principles and later statistically tested. Subsequently human behavior is discovered through data collection only. It focuses on using of existing theory as opposed to creating a new theory (Perry, Riege, & Brown, 1999). Realism considers "*that objects have an existence independent of the human mind*." (Saunders, 2011). Realists attempt to bind qualitative and quantitative designs together (Perry et al., 1999). According to realism "*reality is quite independent of the mind" (*Saunders, 2011).

For this research "*positivist*" research philosophy was used, as it makes use of the scientific perspective. It allowed the researcher to make an observation about a social behavior or condition, construct a hypothesis, test the hypothesis and finally analyze the results (Saunders, 2011). This philosophy has been selected as current research shall be based upon utilization of existing theory (Guba & Lincoln, 1994). This researched is focused towards examining the KSB of software developers by analyzing certain variables (independent and dependent), as researcher can make use of "scientific perspective" while witnessing social behavior with an objective

examination possible (Travers, 2001), therefore, this research followed positivist philosophy.

3.4 Research Approach

Depending on the nature of the project, research approach can either be deductive or inductive. In deductive approach a conceptual framework is developed first, and it is tested via data collection at the later stages of research. In deductive approach researcher is independent of what is being observed and theory and hypothesis is developed first (Saunders, 2011). Contrary to deductive approach is the inductive approach which has "*less concern with the need to generalize*" the results and the researcher becomes the part of the research progression. Induction has a "flexible structure" which allows to make alterations at advanced stages of research. In induction data is collected first and later a theory is proposed based upon the data analysis (Saunders, 2011).

The research work is deductive in nature as this study explains the relationship between variables, tests the hypotheses and draws conclusion the basis of data analysis. (Saunders, 2011). As positivist studies usually adopt deductive approach (Crowther & Lancaster, 2012), therefore deductive approach is recommended for this research.

3.5 Research Strategy

Survey research strategy is the normally associated with deductive approach (Saunders, 2011). The survey strategy is used when the researcher needs to acquire information from large number of people. The determination of the researcher is to attain widespread coverage which is represents the desired "research population". Survey allows to easily describe the situation and study relationship between variables. Furthermore, survey assures respondents secrecy while answering questionnaires, which eventually provide more honest answers. With such high reliability obtained, the researcher's own biases are eliminated (Saunders, 2003) . As the nature of our research requires to "study relationships between variables", *"cover a large sample size"*, *"maintain privacy of survey respondents"* and conclude *"precise results*", therefore a survey is recommended. In this research *"surveys"* was used as research strategy.

3.6 Choices: Mono Method

Research choices are divided in to two broad categories: mono method and mixed method. The mono-method involves using "one research approach" for the collection of data (Saunders, 2011). Mono-method study uses either quantitative or qualitative methods to conduct research. Mixed methods research approach *"combines quantitative and qualitative research methods in the same research inquiry"* (Venkatesh, Brown, & Bala, 2013). The research choice relies upon the nature and objectives of the intended study (Saunders, 2011). Barbour (1998) argued that issues usually arise by mixing of methodologies (Barbour, 1998). Also

authors argued that mixed method research is not superior to mono method research (Cameron & Molina-Azorin, 2010). Sale et al., (2002) argued that results of two paradigms might not produce similar results due to the difference in two phenomena (Sale, Lohfeld, & Brazil, 2002). By combining both quantitative and qualitative approaches the potential of "*unanticipated outcomes"* is increased. Further, mixed method researches are generally more "time-consuming" and "complex" as "qualitative phase" and "quantitative phase" need to be conducted concurrently (Whitehead & Elliott, 2007).

Based on these arguments, mono-method study was selected for this research. Positivism is typically associated with quantitative research methods such as experiments and surveys (Bhattacherjee, 2012). The proposed research used quantitative approach, as it is effectively used for situations with "large respondents number", where the "data can be effectively measured using quantitative techniques", and where "statistical methods of analysis can be used" (May, 2011).

3.7 Time Horizons

There are two choices for time horizon cross sectional time horizon and longitudinal. Cross sectional studies can be referred as the "*snapshot*" of time collection, where the data is collected at a "certain point". Longitudinal studies can be referred as "*diary*", as data is collected over a longer period.

Cross sectional approach is used when the examination is related to the study of a "specific phenomenon" at a "specific time" (Flick, 2015). In this

research, the data was collected at a single point using cross sectional time horizon. The advantage of cross-sectional data is that, data can easily be organized. It takes less in conducting the study and is cost effective approach. Another reason for choosing this option is due to the academic research which is usually time bound. The most common method for cross sectional method is "survey", which was incorporated in this research (Easterby-Smith, Golden-Biddle, & Locke, 2008).

3.8 Data Collection and Analysis

"Questionnaire" is the technique, researchers conducting survey mostly lean towards because of its popularity. It allows respondents to have adequate time to give well thought out answers (Kothari, 2004). This proposed study used questionnaire as the main source of primary data. Feedback from questionnaire was collected from software developers working in Malaysian GSDOs.

3.9 Research Technique and Procedure

Positivist approach followed by quantitative methodology was applied. Questionnaires were used to collect the data in survey. Finally, statistical analysis was performed on the data collected.

3.10 Purpose of Research

The research purpose is often classified into three major categories: exploratory, descriptive and explanatory. However, a research may be both descriptive and explanatory and may have more than one purpose (Saunders, 2011). The purpose of the research may also change over time (Robson, 2002). The current study comes under the category of *"descripto-explanatory"*. The first portion of research revolves around determining the factors (barriers and facilitators) related to knowledge sharing behavior. Second stage is to explain how these factors impact the knowledge sharing intention and behavior. Thus, the emphasis is on a problem which focused to explain the relationship between different variables (explanatory research) (Saunders, 2011). The second portion of the study aims to determine the impact of KSB of software developers on JP working in GSDOs. Thus, this portion of research intends to provide explanation that how knowledge sharing behavior is related (explanatory study) (Saunders, 2011) to JP (positively or negatively).

3.11 Types of Research

There are two types of researches: basic and applied research. Both have different aims. Basic research helps in enhancing researchers understanding about a specific problem, whereas applied research as the name suggests is done with the intention to develop new products, ideas and goods. The results can be applied to a specific problem (Sekaran & Bougie, 2016; Shapiro & Taylor, 2013). In the basic research, the research topic and objectives are selected by the researcher and is

usually undertaken by students in universities. In applied research the objectives are determined by the organizer and can be undertaken by people working in organizations or universities (Saunders, 2011). The current research is basic research, as it tries to expand knowledge base rather than focusing on invention. The current research emphasized on answering the problems related to the KSB of software developers working in GSDOs.

3.12 Questionnaire Development

Questionnaire design is the most vital component in the research which has great influence on the data selected (Burns & Bush, 2003). The questionnaire was adapted from the existing literatures. The variables in this research are given in Table 3.1.

Table 3.1: Questionnaire Development

Variable	Adopted/Adapted	Measurement Items	Author
Attitude (ATT)	Adapted	1. To me, sharing knowledge with my co-workers is good. 2. To me, sharing software development knowledge with my co-workers is harmful. 3. To me, sharing software development knowledge with my co-workers is enjoyable experience. 4. To me, sharing software development knowledge with my co-workers is valuable. 5. To me, sharing software development knowledge with my co-workers is a wise move.	Bock et al., (2005); Taylor & Todd, (1995)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Subjective norms (SN)	Adapted	1. People who influence my behavior (e.g. boss, co-worker etc.) think that I should share my software development knowledge and expertise. 2. People who are important to me (e.g. boss, co-worker etc.) think that I should share my software development knowledge and expertise. 3. Generally speaking, I try to follow the CEO's policy and intention. 4. Generally speaking, I accept and carry out my boss's decision even though it is different from mine. 5. Generally speaking, I respect and put in practice my co-worker's decision.	Bock et al., (2005); Taylor & Todd, (1995)
Perceived behavioral control (PBC)	Adapted	1. I have the ability to share my knowledge with my co-workers. 2. I have the useful resources to share my knowledge with the other employees. 3. Sharing my software development skills is currently within my control. 4. Sharing my knowledge related to *"software construction tools and technologies"* is currently within my control.	Bock et al., (2005); Taylor & Todd, (1995)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Social interaction (SI)	Adapted	1. I maintain close social interaction with some of my co-workers. 2. I spend a lot of time sharing knowledge with some of my co-workers. 3. I have frequent exchange of knowledge with some of my co-workers. 4. I have frequent exchange of software development ideas with some of my co-workers 5. I like to share my software expertise to some members whom I know on personal level.	Huang (2009)
Trust (TR)	Adapted	1. I believe that my co-workers can be trusted completely to share knowledge. 2. I believe that my co-workers software development knowledge is reliable. 3. I believe that my co-workers software development knowledge is useful. 4. I believe that my co-worker software development knowledge is effective. 5. I believe that my co-workers would not take advantage of my software development knowledge that we share. 6. I believe that my co-workers can't be trusted completely to share knowledge.	Safa and Von Solms (2016)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Motivation (MOT)	Adapted	1. I enjoy sharing knowledge with my co-workers. 2. It feels good to share my software development techniques with my co-workers to solve their work related problems. 3. Sharing knowledge with my co-workers gives me pleasure. 4. Sharing my knowledge improves others recognition of me. 5. When I share my software development knowledge with my team members, my superiors respect me.	Kankanhalli, Tan, & Wei (2005); Wasko & Faraj (2005)
Technological support (TS)	Adapted	1. Whenever I want to share knowledge, I can easily access tools and technology in our organization. 2. In our organization, tools and technology for sharing knowledge are reliable. 3. Tools and technology for sharing knowledge can be customized to fit individual needs. 4. I share knowledge by inputting it into knowledge repository/company databases (containing existing expertise, lessons learned, best practices etc.). 5. I use discussion forum (using tools like electronic bulletin board, chat room etc.) to share knowledge with my co-workers. 6. I use videoconferencing to share knowledge with my co-workers.	Chennamaneni, (2007)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Organizational support (OS)	Adapted	1. "*Knowledge sharing culture*" is of great value in my organization. 2. My organization encourages knowledge sharing activities (workshops, trainings, group discussions, seminars, visits etc.) for new opportunities. 3. The management awards employees for taking part knowledge sharing activities. 4. The management develops adequate plans and schedules for the implementation of knowledge sharing activities. 5. My organization puts much value on sharing knowledge and taking risks even if that turns out to be a failure.	Bock et al., (2005), Safa and Von Solms (2016)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Knowledge sharing intention (KSI)	Adapted	1. If given opportunity, I will always share my work reports and official documents with members of my organization more frequently in the future. 2. If given opportunity, I will always share my manuals, methodologies and models for members of my organization. 3. If given opportunity, I will always share my know-where or know-whom at the request of other organizational members. 4. If given opportunity, I will always share my expertise from my education or training with other organizational members in a more effective way. 5. If given opportunity, I will share my experience or know-how from work with other organizational members more frequently in the future.	Bock et al., (2005); Taylor & Todd, (1995)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Knowledge sharing behavior (KSB)	Adapted	1. I frequently participate in knowledge sharing activities in my organization. 2. I frequently spend a lot of time conducting knowledge sharing activities in my organization. 3. I frequently share my software development knowledge with others. 4. When discussing a complicated issue, I am frequently involved in the subsequent knowledge sharing interactions. 5. I frequently involve myself in discussions of various software development topics rather than specific topics. 6. I frequently share my knowledge related to *"software construction fundamentals"* with others. 7. I frequently share my knowledge related to *"managing software construction"* with others. 8. I frequently share my knowledge related to *"practical software considerations"* with others. 9. I frequently share my knowledge related to *"software construction tools and technologies"* with others.	Davenport & Prusak (1998)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Linguistic distance (LD)	Adapted	1. Most people in my organization can communicate well in English. 2. Differences in language makes it difficult to share knowledge. 3. Linguistic diversity can make it difficult to communicate and collaborate across borders. 4. I believe Linguistic distance affects quality of knowledge sharing. 5. I believe my co-workers have to spend some time thinking about my software development knowledge to understand my real meaning. 6. Linguistic diversity in our organization opens cross-border software knowledge sharing opportunities.	Froese, Peltokorpi, & Ko (2012); Nordio et al., (2011); Unit (2012)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Geographic distance (GD)	Adapted	1. When working with cross-border co-workers, we incur losses due to ineffective knowledge sharing. 2. When working with cross border team, I lose time trying to figure out who to share knowledge regarding my work. 3. When working with cross border team, there have been times when I was accidently excluded from information which was shared by my co-workers. 4. When working with cross border team, it becomes difficult for me to find right people to whom I have to share my knowledge. 5. I believe geographic distance affects quality of knowledge sharing.	Herbsleb & Mockus (2003); Unit (2012)

Table 3.1: Questionnaire Development (Cont'd...)

Variable	Adopted/Adapted	Measurement Items	Author
Time zone difference (TZD)	Adapted	1. I believe time zone difference affects quality of knowledge sharing. 2. I believe time zone difference affects quality of software product development. 3. I believe time zone difference affects productivity of knowledge sharing. 4. I believe time zone difference causes communication overhead. 5. When working with cross border team, I experience difficulty in scheduling schedule common meeting times in order to share my knowledge with my co-workers.	Herbsleb & Mockus (2003); Nordio et al.,(2011)
Job performance (JP)	Adopted	1. I think that my ability to perform my job duties has improved as a result of knowledge sharing activities. 2. I think that my job-related communications have improved as a result of knowledge sharing activities. 3. I think that the reliability of my job performance has improved as a result of knowledge sharing activities. 4. I think that my knowledge-sharing activities have allowed me to properly play the roles given to me. 5. I think that my knowledge sharing activities have helped me to achieve the job duties that are required of me.	Williams & Anderson (1991)

3.13 Designing the Survey Instrument

Foddy (1994) emphasized that "*the question must be understood by the respondent in the way intended by the researcher and the answer given by the respondent must be understood by the researcher in the way intended by the respondent*" (Foddy, 1994, p.17). In this research four stages namely validity, readability, pilot study and mistake elimination were considered (Dillman, 2000).

3.13.1 Assessing Validity

3.13.1.1 Construct Validity

Previously, various researchers such as Safa et. al (2016), So & Bolloju, (2005), Jeon et al., (2011), Pi, Chou, & Liao (2013) have tested the "reliability" and "validity" of the measurement scales used with TPB. The second model used is the TIB (Triandis, 1977) which also has been validated in various studies (Safa & Von Solms, 2016; Tamjidyamcholo et al., 2014; Thompson, Higgins, & Howell, 1991).

3.13.1.2 Content Validity

Content validity which *"refers to the extent that the measure apparently 124 reflects the content of concept in question"* (Bryman & Bell, 2007, p. 165). The theoretical models which have been used in the current study have been earlier tested for their validity. This fact provides fair justification that collected data from the questionnaire certainly provides answers to the desired questions for which the researcher had intentions for.

3.13.2 Assessing Reliability

3.13.2.1 Assessment of Construct Reliability

Construct reliability assessment *"focuses on composite reliability as an estimate of a construct's internal consistency"* (Hair, Ringle, & Sarstedt, 2011, p. 145). The reliability of the measurement items was evaluated using an internal consistency analysis by means of coefficient alpha (Cronbach, 1951) in the "Pilot Study" (Section 3.14.2, Table 3.5, Page number 95). Cronbach alpha values 0.55 or higher are considered as satisfactory (Van de Ven, 1980).

3.13.1 Readability

The main focus in this stage is made on writing clear statements and questions with appropriate measurement scales, questions with proper format and font size (Radhakrishna, 2007). Following points were considered:

1. Instructions were given at the start of the questionnaire.
2. The researcher indicated what the questionnaire is measuring.
3. The words used in the questionnaire are understandable by the respondents.
4. The questionnaire addressed the objectives of the study.

3.14 Pre-Testing and Pilot Study

3.14.1 Pre-Testing

Pretesting is done to check the readability of the instrument (Baker, 2003). For pre-testing five respondents were selected including two IT faculty members, and three software developers. Their feedback on the questionnaire was considered to further refine the questionnaire. As stated earlier, the survey instrument used in this research has been developed from previously validated scales, so few minor corrections were made as presented in table 3.3.

Table 3.2: Revisions in Questionnaire after Pilot Study

Initial	Change Suggested	Action Taken	Revised
1. I frequently participate in knowledge sharing activities in my organization. 2. I frequently spend a lot of time conducting knowledge sharing activities in my organization. 3. I frequently share my software development knowledge with others. 4. When discussing a complicated issue, I am frequently involved in the subsequent knowledge sharing interactions. 5. I frequently involve myself in discussions of various software development topics rather than specific topics.	Add questions specifically related to software coding behavior	Four questions related to software coding specific behavior were added (making total 9)	6. I frequently share my knowledge related to "software construction fundamentals" with others. 7. I frequently share my knowledge related to "managing software construction" with others. 8. I frequently share my knowledge related to "practical software considerations" with others. 9. I frequently share my knowledge related to "software construction tools and technologies" with others.

Table 3.2: Revisions in Questionnaire after Pilot Study (Cont'd...)

Initial	Change Suggested	Action Taken	Revised
Age Group _____18 to 21 years old _____21 to 30 years old _____31 to 40 years old _____41 to 50 years old _____51 to 60 years old _____Above 60 years old	Revise the age group options	Options were reduced from 6 to 4	**Age Group** ☐ Less than 25 years old ☐ 25 to 35 years old ☐ 36 to 40 years old ☐ Above 40 years old
Level of education _____Some High School _____High School Degree _____Bachelor's Degree _____Master's Degree _____Doctorate Degree _____Other – Please Specify_____	Remove the School degrees, as they can't be qualified to work in software house	School degree options were removed	**Level of Education** ☐ Diploma ☐ Bachelor's Degree ☐ Master's Degree ☐ Doctorate Degree ☐ Other – Please Specify_____
Experience _____Under 2 years _____3 to 5 years _____6 to 10 years _____11 to 20 years _____21 to 30 years _____Above 30 years _____Others, Please Specify _____Not Applicable Never worked	Revise the age group options	Options were reduced from 8 to 3 "Others" and "Never worked" were removed	**Experience** ☐ Less than 5 years ☐ 5 to 10 years ☐ More than 10 years

3.14.2 Pilot Study

Pilot study allows the researcher to make necessary changes to reduce the unforeseen issues (Zikmund, 2003). Twenty respondents (software developers) participated in the pilot study. Respondent's demographic information is presented in table 3.4. "80.0%" of the pilot study participants were male and remaining "20.0%" were females. Most of the respondents had experience of 5-10 years (80.0%) and "20.0%" had "more than 10 years" of experience. "60.0%" were "25

to 35 years" old. Respondents who had master's degree formed "80.0%" of the total, whereas 20.0% had Doctorate degree. Table 3.2 presents the demographics of pilot study.

Table 3.3: Pilot Study Demographics

Gender	No of Respondents	Percentage
Male	16	80.0%
Female	4	20.0%
Age Group		
Less than 25	0	0.0%
25 to 35	12	60.0%
26 to 40	8	40.0%
Above 40	0	
Education Level		
Diploma	0	0.0%
Bachelors	0	0.0%
Masters	16	80.0%
Doctorate	4	20.0%
Others	0	0.0%
Work Experience		
Less than 5 years	0	0.0%
5 to 10 years	16	80.0%
More than10 years	4	20.0%
Job Title		
Software Developers	20	100.0%
Organization Size		
Less than 50	4	20.0%
51 to 100	12	60.0%
Above 100	4	20.0%

As discussed in section 3.13.2.1 "*Assessment of Construct Reliability*" (Page number 91), the reliability of the measurement items was evaluated using an internal consistency analysis by means of coefficient alpha (Cronbach, 1951). The Cronbach alpha values are presented in table 3.4 which demonstrates that variable items developed for this empirical investigation are reliable.

Table 3.4: Cronbach Values

Items	Cronbach's Alpha
Attitude	0.775
Geographic Distance	0.990
Job Performance	0.625
Knowledge Sharing Behavior	0.893
Knowledge Sharing Intention	0.650
Linguistic Distance	0.600
Motivation_	0.972
Perceived Behavioral Control	0.641
Social Interaction	0.650
Subjective Norms	0.972
Time Zone Difference	0.881
Trust	0.851
Technological Support	0.919
Organizational Support	0.990

3.15 Scale Design

Likert scales are commonly used because of their ease of use and understanding (Burns & Bush, 2003). Likert scales allow to measure respondent's opinions by "measuring their agreement/ disagreement" for each question (Zikmund, 2003). Commonly used scaling method is 1-5 although many researchers also use 7 or 9-point likert scale. Previous literature suggests using 5-point likert scale because it is less confusing, and it increases response rate (Buttle, 1996). Babakus and Mangold (1992) suggested to use five-point likert scales due to the reason, that it would decrease the "frustration level" of the respondents and

increase "response rate" and "response quality" (Babakus & Mangold, 1992). In this study 5 point likert scale was used as shown in figure 3.3.

SA means that you strongly agree with the statement (value = 5) A means that you agree with the statement (value = 4) N means that you are undecided about the statement (value = 3) DA means that you disagree with the statement (value = 2) SD means that you strongly disagree with the statement (value = 1)				
Strongly Disagree **SD**	Disagree **DA**	Neither Disagree nor Agree **N**	Agree **A**	Strongly Agree **SA**
1	2	3	4	5

Figure 3.2: Likert scale (Salkind, 2000)

3.16 Research Ethics and Generalization

3.16.1 Research Ethics

"Research ethics refers to the appropriateness of your behavior in relation to the rights of those who become the subject of your work, or are affected by it" (Saunders, 2011, P 183). When conducting a research, the researcher needs to follow the research ethics, such as not to manipulate the results for personal goals (Bhattacherjee, 2012). In this study the researcher made sure that all the participants were made aware that their participation is based upon voluntary basis and responses shall remain confidential. The purpose of the study was clearly shared with the respondents, so that respondents get clear idea about before participating in the survey.

3.16.2 Generalizability

Generalizability or sometimes called as external validity refers to "*whether the observed associations can be generalized from the sample used to the population or to other people, organizations, contexts, or time*" (Bhattacherjee, 2012). The main concern regarding generalization is whether the findings of the current research can be equally applied to other research settings or not such as other organizations (Saunders, 2011). The research was conducted with focus on software industry. Based on this domain, we can generalize the findings of this research to GSDOs. Further, the online questionnaire opened the possibility for the respondents from various regions, hence enhancing the generalizability of the study.

3.17 Sample Size and Sampling

Questionnaires provide several benefits which were crucial to the nature of this research. Few advantages described by (Recker) 2013 are given below:

1. Easy and inexpensive to manage to a large population.
2. Easy determination of the relationships of variables and constructs.
3. Can be used to forecast behavior.

3.17.1 Sampling

Sampling is categorized into two main categories namely: probability and non-probability sampling (Kumar, 2014). In non-probability sampling, the

researcher uses his/her own personal experience to make decisions (Zikmund, 2003), all samples are not given equal chance (Kumar, 2014) and sampling is not organized (Zikmund, 2003). In probability sampling results are more likely to accurately reflect the entire population and sampling is often associated with survey research design. Probability sampling is mostly used in quantitative research (Zikmund, 2003). Simple random sampling is the most frequently used method of selecting a probability sample (Kumar, 2014). In proposed research data was collected using simple random sampling technique.

Various studies have recommended different minimum sample size such as Gorsuch (1983) and Kline (1979), recommended a minimum 100 sample size. Hutcheson and Sofroniou, (1999) recommended 150, other authors recommended 200 (Guilford, 1954), and 250 (Hakistian & Catel, 1978). Generally, 100 is recommended as the "practical minimum sample size" while using SEM (Hair, 2009). Also, Cliff, (1987) recommended a sample size of 150 for 40 variables (item statements) in a scale. While using the partial least square (PLS) technique, sample size becomes "independent" of the number of indicators when the model is "reflective" (Chin et al., 2003). Chin et al.,(2003) stated that sample size needs to be "ten times" the construct which has the largest number of "indicators" towards it. Following this rule, in the proposed model either of the two "exogenous variables" can help to determine the sample size. The proposed model has two "exogenous variables" including total 14 indicators; 9 for KSB and 5 for KSI. This method suggests to use KSB to determine the sample size as it has highest number

of indicators. Hence, indicates 10 x 9= 90 as a suitable sample size (Chin et al., 2003). However, this research used 300 sample size, which exceeds the minimum sample size mentioned in the literature.

3.17.2 Response Rate

In this research the data was collected from Malaysian GSDOs. According to Malaysian annual industrial report 2015, a total number 2403 companies in Information and communication technology sector are actively working in Malaysia (Malaysia, 2015). As the sample size for this research is 300, hence 600 companies were contacted. This research used self-administrative questionnaires as it is mostly used by cross-sectional studies (Robson, 2002). The respondents included Software developers. Questionnaire was posted online on the website "www.surveyplanet.com" Table 3.4 and 3.5 presents the response rate details. Total 600 questionnaires were sent. 243 respondents refused to take part in the survey, 55 incomplete surveys were returned, and 302 valid responses were collected. "34.0%" of responses were collected from online survey and "55.7%" were collected from hard copy.

Table 3.5: Response Rate

	Online	**Hard Copy**	**Total**
Total Questionnaire Send	150	450	600
Incomplete	0	55	55
Refusal	99	144	243
Valid Responses	51	251	302

Table 3.6: Over All Response Rate

Source	Response Rate (%)
Online	34.0%
Hardcopy	55.7%
Total	50.33%

3.17.3 Examination of the Returned Questionnaires

Data collection was carried out from January 2017 to May 2017. Total 302 surveys were returned from respondents. Raw data was examined for "completeness", "respondent eligibility", and "accuracy" (Uma & Roger, 2003). Reminders were sent to respondents to complete the questionnaire. The survey letter is presented in APPENDIX D.

3.17.4 Demographics

Table 3.8 provides demographic details. Most of the respondents were male (78.15%). Female participation was 21.85%. The respondents were software developers and "71.85%" had "Less than 5 years" of experience, "18.54%" had "5 to 10 years" of experience and remaining "9.60%" had "More than 10 years of experience". "58.28%" of the respondents were in the age bracket of "25 to 35 years", "16.89%" were in the age bracket of "Less than 25", "11.26%" were in the age bracket of "26 to 40" and remaining "13.58%" were "Above 40" years of age. "56.62%" of the respondents had bachelor's degree, "23.84%" had Diploma, "17.88%" had master's degree and "1.66%" had Doctorate. "78.48%"

organizations had “Less than 50 employees”, “12.25%” had more than “100” employees and remaining “9.27%” had “51 to 100” employees.

Table 3.7: Demographics

Gender	Percentage
Male	78.15%
Female	21.85%
Total	
Age Group	
Less than 25	16.89%
25 to 35	58.28%
26 to 40	11.26%
Above 40	13.58%
Education Level	
Diploma	23.84%
Bachelors	56.62%
Masters	17.88%
Doctorate	1.66%
Others	0%
Work Experience	
Less than 5 years	71.85%
5 to 10 years	18.54%
More than10 years	9.60%
Organization Size	
Less than 50	78.48%
51 to 100	9.27%
Above 100	12.25%
Location	
Kuala Lumpur	16.56%
Cyberjaya	23.18%
Penang	12.25%
Melaka	3.97%
Perak	6.62%
Sabah	2.65%

3.18 Selected Software for Data Analysis

To test the hypothesis, SmartPLS 3 software was used (Hair et al., 2014). PLS-SEM approach was selected in this research assess the “measurement model” and “structural model”.

3.19 Chapter Summary

In this chapter research methodology and data collection has been discussed. Research philosophy, research approach, research strategy, research choice, research technique has been discussed. A survey instrument was developed to test the hypothesis. Pilot study was conducted with the purpose of improving and refining the questionnaire. After refining the questionnaire, 302 valid response were obtained. Demographic information regarding the sample has also been discussed.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Overview

This study has employed SEM-PLS, which has been used by many academics as it provides a robust way to analyze the survey data (Hair et al., 2011). PLS has been used as it is considered suitable to investigative complex "cause-effect-relationship" models (Henseler et al., 2009; Lowry & Gaskin, 2014) and it also does not imposes large sample size restriction and data distribution (Chin, 1998). Moreover, PLS has the potential to measure the measurement model and structural model simultaneously (Cheung et al., 2015). In the first stage the assessment of the adequacy of the "measurement model" is presented. In the second stage assessment and evaluation of the "structural model" is done. Structural equation modelling (SEM) has been adopted for data analysis. The validation of the structural model is achieved by using "SmartPLS 3.0".

4.2 Measurement Model Identification (Reflective vs Formative)

The identification of measurement model in research has a significant impact on the data analysis. Inattention to directional causality leads to serious consequences. There are namely two types of latent construct measurement models "reflective model" and "formative model". It is important for researchers to pay attention to the direction of causality between measures and constructs. two types of latent construct measurement models are reflective and formative (Freeze &

Raschke, 2007). Bollen & Lennox (1989) suggested a "three measure rule", according to this rule a single factor in a measurement models needs to have at least three indicators. construct with three reflective measures allows for the covariances among the measures to be used to estimate the factor loading. For formative models, "*two paths must emit from the measurement model. This is either done in isolation of the structural model (two reflective indicators) or within the structural model (paths emit to latent reflective constructs)"*. formative (Freeze & Raschke, 2007, p. 11). Based upon this, the framework used in this study is identified as "reflective model"

4.3 Measurement Model Assessment

The first step in PLS analysis is to analyse the "measurement model". The measurement model defines the "rules for correspondence" between measured and latent variables (Hair et al., 2009). Two main criteria are used to assess the measurement model which include "reliability" and "validity" (Ramayah, Lee, & In, 2011). Figure 4.1 presents the initial model for analysis used in this study.

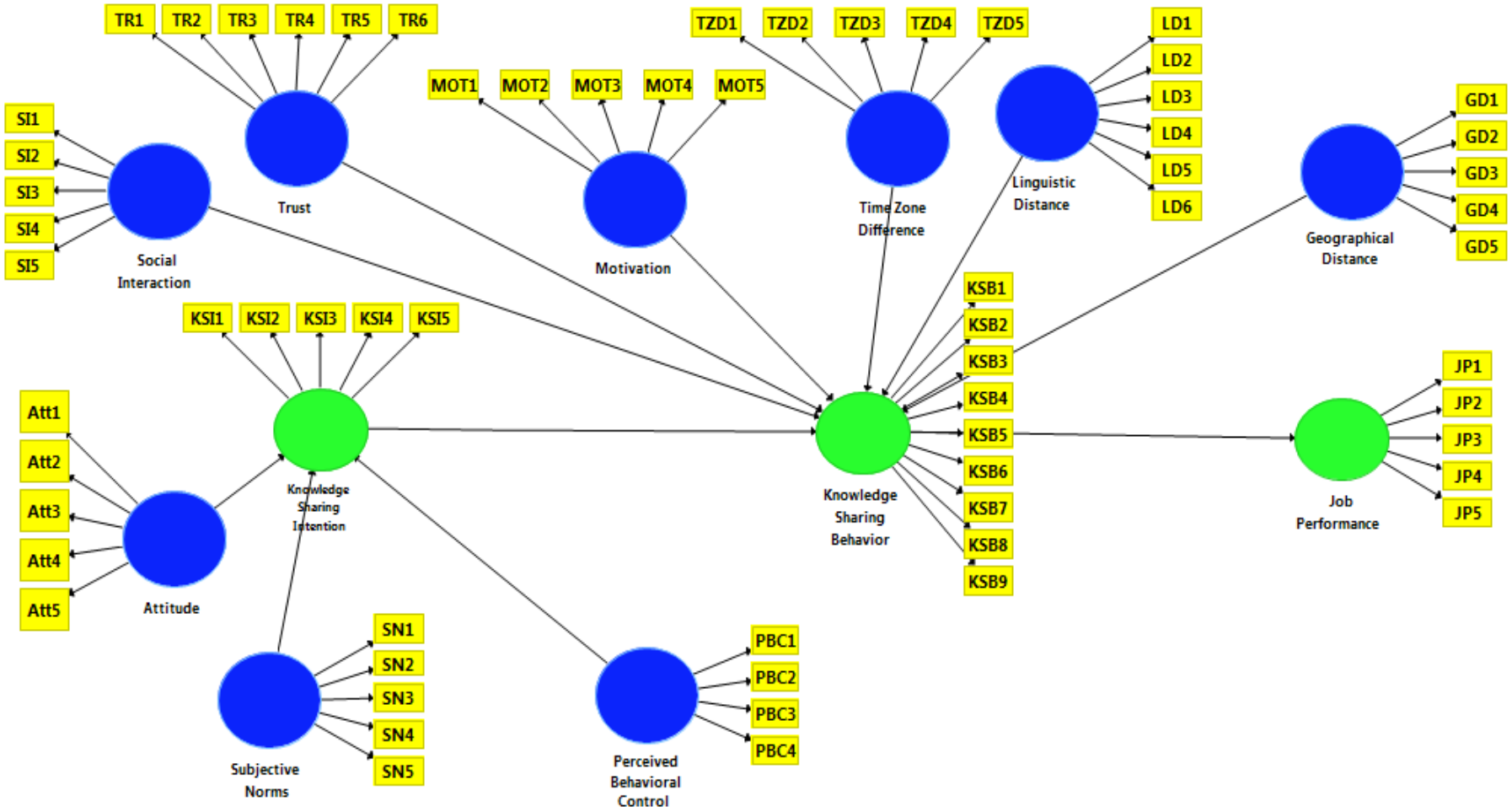

Figure 4.1: Conceptual Model

4.3.1 Assessment of Construct Reliability

According to (Hair et al., 2011) reliability extends to which a variable or set of variables is consistent in what it is intended to measure". The suggested value for construct reliability is 0.7 (Bagozzi & Yi, 1988). The "outer loadings" values of the latent variables are presented in Appendix D.

4.3.1.1 Item Purification

On the basis of the above mentioned (Bagozzi & Yi, 1988) recommended value, one reflective indicator from "Social Interaction", "Knowledge Sharing Intention", "Time Zone Difference", "Perceived Behavioral Control", "Subjective Norms" was removed respectively. Two reflective indicators from "Attitude", "Geographic Distance", "Linguistic distance" and "Trust" were removed respectively. Six reflective indicators from "Knowledge Sharing Intention" were removed. Figure 4.2 shows the values of all constructs before item purification.

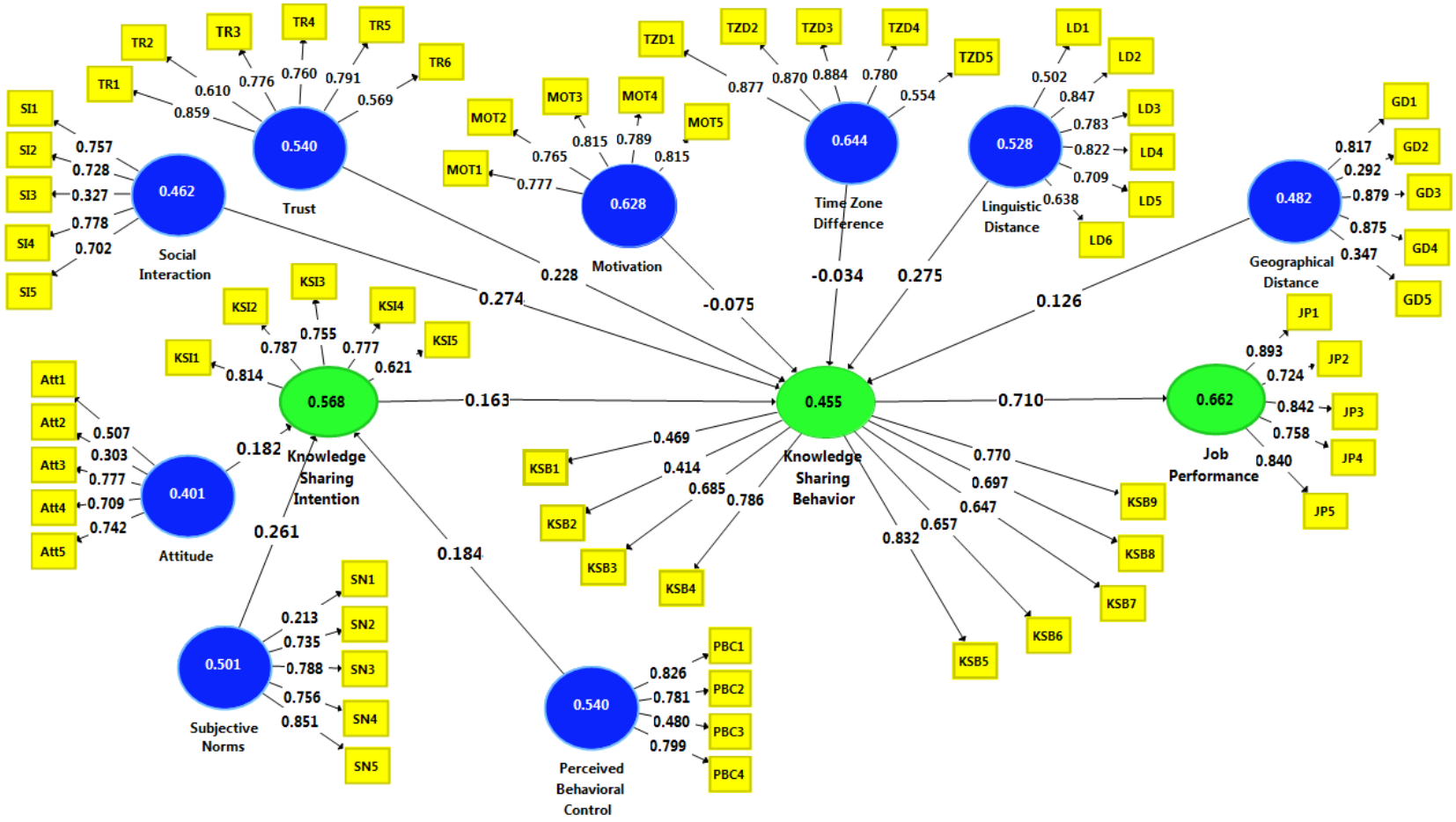

Figure 4.2: Conceptual Model before Item Purification

Table 4.1 presents outer loadings values after item purification.

Table 4.1: Outer Loadings after Item Purification

Constructs / Items	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Time Zone Difference	Trust
Att3	**0.827**											
Att4	**0.726**											
Att5	**0.797**											
GD1		**0.820**										
GD3		**0.892**										
GD4		**0.889**										
JP1			**0.886**									
JP2			**0.729**									
JP3			**0.839**									
JP4			**0.764**									
JP5			**0.840**									
KSB4				**0.855**								
KSB5				**0.888**								

Table 4.1: Outer Loadings After Item Purification (Cont'd...)

Constructs / Items	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Time Zone Difference	Trust
KSB9				0.793								
KSI1					0.827							
KSI2					0.835							
KSI3					0.740							
KSI4					0.753							
LD2						0.855						
LD3						0.797						
LD4						0.874						
LD5						0.750						
MOT1							0.773					
MOT2							0.767					
MOT3							0.817					
MOT4							0.793					
MOT5							0.812					
PBC1								0.855				
PBC2								0.793				
PBC4								0.825				

Table 4.1: Outer Loadings after Item Purification (Cont'd...)

Constructs / Items	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Time Zone Difference	Trust
SI1									**0.795**			
SI2									**0.705**			
SI4									**0.769**			
SI5									**0.730**			
SN2										**0.781**		
SN3										**0.788**		
SN4										**0.748**		
SN5										**0.844**		
TR1												**0.852**
TR3												**0.821**
TR4												**0.806**
TR5												**0.802**
TZD1											**0.885**	
TZD2											**0.881**	
TZD3											**0.898**	
TZD4											**0.772**	

After deletion of the constructs, the new model is presented in figure 4.3.

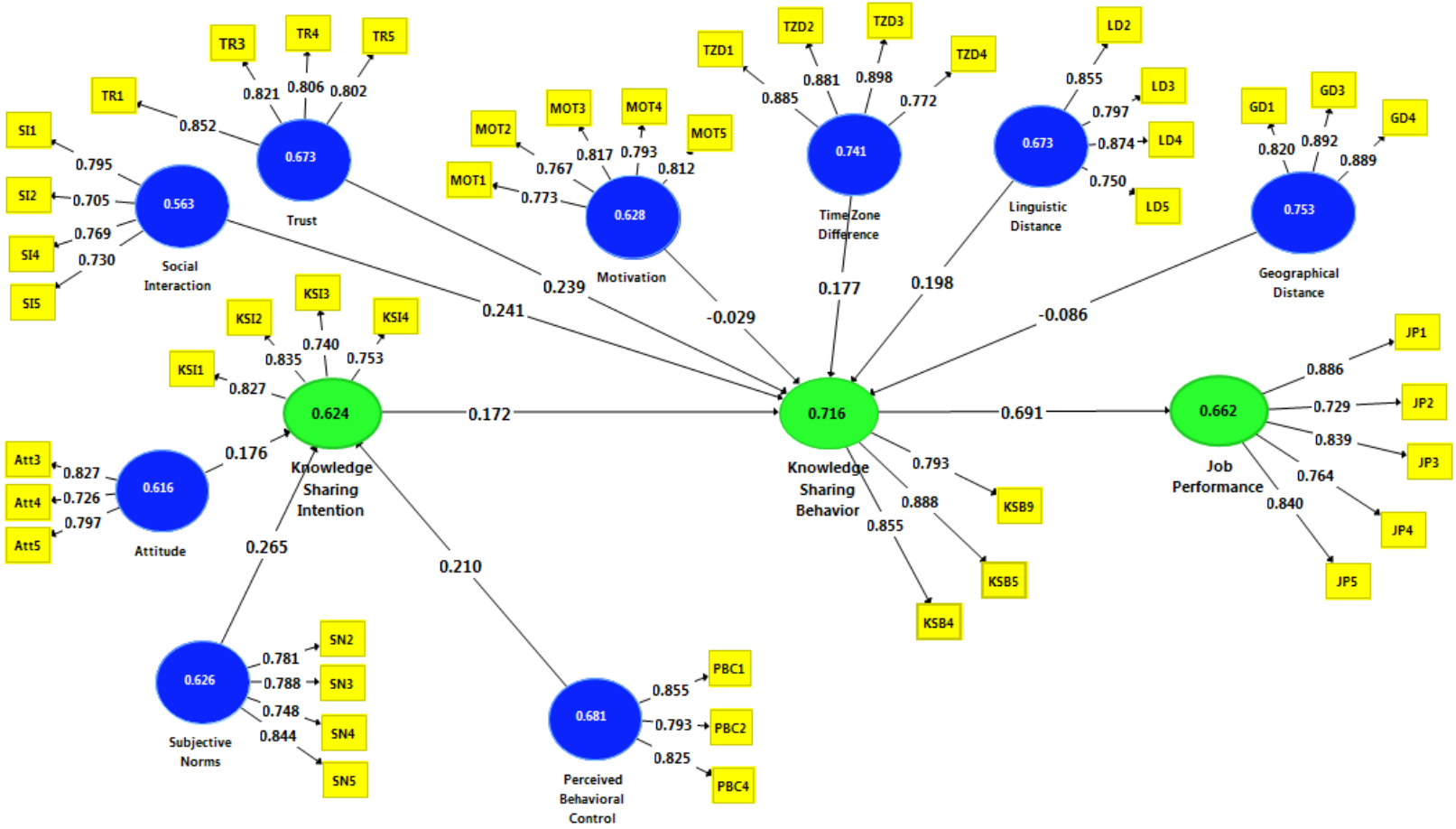

Figure 4.3: Outer Loading after Item Purification

4.3.2 Assessment of Validity

4.3.2.1 Convergent Validity

Convergent validity assesses the level of correlation of multiple indicators of the same construct. In this research "average variance extracted (AVE)", "composite reliability (CR)" and "Cronbach's Alpha" was calculated to determine the convergent validity The recommended minimum value for AVE is 0.50 and for CR is 0.6 (Hair, 2006). For Cronbach alpha any value that range between 0.5 to 0.7 is considered to provide moderate reliability (Hinton, et al., 2004; Loewenthal, 2001). Table 4.2 presents convergent validity results.

Table 4.2: Convergent Validity Results

	Cronbach's Alpha	**Composite Reliability (CR)**	**Average Variance Extracted (AVE)**
Attitude	0.686	0.827	0.616
Geographic Distance	0.837	0.901	0.753
Job Performance	0.872	0.907	0.662
Knowledge Sharing Behavior	0.800	0.883	0.716
Knowledge Sharing Intention	0.804	0.869	0.624
Linguistic Distance	0.838	0.891	0.673
Motivation_	0.852	0.894	0.628
Perceived Behavioral Control	0.769	0.865	0.681
Social Interaction	0.741	0.837	0.563
Subjective Norms	0.801	0.870	0.626
Time Zone Difference	0.882	0.919	0.741
Trust	0.840	0.892	0.673

4.3.2.2 Discriminant Validity

Discriminant validity refers to the extent in which one construct is differing from one another (Hair et al., 2013). It basically is the extent to which a variable is separate from other variables, in terms of how much it correlates with other variables (Hair et al., 2013). In this study **"**Fornell & Larcker" criterion for cross-loading scores were used to establish discriminant validity (Fornell & Larcker, 1981).

Hair et al (2013) suggested that the squared root of "*each constructs' AVE should be higher than its highest correlation with any other construct to evidence discriminant validity*" (Hair et al., 2013). In Table 4.3, it can be observed that the square root of AVE for all latent variables was greater than the inter-construct correlations (Fornell & Larcker, 1981). Further, individual loadings of all indicators were found to be higher than their respective cross-loadings (Hair et al., 2013). This provides additional confirmation for discriminant validity. The bold numbers in table 4.3 in the diagonal row presents the square roots of the average variance extracted.

Table 4.3: Construct Validity and Discriminant Validity – Fornell and Lacker Criterion

	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Time Zone Difference	Trust
Attitude	**0.785**											
Geographic Distance	0.177	**0.868**										
Job Performance	0.402	0.558	**0.814**									
Knowledge Sharing Behavior	0.294	0.489	0.691	**0.846**								
Knowledge Sharing Intention	0.335	0.376	0.513	0.529	**0.790**							
Linguistic Distance	0.156	0.662	0.537	0.583	0.454	**0.821**						
Motivation	0.256	0.351	0.254	0.391	0.242	0.529	**0.793**					
Perceived Behavioral Control	0.372	0.257	0.606	0.569	0.396	0.390	0.298	**0.825**				
Social Interaction	0.391	0.630	0.665	0.666	0.554	0.616	0.459	0.629	**0.751**			
Subjective Norms	0.309	0.478	0.546	0.411	0.415	0.284	0.022	0.456	0.657	**0.791**		
Time Zone Difference	0.200	0.762	0.668	0.555	0.407	0.597	0.302	0.466	0.629	0.534	**0.861**	
Trust	0.462	0.431	0.547	0.610	0.423	0.525	0.585	0.599	0.686	0.437	0.470	**0.821**

4.3.2.3 Inter-Construct Correlation

Chin and Newsted (1999) stated that all the loadings for the construct being measured should be greater than the cross-loadings. Table 4.4 presents inter construct correlation. It can be seen that all constructs had more variance with their corresponding indicators than with the other constructs (bold number is higher as compared to other numbers).

Table 4.4: Inter-Construct Correlations - Cross Loadings

Constructs / Items	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Trust	Time Zone Difference
Att3	**0.827**	0.128	0.301	0.188	0.280	0.151	0.330	0.315	0.328	0.187	0.483	0.177
Att4	**0.726**	0.099	0.277	0.167	0.250	0.013	0.019	0.154	0.200	0.282	0.192	0.143
Att5	**0.797**	0.190	0.368	0.339	0.259	0.198	0.237	0.400	0.388	0.265	0.400	0.149
GD1	0.079	**0.820**	0.351	0.345	0.232	0.599	0.383	0.140	0.487	0.289	0.313	0.552
GD3	0.184	**0.892**	0.498	0.437	0.290	0.549	0.337	0.219	0.546	0.371	0.406	0.624

Table 4.4: Inter-Construct Correlations - Cross Loadings (Cont'd...)

Constructs / Items	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Trust	Time Zone Difference
GD4	0.181	**0.889**	0.575	0.475	0.432	0.585	0.220	0.288	0.596	0.552	0.394	0.782
JP1	0.471	0.635	**0.886**	0.621	0.522	0.569	0.332	0.575	0.718	0.561	0.609	0.695
JP2	0.265	0.168	**0.729**	0.435	0.428	0.196	0.017	0.574	0.397	0.422	0.284	0.382
JP3	0.254	0.573	**0.839**	0.615	0.415	0.539	0.293	0.502	0.557	0.429	0.451	0.624
JP4	0.274	0.321	**0.764**	0.517	0.316	0.452	0.266	0.418	0.427	0.285	0.443	0.425
JP5	0.351	0.482	**0.840**	0.592	0.401	0.367	0.081	0.419	0.560	0.508	0.400	0.541
KSB4	0.245	0.412	0.571	**0.855**	0.474	0.487	0.299	0.476	0.613	0.372	0.520	0.467
KSB5	0.213	0.450	0.578	**0.888**	0.473	0.464	0.302	0.453	0.601	0.461	0.493	0.481
KSB9	0.287	0.378	0.603	**0.793**	0.395	0.528	0.390	0.515	0.474	0.209	0.533	0.459
KSI1	0.241	0.403	0.372	0.448	**0.827**	0.458	0.334	0.246	0.468	0.256	0.345	0.340
KSI2	0.335	0.220	0.534	0.541	**0.835**	0.408	0.188	0.507	0.510	0.392	0.479	0.419
KSI3	0.230	0.356	0.318	0.291	**0.740**	0.287	0.152	0.190	0.388	0.338	0.264	0.247
KSI4	0.222	0.255	0.333	0.320	**0.753**	0.242	0.073	0.201	0.347	0.311	0.163	0.224
LD2	0.086	0.533	0.453	0.563	0.384	**0.855**	0.470	0.319	0.464	0.154	0.431	0.530
LD3	0.149	0.596	0.369	0.404	0.322	**0.797**	0.493	0.182	0.535	0.206	0.409	0.420
LD4	0.170	0.604	0.462	0.481	0.431	**0.874**	0.477	0.362	0.598	0.274	0.486	0.516
LD5	0.119	0.447	0.471	0.443	0.345	**0.750**	0.293	0.406	0.435	0.318	0.395	0.478

Table 4.4: Inter-Construct Correlations - Cross Loadings (Cont'd...)

Constructs / Items	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Trust	Time Zone Difference
MOT1	0.290	0.306	0.263	0.325	0.234	0.378	**0.773**	0.247	0.394	0.090	0.473	0.230
MOT2	0.218	0.195	0.208	0.286	0.174	0.424	**0.767**	0.267	0.364	0.034	0.466	0.207
MOT3	0.183	0.316	0.170	0.291	0.215	0.467	**0.817**	0.225	0.377	0.008	0.489	0.265
MOT4	0.201	0.250	0.195	0.334	0.203	0.425	**0.793**	0.243	0.358	-0.062	0.459	0.244
MOT5	0.117	0.319	0.167	0.306	0.130	0.405	**0.812**	0.198	0.323	0.022	0.432	0.250
PBC1	0.336	0.161	0.504	0.482	0.345	0.342	0.364	**0.855**	0.529	0.249	0.543	0.368
PBC2	0.402	0.163	0.478	0.450	0.247	0.350	0.273	**0.793**	0.459	0.317	0.504	0.356
PBC4	0.218	0.294	0.516	0.476	0.366	0.287	0.118	**0.825**	0.554	0.539	0.447	0.424
SI1	0.338	0.614	0.445	0.481	0.408	0.541	0.532	0.338	**0.795**	0.447	0.524	0.506
SI2	0.316	0.263	0.521	0.517	0.530	0.389	0.150	0.560	**0.705**	0.531	0.410	0.377
SI4	0.324	0.520	0.604	0.533	0.414	0.330	0.142	0.558	**0.769**	0.666	0.517	0.553
SI5	0.185	0.503	0.407	0.458	0.295	0.614	0.600	0.410	**0.730**	0.297	0.619	0.449
SN2	0.119	0.522	0.424	0.300	0.346	0.355	0.027	0.294	0.478	**0.781**	0.347	0.567
SN3	0.262	0.156	0.358	0.255	0.345	0.127	-0.018	0.398	0.469	**0.788**	0.301	0.240
SN4	0.302	0.406	0.419	0.295	0.256	0.217	0.152	0.329	0.532	**0.748**	0.345	0.410
SN5	0.311	0.440	0.527	0.446	0.351	0.201	-0.054	0.417	0.608	**0.844**	0.393	0.472

Table 4.4: Inter-Construct Correlations - Cross Loadings (Cont'd...)

Constructs / Items	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Trust	Time Zone Difference
TR1	0.434	0.548	0.568	0.602	0.445	0.662	0.637	0.509	0.659	0.346	**0.852**	0.538
TR3	0.530	0.215	0.370	0.434	0.308	0.228	0.378	0.432	0.488	0.389	**0.821**	0.221
TR4	0.295	0.153	0.392	0.451	0.315	0.258	0.333	0.612	0.492	0.365	**0.806**	0.299
TR5	0.259	0.427	0.428	0.483	0.293	0.490	0.518	0.417	0.583	0.345	**0.802**	0.428
TZD1	0.102	0.766	0.589	0.477	0.377	0.531	0.195	0.356	0.552	0.499	0.339	**0.885**
TZD2	0.239	0.675	0.586	0.472	0.380	0.473	0.253	0.397	0.580	0.483	0.395	**0.881**
TZD3	0.183	0.608	0.584	0.489	0.347	0.466	0.228	0.403	0.546	0.501	0.442	**0.898**
TZD4	0.165	0.572	0.539	0.469	0.295	0.584	0.364	0.447	0.485	0.349	0.439	**0.772**

Table 4.5: Heterotrait-Monotrait Ratio

	Attitude	Geographical Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Time Zone Difference	Trust
Attitude												
Geographical Distance	0.241											
Job Performance	0.515	0.616										
Knowledge Sharing Behavior	0.398	0.590	0.820									
Knowledge Sharing Intention	0.436	0.462	0.584	0.628								
Linguistic Distance	0.213	0.798	0.610	0.704	0.533							
Motivation_	0.353	0.426	0.296	0.472	0.283	0.627						
Perceived Behavioral Control	0.527	0.301	0.744	0.723	0.444	0.487	0.376					
Social Interaction	0.555	0.799	0.806	0.861	0.693	0.798	0.597	0.814				
Subjective Norms	0.428	0.572	0.648	0.511	0.503	0.354	0.120	0.565	0.842			
Time Zone Difference	0.259	0.876	0.749	0.661	0.460	0.691	0.349	0.562	0.777	0.634		
Trust	0.601	0.482	0.616	0.732	0.469	0.595	0.671	0.748	0.861	0.537	0.526	

4.3.2.4 Indicator Reliability

Indicator reliability determines the variation of an item (Hair et al., 2013). Hair et.al (2013) suggested that items having an outer loading greater than 0.70 should be retained and items having an outer loading value <0.40 should be omitted. (Hair et al., 2013). In this study CR was used to determine "indicator reliability". The CR values are presented in table 4.2.

4.4 Structural Model Assessment

Hair et.al (2014) proposed four steps to examine "endogenous variables" and "exogenous variables" relationship. The steps are given below (Hair et al., 2014) :

1) Assess structural model for collinearity issue

2) Assess the significance of path coefficients

3) Assess R^2 level

4) Assess f^2 effect size

4.4.1 Collinearity

Collinearity occurs when two predicators (independent variables) are correlated to each other very strongly (Meyers et al., 2006), indicating that they might be two comparable measures for the same thing (Tabachnick & Fidell, 2006). In this research Variance Inflation Factor (VIF) was used to detect

multicollinearity. All values of VIF equal or above 10 can be seen as a cause of concern, and may require further investigation (Ho, 2006). In this study all VIF values were found to be less than 10 as shown in table 4.5.

Table 4.6: VIF Values

	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Time Zone Difference	Trust
Attitude					1.194							
Geographic Distance				2.973								
Job Performance												
Knowledge Sharing Behavior			1.000									
Knowledge Sharing Intention				1.514								
Linguistic Distance				2.413								
Motivation_				1.745								
Perceived Behavioral Control					1.364							
Social Interaction				2.982								
Subjective Norms					1.300							
Time Zone Difference				2.701								
Trust				2.343								

4.4.1.1 Common Method Bias

For PLS-SEM, common method bias (CMB) is detected through a "full collinearity" assessment method (Kock, 2015). Full collinearity VIFs tend to

increase with the complexity of the model, in terms of number of latent variables in the model because

(a) "*the likelihood that questions associated with different indicators will overlap in perceived meaning goes up as the size of a questionnaire increases, which should happen as the number of constructs covered grows"* (Kock, 2015, p. 8).

(b) "*the likelihood that latent variables will overlap in terms of the facets of the constructs to which they refer goes up as more latent variables are added to a model*" (Kock, 2015, p. 8).

It suggests that VIF values of 5 could be employed when algorithms that incorporate measurement error are used (Kock, 2015). Appendix J shows all VIF values are less than 5. This indicates that the model is free from "common method bias".

4.4.2 Path Coefficients

Path coefficients basically represent the hypothesized relationships which linkup the constructs. The values are standardized from -1 to +1. The coefficients which are closer to +1 represent a strong positive relationship. Whereas, path coefficients closer to -1 represent a strong negative relationship (Joe et al. 2014). Table 4.6 presents the initial path coefficients.

Table 4.7: Path coefficients

	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Time Zone Difference	Trust
Attitude					0.176							
Geographic Distance				-0.086								
Job Performance												
Knowledge Sharing Behavior			0.691									
Knowledge Sharing Intention				0.172								
Linguistic Distance				0.198								
Motivation				-0.029								
Perceived Behavioral Control					0.210							
Social Interaction				0.241								
Subjective Norms					0.265							
Time Zone Difference				0.177								
Trust				0.239								

Bootstrapping is used to access the significance of all the path coefficients (Chin, 2010). Table 4.7 presents the results of the bootstrapping.

Table 4.8: Bootstrapping Results

	Original Sample (O)	T Statistics (O/STDEV)	P Values
Attitude -> Knowledge Sharing Intention	0.176	2.804	0.005
Geographic Distance-> Knowledge Sharing Behavior	-0.086	0.924	0.356
Knowledge Sharing Behavior -> Job Performance	0.691	12.440	0.000
Knowledge Sharing Intention -> Knowledge Sharing Behavior	0.172	2.764	0.006
Linguistic Distance-> Knowledge Sharing Behavior	0.198	1.747	0.081
Motivation -> Knowledge Sharing Behavior	-0.029	0.579	0.563
Perceived Behavioral Control -> Knowledge Sharing Intention	0.210	3.029	0.002
Social Interaction -> Knowledge Sharing Behavior	0.241	2.438	0.015
Subjective Norms -> Knowledge Sharing Intention	0.265	4.598	0.000
Time Zone Difference -> Knowledge Sharing Behavior	0.177	1.906	0.057
Trust -> Knowledge Sharing Behavior	0.239	2.103	0.036

The models for the results of the bootstrapping (t values) and (p values) are presented in appendix E and F respectively.

4.4.3 Assessing R^2 Values

The combined effect of "exogenous variables" on "latent variables" is determined by R^2 values (Hair et al., 2013). The value of R^2 relies upon the complexity of the research model and research discipline (Hair et al., 2013). For example, the value of R^2 may be considered as high in disciplines such as consumer behavior, and 0.75 for studies involving "customer satisfaction" or

"loyalty". According to Cohen (1988) R^2 values for endogenous latent variable is evaluated as follows:

0.26 large

0.13 moderate

0.02 weak

In this research endogenous variables namely "job performance", "knowledge sharing intention" and "knowledge sharing behavior" had R^2 values 0.477, 0.577 and 0.252 respectively. The R^2 values are shown in table 4.8.

Table 4.9: R^2 Values

Matrix	R Square	R Square Adjusted
Job Performance	0.477	0.475
Knowledge Sharing Behavior	0.557	0.547
Knowledge Sharing Intention	0.252	0.244

4.4.4 Assessing f^2 Values

The impact of "exogenous constructs" on "endogenous constructs" is measured by f^2 (Janadari, Sri Ramalu, & Wei, 2016). According to Cohen (1988), f^2 is assessed as follows (Jacob Cohen, 1988):

0.02 small

0.15 medium

0.35 large

In this study, f^2 size effect varies from small to large values for all the exogenous variables as presented in table 4.9.

Table 4.10: f^2 Values

	Attitude	Geographic Distance	Job Performance	Knowledge Sharing Behavior	Knowledge Sharing Intention	Linguistic Distance	Motivation	Perceived Behavioral Control	Social Interaction	Subjective Norms	Time Zone Difference	Trust
Attitude					0.034							
Geographic Distance				0.006								
Job Performance												
Knowledge Sharing Behavior			0.912									
Knowledge Sharing Intention				0.044								
Linguistic Distance				0.037								
Motivation				0.001								
Perceived Behavioral Control					0.043							
Social Interaction				0.044								
Subjective Norms					0.072							
Time Zone Difference				0.026								
Trust				0.055								

4.5 Hypothesis Results

To begin, a direct effects model was estimated, without moderators, to provide a baseline for comparison (Chin, et al., 2003) and the results are presented in Table 4.10

Table 4.11: Results of Hypothesis Testing

Hypothesis	Path	t-Statistic	Decision
H1a	ATT - > KSI	2.822	Supported
H1b	SN - > KSI	4.543	Supported
H1c	PBC - > KSI	2.983	Supported
H1d	KSI - > KSB	2.792	Supported
H2a	MOT - > KSB	0.585	Not Supported
H2a	SI - > KSB	2.494	Supported
H2c	TR - > KSB	2.111	Supported
H3a	LD - > KSB	1.788	Not Supported
H3b	GD - > KSB	0.910	Not Supported
H3c	TZD - > KSB	1.895	Not Supported
H5	KSB- > JP	12.714	Supported

4.6 Moderation

Moderating effect can be explained in simple terms as *"when one construct moderates the relationship between other two constructs"* (Fassott et al., 2016). The variation of the moderating variable affects the strength of a relation between an "independent" and a "dependent" variable (Baron & Kenny, 1986). Besides investigation simple affects between a dependent and independent variable, researchers are often interested to explore the impact of moderating variables on the dependent and independent variables. In order to model the moderating effects in SEMs, authors proposed the concept of building product terms between the indicators of the "latent independent variable" and the indicators of the "latent moderator variable" (Kenny & Judd, 1984). Figure 4.7

presents this interaction. Two moderating variables “technological support” and “organizational support” were introduced in this study. The new model is presented in the figure 4.4.

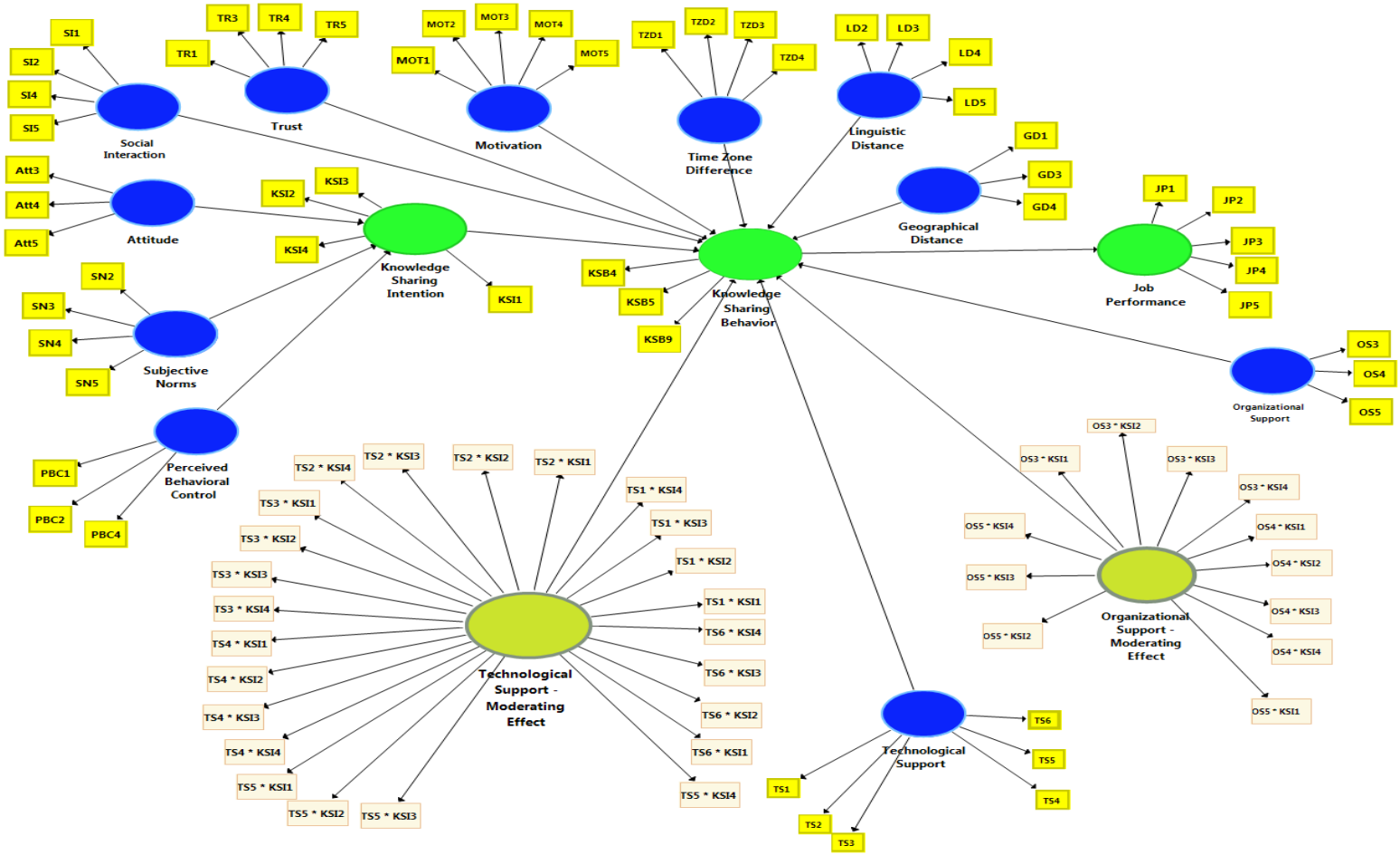

Figure 4.4: Conceptual Model with Moderating Variables

4.6.1 Interpreting Moderating Effects

Fassott et al., (2016) suggested following steps in order to interpret the moderating effects:

1. Determine whether the moderating effects really exists or not? For this step check the path coefficient to capture the moderating effect

2. Determine the strength of the identified moderating effect

The interaction model has been tested by using the above-mentioned steps. This model tested all hypotheses simultaneously along with the combined moderating effect of technological support and organizational support. Technological support moderating effect had a value of 1.119 and organizational support moderating effect had a value of 4.412. Table 4.11 summarizes the results of the hypothesis.

Table 4.12: Hypothesis Results Comparison

Hypothesis	Path	t-Statistic (Without Moderation)	t-Statistic (With Moderation)	Decision
H1a	ATT - > KSI	2.822	2.786	Supported
H1b	SN - > KSI	4.543	4.622	Supported
H1c	PBC - > KSB	2.983	2.953	Supported
H1d	KSI - > KSB	2.792	1.761	Not Supported
H2a	MOT - > KSB	0.585	0.935	Not Supported
H2a	SI - > KSB	2.494	2.482	Supported
H2c	TR - > KSB	2.111	3.061	Supported
H3a	LD - > KSB	1.788	1.085	Not Supported
H3b	GD - > KSB	0.910	2.570	Supported
H3c	TZD - > KSB	1.895	1.811	Not Supported
H4a	TS - > KSB	N/A	1.119	Not Supported
H4b	OS - > KSB	N/A	4.412	Supported
H5	KSB- > JP	12.714	12.279	Supported

Next the R^2 values were determined. Table 4.12 provides a comparison of R^2 values with and without moderating effects:

Table 4.13: R^2 Values Comparison

R^2 Values	Without Moderation	With Moderation
JP	0.477	0.476
KSB	0.557	0.660
KSI	0.252	0.252

By doing a comparison of the coefficient R^2 of the main effect model (model without moderating effect) with R^2 of the full model strength of the moderating effect (model with the moderating effect) can be assessed (Fassott et al., 2016). The effect size f^2 of the moderator has been determined by the following formula (Jacob Cohen, 1988).

[R^2 (model with moderator) - R^2 (model without moderator)] / 1 - R^2 model with moderator

For this research f^2 for KSB=

(0.660-0.557)/1- 0.660)

0.103/0.34

=0.302

For this model f^2 is 0.302 which indicates a strong effect size.(Chin et al., 2003) states that a low effect size f^2 does not necessarily suggest that the underlying moderator effect is unimportant: Even a small interaction effect can be meaningful under extreme moderating conditions, if the resulting beta changes are meaningful, then it is important to take these conditions into account (Chin et al., 2003). The moderating variables organizational support

and technological support were introduced separately (one variable at a time). The interaction graphs for OS and TS are presented in Appendix H and Appendix I respectively.

4.7 Mediation Analysis

Maxwell (2007) stated *"mediation consists of causal processes that unfold over time".* In research "time" holds significance importance in studying of mediational processes (Cole & Maxwell, 2003; Collins et. al, 1998). As this study is cross sectional so the mediation analysis was not required (Maxwell, 2007).

4.8 Discussions of Findings

The current study used TBP as the main model to predict JP through KSB. After doing analysis, five of the hypotheses were not supported out of total thirteen hypothesis.

4.8.1 Knowledge Sharing Behavior and Theory of Planned Behavior in GSDOs

As hypothesized, "attitude", "subjective norms" and "perceived behavioral control" appeared as significant predictors of intention towards KSB. These findings comply with prior findings of TPB related research (Taylor & Todd, 1995). The results of hypothesis are shown in Table 4.13

Table 4.14: Hypothesis Results of Theory of Planned Behavior

	Hypothesis	Path	Decision
H1a	ATT towards KSB has a positive relationship with KSI of software developers working in GSDOs	ATT - > KSI	Supported
H1b	SNs regarding KSB have a positive relationship with KSI of software developers working in GSDOs.	SN - > KSI	Supported
H1c	PBC over KSB has a positive relationship with KSI of software developers working in GSDOs	PBC - > KSI	Supported

Individual attitudes form a major part of the cognitive system and influence behavioral intention to share knowledge (Yih-Tong Sun & Scott, 2005). Consistent with TPB, the current study hypothesized "attitude" as one of the antecedents of KSI towards KSB. "Attitude" had a significant and little impact on the behavioral intention to share knowledge (path coefficient = 0.176 and t-stats = 2.786). This contribution of "attitude" towards KSI suggests that software developers in GSDOs with favourable attitudinal nature are more likely to engage in KSB. The findings of this study are consistent with the results of previous studies (Safa & Von Solms, 2016; Morris & Venkatesh, 2000; Taylor & Todd, 1995; Ifinedo, 2012). Since the path from attitude towards KSI to share knowledge was found to be significant, it is suggested that higher management may consider on developing and promoting positive attitude among software developers.

"Subjective norms" had a significant and strong impact on the KSI (path coefficient = 0.265 and t-stats = 4.622). The impact of "subjective norms" towards KSI is strongest as compared to "attitude's" and "perceived behavioral control's" impact. It can be deduced that software developers consider input

from co-workers to be significant while sharing knowledge. These findings comply with prior findings of TPB related research (Bock et al., 2005; Mathieson, 1991; Morris & Venkatesh, 2000; Pavlou & Chai, 2002; Taylor & Todd, 1995). But this result is not consistent with the findings of So & Bolloju (2005), where subjective norms were found to be insignificant on KSI. The possible explanation of this difference could be due to difference in the characteristic of the sample size. So & Bolloju (2005) included only respondents with 9 years of experience, upon which the influence of subjective norms was minimum. In the current study 71.85% of the sample had "Less than 5 years" of experience, while 18.54% had "5 to 10 years" of experience and remaining 9.60% had "More than 10 years of experience". Thus, major portion of the sample included software developers with less than 5 years of experience, to whom subjective norms had a significant impact.

Intention to perform a certain behavior can be influenced by the perception of the individual about his/her level of control over that behavior (Tohidinia & Mosakhani, 2010). The last antecedent to determine KSI in this research was "perceived behavioral control". "Perceived behavioral control" was found to have significant and moderate impact on the KSI (path coefficient = 0.209 and t-stats = 2.953). This impact of "perceived behavioral control" is greater as compared "attitude" impact on KSI and is smaller as compared to impact of "subjective norms" on KSI. It can be concluded that software developers working for GSDOs engage in KS only when they are equipped with necessary software resources and relevant opportunities. This result is consistent with previous studies (Safa & Von Solms, 2016; Mathieson, 1991; So & Bolloju,

2005). Research results indicate that, at least in this sample, the higher the intention to share knowledge the higher knowledge donation and collection. Figure 4.5 shows the impact T values and Path Coefficients of TPB.

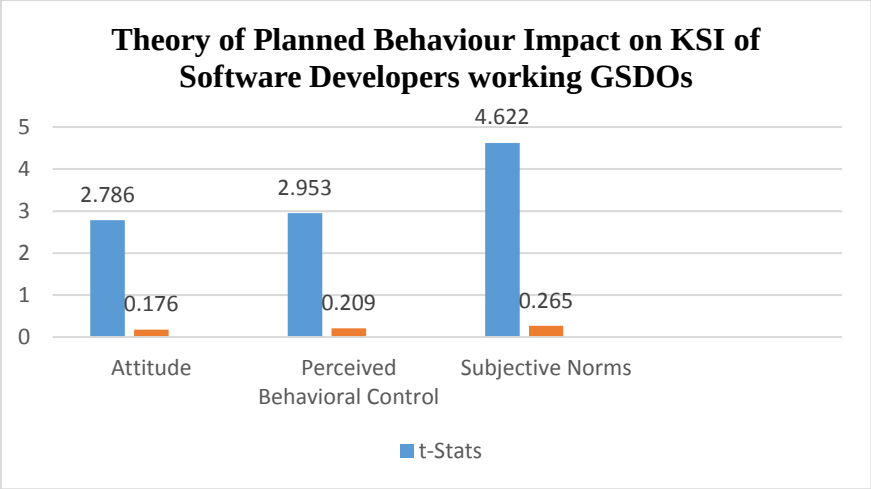

Figure 4.5 T Values and Path Coefficients of TPB

Thus, the findings of the study revealed that ATT, PBC and SNs have a significant impact on KSI of software developers working in GSDOs and KSI also positively influences KSB. All direct determinants of intention were significant. This further proves, that TPB provides an adequate baseline in predicting the KSB of software developers with regards to GSDOs. Since, the path from SNs KSI had the strongest impact, we suggest that top management of GSDOs should work on focusing and building up a positive environment where co-workers, team leads, and peers engage in KSB. Senior management may drive knowledge sharing activities by creating relevant policies.

4.8.2 Knowledge Sharing Behavior and Social Cognitive Theory (SCT) in GSDOs

In the current study the personal/individual factors included “motivation”, “social interaction” and “trust”. The results of hypothesis are shown in Table 4.14.

Table 4.15: Hypothesis Results of Individual factors of Social Cognitive Theory

	Hypothesis	**Path**	**Decision**
H2a:	Motivation has a positive relationship with KSB of software developers working in GSDOs	MOT - > KSB	Not Supported
H2b:	Social interaction has a positive relationship with KSB of software developers in GSDOs	SI - > KSB	Supported
H2c:	Trust has a positive relationship with KSB of software developers working in GSDOs	TR - > KSB	Supported

In the current study the first factor which was included in the “individual factors” of SCT was “motivation”. The results did not support this hypothesis (H2a), showing that “motivation” does not positively impact the KSB. Motivation had an insignificant and negative influence on the KSB (path coefficient = -0.059 and t-stats = 0.935). The path coefficient and t-stats for “motivation” had the lowest values as compared to other two (trust and social interaction) individual factors of SCT to predict KSB. This result is not consistent with findings of Chen et al. (2016). It can be concluded that software developers working in GSDOs on individual level had no urge to share knowledge (Chen et al., 2016). There could be several reasons for this insignificance, Zahedi et al., (2016) stated that software developers feel unmotivated to share knowledge specially when the of sharing knowledge from

senior employees to new employees. In order to understand the impact of intrinsic and extrinsic motivation on KSB of software developers, the current research included questions related to both intrinsic and extrinsic motivation. Surprisingly, the results showed insignificant impact of motivation on KSB. Possible explanation for the insignificance of motivation can be due to the fact that individuals may become happy after getting monetary rewards, but the motivation to perform a certain action is intrinsic. In longer run incentives cannot ever overshadow the supremacy of intrinsic motivation. If individuals get a feeling of "being controlled", they might tend to lose their interest. Also, negative rewards like "*punishments*" weaken the intrinsic motivation. Individuals may have a high desire towards incentives, but individuals might get feelings of being manipulated by management with passage of time if acceptance of the incentives is relying on certain behaviors (Kohn, 1993). The insignificance of motivation in this study suggests that for the selected sample of software developers, intrinsic motivators (enjoyment, pleasure) and extrinsic motivators (recognition, respect) were not as important as other individual factors (trust and social interaction).

Social Interaction is acknowledged to be a vital construct in promoting KS (Tamjidyamcholo et al., 2014). Significant and strong impact was found on the KSB by SI (path coefficient = 0.210 and t-stats = 2.482). The impact of social interaction towards KSB was strongest as compared to trust and motivation. Recent studies have provided empirical support for the influence of social interaction (Wendling et al., 2013; Wickramasinghe & Widyaratne, 2012;

Zahedi et al., 2016). The results of the current study are in accordance with the findings of above-mentioned researches. The results of data analysis confirm that social interaction can play a major role in KSB in GSDOs, therefore, it can be concluded that as the degree of social interaction increases, KSB will also increase between software developers working in GSDOs.

Previous studies of Ghobadi (2015), Zahedi et al., (2016), Noll, Beecham et al. (2010) and Kroll, Mäkiö et al.(2016), have demonstrated that "trust" impacts KSB significantly. Likewise, the results of the present study showed that trust, had a significant and moderate impact KSB of software developers working in GSDOs, as compared to other two (social interaction and motivation) individual factors of SCT to predict KSB. The path co-efficient for trust was 0.259 and t-stats were 3.061. Based on these values it can be concluded that, software developers are inclined to share knowledge based on mutual trust. The software developers who have trust in each other are more passionate and eager to share knowledge with each other. Moreover, when software developers get to know each other more seriously and profoundly, they gain access to knowledge from co-workers. In doing so, they easily involve themselves KS. Figure 4.6 presents a comparison of T values and Path Coefficients of SCT (Individual Factors)

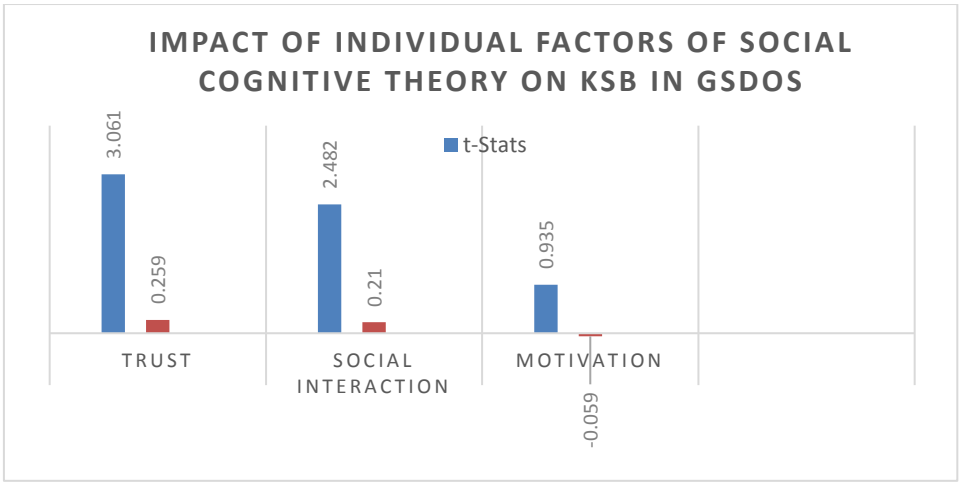

Figure 4.6: T Values and Path Coefficients of SCT (Individual Factors)

Since the path from social interaction towards KSB had the strongest impact, we suggest that top management of GSDOs should develop social interaction sessions such as "*group activities*" and "*common chat rooms*" where software developers can freely interact with peers. The top management may also consider "*pair programming*" which allows sharing of knowledge between software developers in a globally distributed project. Pair programming, allows two developers work together at one computer with a common goal (Razzak & Ahmed, 2014), hence chances of social interaction will increase. According to Wasko & Faraj, (2005), social interaction creates a bond between members of a network, and these bonds can be considered as a major predictor of collective action. These resulting bonds are built among individuals with identical interests and resources rather than between individuals of dissimilar interests (Johnson, 2007).

4.8.3 Knowledge Sharing Behavior Social Cognitive Theory and KSB in GSDOs

In current study, the environmental factors of SCT were categorized into two types namely "physical environment" and "social environment". The physical environmental factors of SCT included "geographic distance" and "time zone difference" and social environmental factor of SCT included only one factor namely "linguistic distance". The results of hypothesis for this category are shown in Table 4.15.

Table 4.16: Hypothesis Results of Geographic and Cultural factors of Social Cognitive Theory

	Hypothesis	Path	Decision
H3a	Geographic distance is negatively related to KSB of software developers working in GSDOs	GD - > KSB	Supported
H3b:	Time zone difference is negatively related to KSB of software developers working in GSDOs	TZD - > KSB	Not Supported
H3c	Linguistic distance is negatively related to KSB of software developers working in GSDOs	LD - > KSB	Not Supported

In the current study, the first factor which was included in the physical environment of SCT was "geographic distance". The results of current study showed that geographic distance is negatively related to KSB of software developers working in GSDOs. Geographic distance had a significant impact on the on KSB with a path coefficient of -0.190 and t-stats (2.570). This result coincides with the previous studies of Alam et al., (2012), Kroll et al., (2016); Yaseen et al., (2015), Kukko (2013), Betz et al., (2014), and Wendling et al., (2013). In GSD environment the "geographic distance" creates physical isolation between software developers and management (Carmel, 1999). Effective coordination, collaboration and visibility between locations essential

in GSD environment (Karolak, 1999). Accessing of information scattered at various remote sites such as *"updates about changes in requirements"* and *"dependencies between the products"*, and "*product and technology roadmaps"* becomes a tedious task due to difference in geographic locations (Oshri, Kotlarsky, & Willcocks, 2007). Prior research has shown that knowledge sharing in GSDOs encounters difficulties as *"face-to-face interaction"* is difficult due to different geographic locations (Razzak & Ahmed, 2014). Geographic distance has been cited as barrier for knowledge dissemination because it reduces and sometimes totally excludes *"face-to-face interaction"* (Wendling et al., 2013). The high value of t stats (as compared to other two antecedents of SCT) and negative path coefficient of "geographic distance" towards KSB suggests that software developers are more likely to engage in KS when the geographic distance is shorter.

In the current study, the second factor which was included in the physical environment of SCT was "time zone difference". Time zone differences cause communication and knowledge sharing issues between individuals working

from various distributed geographic locations (Ghobadi & Mathiassen, 2016). The results of data analysis indicated that "time zone difference" had an insignificant influence on KSB, with path coefficient (0.146) and t-stats (1.811). These results contradict the findings of previous studies (Alam et al., 2012; Kroll et al., 2016; Yaseen et al., 2015). A possible explanation for this insignificance is because, GSDOs are now aware of issues related with geographic distance and have devised preventive measures to utilize the pool of

resources efficiently using the various time zones. Although time zone difference is a barrier for KS, Wendling et al., (2013) suggested that in some situation's barriers can be cited as a facilitator for example, the time zone difference also acts as a facilitator for knowledge sharing because it *"increases the hours available"* to perform any activity. Holmstrom et al. (2006) suggested different approaches to overcome time zone differences by utilizing "time zone effectiveness*"* and implementing *"follow the sun*" approach (Holmstrom, et al., 2006). Holmstrom et al., (2006) also reported different approaches by various managers such as *"We try to make time zone differences manageable by dividing work between no more than two geographic sites" (Project manager, Intel)* (Holmstrom et al., 2006, p. 4). and another suggestion included *"We have 'follow-the-sun' core support during Monday to Friday. Someone should be able to action a call whenever it comes in. A call can be forwarded from site to site to follow the sun…"* (Manager, HP) (Holmstrom et al., 2006, p. 4). It can be deduced that by assigning rotational duties GSDOs can solve "time zone differences" related issues which eventually allows software developers to share knowledge globally. On the basis of these explanations it can be concluded that if management of GSDOS take counter measures to take advantage of time zones properly knowledge sharing barriers caused by time zone differences can be reduced.

Only one factor namely "linguistic distance" was included in the "social factor" of social cognitive theory The data also did not support hypothesis H3c, which was opposite to the previous researches (Ghobadi & Mathiassen, 2016; Kroll, Mäkiö, & Assaad; Kukko, 2013; Noll et al., 2010; Razzak et al., 2013;

Zahedi et al., 2016). A possible explanation for this rejection might be because the study was conducted in GSDOs of Malaysia, which has a multi-cultural and ethnic society and offers home to several different ethnic groups. The statistics present the following breakdown: Malays, "50.1%"; Chinese: "22.6%"; indigenous: "11.8%"; Indian: "6.7%"; other: "0.7%"; and non-citizens: "8.2%" (2010 estimate.) (Tan, et al.,2017). This multi-cultural environment builds up the environment of enhancing the linguistic skills of employees which allows them to enhance their communication skills. Another possible explanation to this rejection of hypothesis is due to the introduction of "*cultural exchange programs*" by GSDOs. The cultural exchange programs help in understanding the behavior, work practices and attitudes of individuals working from different location with various cultural backgrounds (Kroll et al., 2016; Razzak & Ahmed, 2014). Lot of misunderstandings and issues occur between onsite and offshore members from the beginning of the project. In order to mitigate these issues interviewees reported that by initiating *"cultural workshops"* at the start of the project allowed individual's to share knowledge effectively (Betz et al., 2014). Another strategy, which negates Linguistic distance is by utilization *"cultural awareness"* by assigning "*cultural ambassadors*" who can interpret communication and actions of individuals working at remote sites (Noll et al., 2010). Cultural ambassadors (Kroll et al., 2016) and culturally marginal people can be assigned for mediating roles between different team members, as they have common understanding of both cultures (Nguyen, Umemoto, & Dam, 2014; Nuwangi, Sedera, & Murphy, 2012). Expatriate manager are also being assigned to control and coordinate knowledge transfer and introducing

corporate culture between remote sites. Nguyen, et al. (2014) suggested to overcome linguistic distance is by suing "*Information gatekeeper*" as they have skills of understanding and translating knowledge into more meaningful way for their locally oriented colleagues thus, it can be concluded that, efficient use of cross-cultural individuals can provide an environment and baseline for organizations with an aim to enhance the knowledge sharing culture in GSDOs. Without such pre-emptive measures, knowledge sharing is destined to fail between software developers. Figure 4.7 presents a comparison of T values and Path Coefficients of SCT (Environmental Factors).

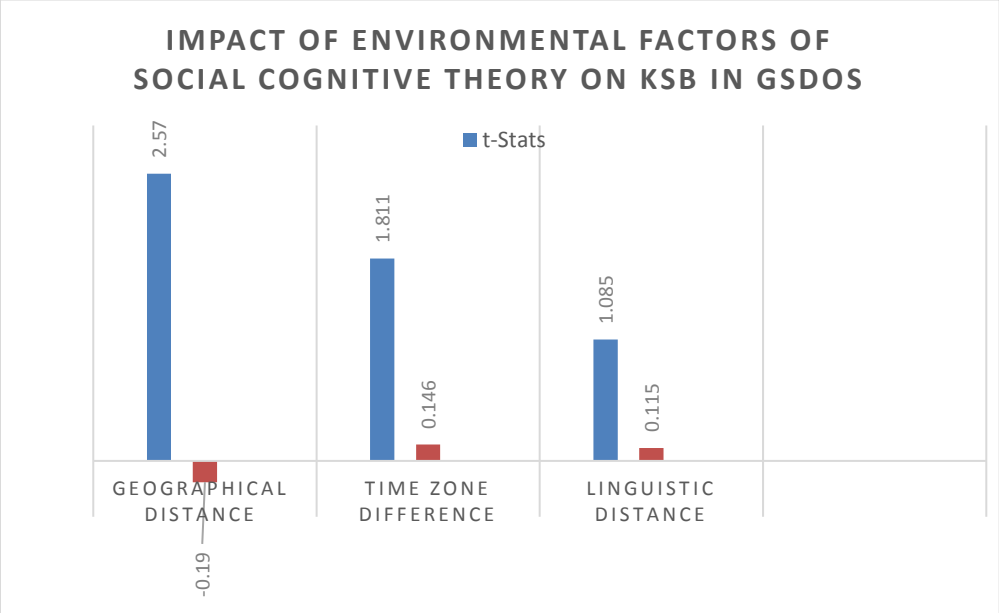

Figure 4.7: T values and Path Coefficients of SCT (Environmental Factors)

Out of the three the factors used in the current research for the SCT only "geographic distance" emerged as significant factor to predict KSB of software developers working in GSDOs. It is suggested for the management of GSDOs to resolve issues related to "geographic distance" to ease KS process.

One solution to overcome geographic distance" is "rotation" of individuals between distributed sites which promotes the sharing of domain related knowledge. Rotation of individual's not only supports knowledge sharing but also promotes trust and communication bandwidth (Razzak & Ahmed, 2014). Rotation of individuals comes with extra cost, but to overcome the cost of frequent rotation, one-line manager reported *"we rotate team members and mostly, the duration of the rotation between team members is 3-6 months"* (Razzak & Ahmed, 2014). Ghobadi (2015) suggested "relocation of experts" between remote sites, accelerated KS and technical expertise in GSDOs (Ghobadi, 2015).

4.8.4 Knowledge Sharing Behavior and Triandis Model Facilitating Conditions in GSDOs

In this study, only one component "*facilitating conditions*" from the Triandis model was included. Two moderating variables namely "organizational support" and "technological support" were introduced as *"facilitating conditions"*. The results of hypothesis for this category are shown in Table 4.16.

Table 4.17: Hypothesis Results of Technological and Organizations factors of Triandis Facilitating Conditions

	Hypothesis	Path	Decision
H4a	Technological support has a positive moderating relationship with KSB of software developers working in GSDOs	TS - > KSB	Not Supported
H4b	Organizational support has a positive moderating relationship with KSB of software developers working in GSDOs	OS - > KSB	Supported

This first hypothesis derived from Triandis facilitating conditions was related with finding of the moderating impact of technological support on KSB of software developers working in GSDOs. The results showed that, technological support had insignificant impact with a t-stat value 1.119. There can be several explanations for this insignificance. As pointed out by Senge (1998) an individual may receive more information because of availability of technological support, but it might not create an impact if the individual does not has the suitable skills to apply specific information in a productive way (Senge, 1997). Previous literature suggests, that various enabling technologies (Kroll et al., 2016) and tools which cater to the needs of distributed stakeholders in the decision making promote KS (Ali et al., 2010) but at the same time, domain knowledge varies from country to country. This leads to critical situation in which onsite individuals assume that the project specifications have been understood whereas individuals on other locations did not provide a valid feedback because of lack of understanding (Betz et al., 2014). Although technology helps in aiding the KS process, but in many studies, it has been found that individuals make little or no use of available technological tools and resources (Al Attar & Shaalan, 2016; Ghobadi & Mathiassen 2016; Kroll et al. 2016; Kukko 2013; Razzak & Ahmed 2014; Zahedi et al., 2016). Another explanation for this insignificant result can be explained that in distributed teams there is "*lack of suitable KS tools*". Unfamiliarity with the available collaborative technologies also negatively impacts KS (Ghobadi & Mathiassen, 2016). Kuko et al. (2013) reported that many of available tools e.g. *"wiki pages"* were not used properly by the individuals These "wiki pages" either

remained unpopulated or did not provide relevant information (Kukko, 2013). As there are specific tools designed to maintain communication in GSDOs, lacking these tools specifically aimed at managing architectural knowledge in a global setting can lead to a challenging situation (Ali et al., 2010). As software development is an innovative process and failure to conduct regular trainings for new employees and senior employees raises issues (Alam et al., 2012; Kukko, 2013). It can be summarized that if the usage and understandability of technology is too complex and it requires lot of trainings, then technological support can be considered as an obstacle which keeps away software developers from knowledge sharing. This shows that software developers used in this study, did not rely on technological support to share knowledge with co-workers

As hypothesized, organizational support had a significant and high impact on KSB of software developers working GSDOs t stat value 4.412. This result is consistent with previous literature (Al Attar & Shaalan, 2016; Betz et al., 2014; Chen et al., 2016; Ghobadi, 2015; Iskoujina & Roberts, 2015; Kroll et al., 2016; Noll et al., 2010; Šmite et al., 2017; Zahedi et al., 2016). King et. al (2008) suggested a high level of organizational support creates a feeling of obligation on the employees, whereby the individual feel grateful to support organizational mutual goals. Eventually employees are inclined. to share their knowledge with those whom they have think would most benefit the organization (King & Marks Jr, 2008). The significance of organizational support implies software developers consider the support provided by GSDOs to facilitate KSB to be an important element. Figure 4.8 presents a comparison of the impact of T values

and Path Coefficients of facilitating conditions.

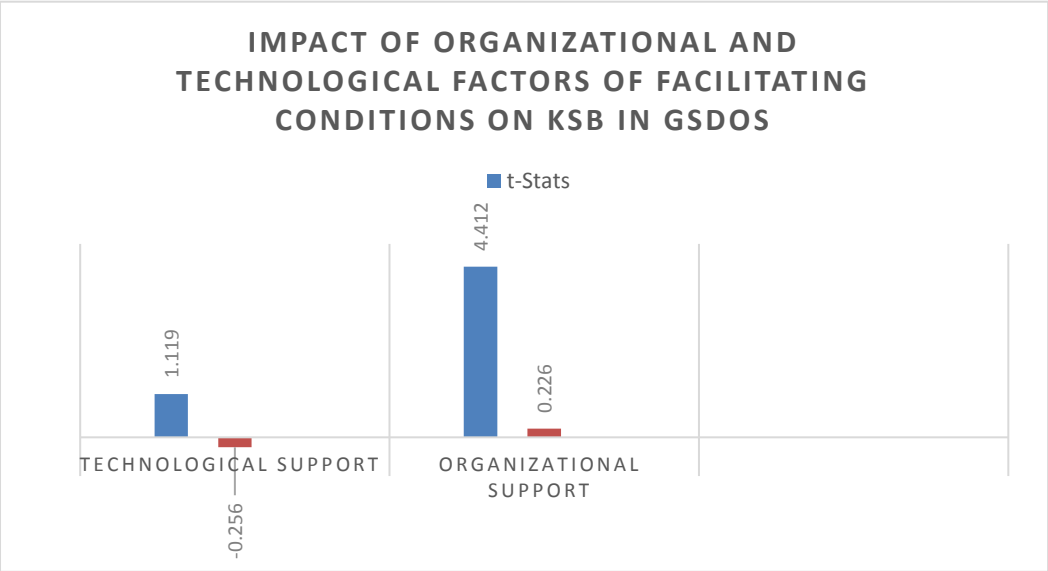

Figure 4.8: Impact of T Values and Path Coefficients of Facilitating Conditions

Out of the two factors used in the current research extracted from the Triandis facilitating conditions only organizational support emerged as significant factor to predict KSB of software developer working in GSDOs. The insignificance of technological support suggests that at least this sample of software developers did not rely on technological support to share knowledge with coworkers. It can be concluded that a GSDO with latest technological support might fail in KS, unless all the software developers are not managed properly and due to lack organizational support.

Further, after the introduction of moderating variables into the model, the hypothesis H1d (KSI - > KSB) was rejected. This result is not consistent with the prior findings of Safa & Von Solms (2016). This shows that the moderating variables proposed in this search are insignificant. This rejection can be

explained by the ‘‘*intention–behavior gap’’* (Sniehotta, 2005). Intentions is significantly correlated with behavior, but intervening events can weaken the intention-behavior relation (Ajzen & Fisbbein, 1974). In this research “organizational support” and “technological supported” acted as an “intervening events” which resulted in the insignificance of KSI - > KSB relationship.

4.8.5 Knowledge Sharing Behavior and Job Performance in GSDOs

In order to analyze effectiveness knowledge sharing, it is recommended to identify knowledge sharing impact on individual’s performance (Akram & Bokhari, 2011). In the current study only one variable namely, “job performance” was added to check the output of KSB of software developers. KSB had a significant and strong impact on JP with a path coefficient of 0.6991 and t-stats (12.279). The significance of JP suggests management of GSDOs paid extra emphasis on KSB, as successful organizations know that employee performance is vital (Bin, 2015). Author argued that effective KS is necessary for performance of individuals (Dosi & Orsenigo, 1988). The results of current research are consistent with the previous findings of Park & Im, (2001) and Hoopes & Postrel, (1999). The significant impact of JP suggests that the software developers are assumed to share knowledge in order to perform well in their respective jobs (Akram & Bokhari, 2011). The results of hypothesis for this category are presented in Table 4.17.

Table 4.18: Hypothesis Results of Knowledge Sharing Behavior and Job Performance

	Hypothesis	Path	Decision
H5	KSB is positively related to the job performance of software developers working in GSDOs.	KSB- > JP	Supported

The significance of JP provides some indication that knowledge sharing has an independent and direct influence on JP, which means that individuals set high goals for their own performance and have available access to performance relevant knowledge which they can share to others (Quigley, et al., 2007).

The last hypothesis of the current study, H5, was strongly supported. No matter how strong is the belief, that software process can be engineered, but the focal point remains consistent with the fact that software developer are "creative human beings" (Dyba, 2000), and "*happy software developers perform better than unhappy ones".* (Graziotin et al., 2014, p. 1). The main purpose of incorporating behavioral aspect to determine JP of software developers was based upon the fact that software development relies upon knowledge sharing (Zahedi et al., 2016) and is dominated by human factors (de Barros Sampaio, et al., 2010) using the cognitive processing abilities (I. A. Khan et al., 2011) and frequently the human aspects in software engineering research are ignored (Graziotin et al., 2014). As knowledge sharing has strong influence on individual performance (Akram & Bokhari, 2011), so the current research tried to analyse psychological aspect to determine knowledge sharing behavior and resulting impact on job performance due to lack relevant studies is software engineering arena (Graziotin et al., 2014). Henceforth, it is vital for GSDOs to adopt KSB because it plays a big role in on job performance and positively

impacts JP. Employees form the basic building block for any organization. Their perception about work and the results which they get from it will have a significant impact organizational stability (Munisamy, 2013). For example if employees are satisfied with their work, they will be extremely motivated to perform well to achieve organizational goals and eventually they will share knowledge which improves performance (Munisamy, 2013) by leading to innovative solutions (Hansen, 2002) Figure 4.10 presents impact of T values and Path Coefficients of JP.

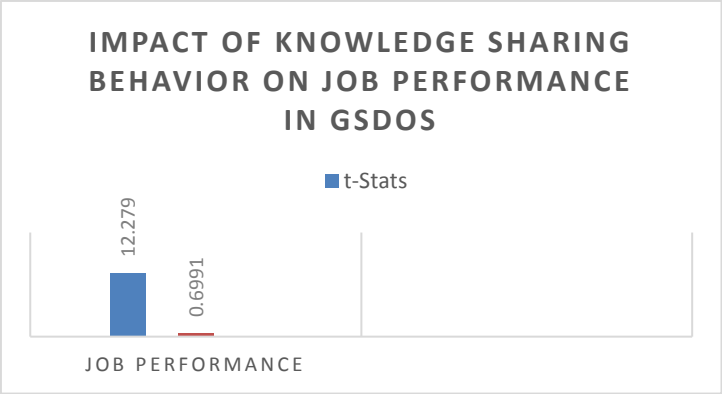

Figure 4.9: Impact of T Values and Path Coefficients of Facilitating Conditions

4.9 Chapter Summary

This chapter presented the results of the study. The study applied theory of planned behavior framework, social cognitive theory and Triandis facilitation conditions to investigate the KSB of employees working in GSDOs. Out of the 13 hypotheses, 8 were supported. The results showed the attitude, subjective norms, perceived behavioral control, social interaction, trust, geographic distance, organizational support and job performance had significant impact on

KSB. In contrast, knowledge sharing intention, motivation, linguistic distance, time zone difference and technological support showed insignificant impact on KSB. The study demonstrates that there is a positive and strong relationship between KSB and JP. The next chapter shall discuss the research conclusion, limitation and possibilities for future work.

CHAPTER 5

CONCLUSION

5.1 Overview

The last chapter of the thesis provides answers to the research questions presented in the first chapter. Research limitations, implications and recommendations are also discussed. Additionally, future directions are also discussed at the end of this chapter.

5.2 Research Objectives

The "descriptive-explanatory" research attempted to fill the gap in existing literature by identifying the KSB factors which had influence on KSB of software developers working in GSDOs. The research was initiated with the following objectives:

1. To identify the facilitators which support KSB in GSDOs

Social interaction, motivation & trust, organizational support and technological support were identified as facilitators in this research. The results of this research showed that social interaction, trust and organizational support had positive impact on KSB of software developers working in GSDOs,

whereas motivation and technological support had no impact on the KSB of software developers working in GSDOs.

2. To identify the barriers which hinder KSB in GSDOs

Geographic distance, linguistic distance and time zone difference were identified as barriers. The results of this research showed that geographic distance had negative impact on KSB of software developers working in GSDOs, whereas time zone difference and linguistic distance had no impact on the KSB of software developers working in GSDOs.

3. To develop and validate a framework for KSB

The framework was developed using TPB, SCT and Triandis facilitating conditions. The conceptual framework was reported in chapter 2. Figure 5.1 shows the finalized validated framework after the analysis:

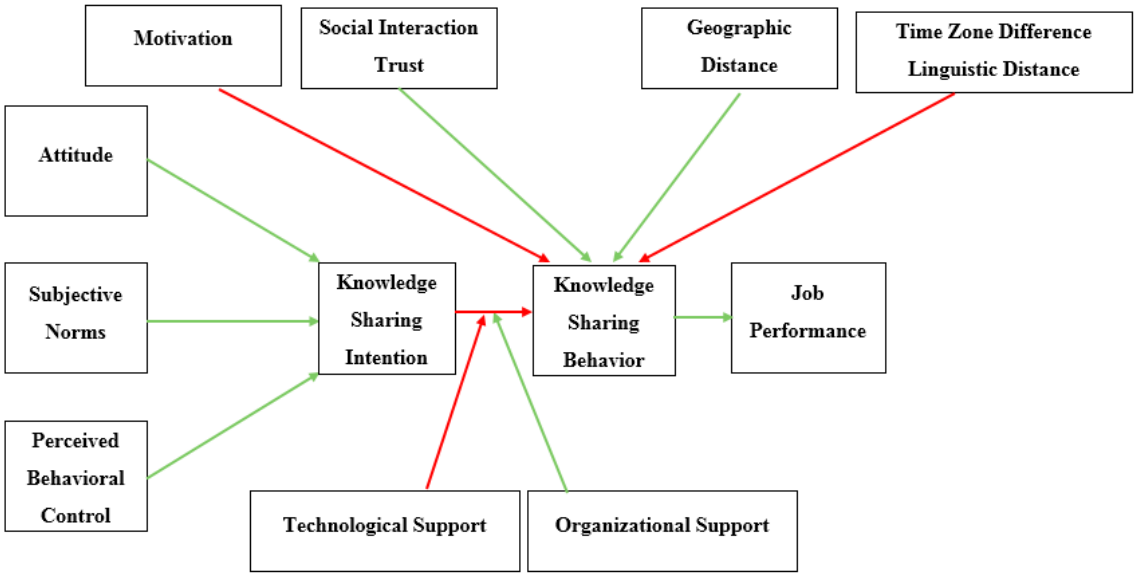

Figure 5.1: Validated Framework for KSB in Global Software Development Organizations

In figure 5.1 the blue arrow represents the accepted hypothesis and red represents the rejected hypothesis.

4. To Analyze the impact of KSB on the JP of software developer's working in global software development organizations

The results related to the impact of KSB on the JP of software developers are discussed in chapter 4. KSB had strongest impact on software developer's JP.

5.3 Contributions of Research Work

I. The results provide an enhanced and comprehensive framework for KSB and which includes all dynamics namely: individual, technological, organizational, cultural and geographic.

II. Impact of KSB on software developer's JP was analyzed.

III. The moderating impact of facilitating conditions (organizational support and technological) support was analyzed for Malaysian software developers.

IV. Constructs derived from TPB, SCT and Triandis facilitating conditions were found useful to predict KSB of software developers working in GSDOs.

5.4 Implications

The academic and managerial implications are given below in section 5.4.1 and 5.4.2 respectively.

5.4.1 Academic Implications

The published work of this research can be used as guide line to understand in detail the issues faced by software developers working in GSDOs. By identifying the factors of KSB, we extended the knowledge on the topic of KSB and GSDO. Through testing the conceptual framework, we further confirmed the importance of using TPB, SCT and Triandis model facilitating conditions to determine KSB in GSDOs. By analyzing the impact of KSB on JP of software developers working in GSDOs, this research showed the significance of KSB on Software developers JP productivity. The outcomes of this study can provide insight of factors related to KSB to future researchers.

5.4.2 Managerial Implications

The top management need to ensure an environment which can enhance and boost up KSB of software developers working in GSDOs. Such environment shall allow easy exchange of ideas and enhance individual's expertise. Form the results of hypothesis 6, another interesting implication can be drawn to enhance software productivity, as Rasch (1992) stated that *"software developers' performance"* has a direct impact on "*software development productivity"* (Rasch & Tosi, 1992, p. 395). On the basis of this explanation, management of

GSDOs can understand the flow to enhance software development productivity, which is summarized in the figure 5.2.

Figure 5.2: Knowledge Sharing Behavior Outcomes

5.4.2.1 Recommendations to Practitioners of GSDOs:

I. GSDOs should put more effort to increase KSB culture
II. GSDOs should conduct trainings to build "trust between software developers", in order to motivate KS between them.
III. GSDOs should provide platforms which will promote "social interaction" among individuals (e.g. events, activities, common chat rooms etc.)

IV. GSDOs should provide sufficient organizational support to the software developers whenever required.

V. By assigning cultural ambassadors the cultural differences can be resolved in GSDOs.

VI. Utilizing time zones properly communication issues can be resolved in GSDOs.

VII. The management of GSDOs need to pay extra emphasis on promoting KSB, as its outcome has a strong impact on software developer's job performance.

5.5 Research Limitation and Future Work

The results of this research can be valuable to the global software industry but are not practical for other industries in general (education construction, agriculture etc.). The focus of current research was on the KSB of software developers from "individual perspective". In future the framework can be tested on "team level" as opposed to "individual level", by analyzing the KSB of distributed teams. As this research work was conducted in Malaysian GSDOs, the impact of "country wise rules", "policies" and "laws" impacting KSB of software developers in GSDOs may be explored. Future work can be done by doing a comparative study to determine KSB of software developers working in "agile" software projects vs. "traditional" (waterfall) software projects in different countries.

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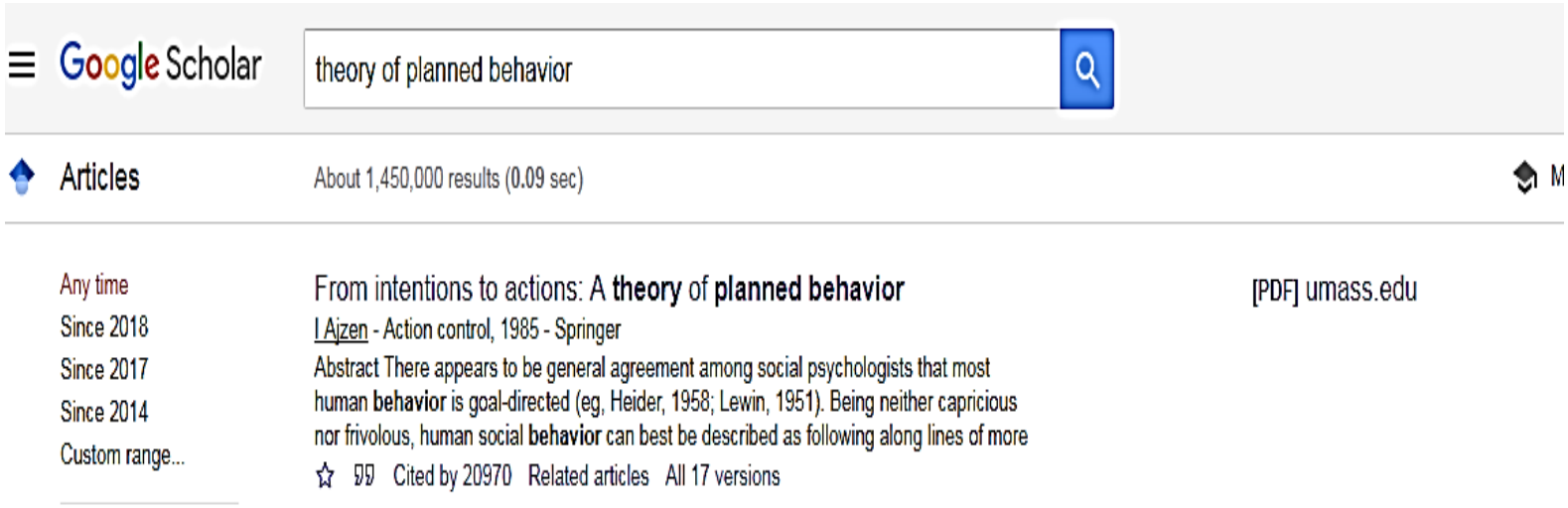
APPENDIX A: THEORY OF PLANNED BEHAVIOR



APPENDIX B: THEORY OF PLANNED BEHAVIOR USAGE WITHIN INFORMATION TECHNOLOGY /INFORMATION SYSTEMS

Theory of Planned Behavior Usage within Information Technology /Information Systems (Al-Lozi & Papazafeiropoulou, 2012)				
Study	**Area**	**Purpose**	**Modifications to TPB**	**Main results**
(Mathieson, 1991)	IS usage	Predict user intentions	Comparing TAM with TPB	1. Both TAM and TPB predicted intention to use IS quite well 2. TAM is easier to apply but only supplies general information on users' opinions about a system 3. TPB provides more specific information that can better guide development
(Taylor & Todd, 1995)	IT usage	Understand IT usage	A comparison of the TRA and the TPB	The decomposed TPB provides a fuller understanding of behavioral intentions by focusing on the factors that are likely to influence systems use
(Liao, Shao, Wang, & Chen, 1999)	Virtual banking	Study the adoption intention of virtual banking	TPB and Diffusion of Innovation Theory	1. Attitude towards virtual banking was dependent on relative advantage, compatibility, ease of use, result demonstrability, and perceived risk 2. Subjective norms about virtual banking were dependent on image, visibility and critical mass

				3. PBC about virtual banking was dependent on voluntariness, support and organizational learning 4. Intention to use virtual banking was determined by attitude, subjective norms and PBC
(Venkatesh, Morris, & Ackerman, 2000)	Technology adoption	Investigate gender differences in individual technology adoption decision-making processes	TPB	1. Men's decisions of using the technology were more strongly influenced by their attitudes 2. Women were more strongly influenced by subjective norms and PBC 3. Sustained technology usage behavior was driven by early usage behavior
	Adoption of negotiation support systems (NSS)	Identify factors affecting the intention to adopt negotiation support systems by managers and executives	Integrating TPB and TAM	1. Subjective norms and PBC emerged as strongest determinants of intention to adopt NSS 2. Probing of subjective norm revealed organizational culture and industrial characteristics to play significant roles
(Riemenschneider et al., 2003)	IT adoption decisions in small businesses	Understand IT adoption decisions of small business executives regarding a Web site	A collected model of TAM and TPB with the underlying categories of cognitions	Improved social contact with customers and vendors facilitated by the Internet is the driving force behind Web site adoption
(Hsu & Chiu, 2004)	WWW	Internet self-efficacy and electronic service acceptance	An extended model of the TPB	1. General internet self-efficacy and Web specific self-efficacy are found to play important roles in shaping individual behavior 2. General Internet self-efficacy had a significant influence on attitude toward the e-service usage

				3. General Internet self-efficacy contributed to the shape of an individual's Web specific self efficacy 4. Web specific self-efficacy had a significant direct effect on e-service usage 5. Attitude toward the e-service usage was the major determinant of behavioral intention 6. Interpersonal norm and subjective norm did not have a direct effect on behavioral intention
(T. Hansen, Jensen, & Solgaard, 2004)	WWW	Predict online grocer buying intention	A comparison between the TRA and the TPB	The TPB with the inclusion of a path from subjective norm to attitude provides the best fit to the data and explains the highest proportion of variation in online grocery buying intention
(Celuch, Taylor, & Goodwin, 2004)	WWW	Understand insurance sales person Internet information management intentions	A comparison of the TRA and the TPB	1. The TRA fails to account for the important role of self-efficacy in predicting information management intentions in both the customer and company related settings 2. Perceived control was not found to have impact in the customer model and had minor impact in the company model
(George, 2004)	WWW	Investigate the relationships among beliefs about Internet privacy and trustworthiness, along with beliefs about perceived behavioral control and the	TPB	1. Beliefs about trustworthiness positively affect attitudes toward buying online, which in turn positively affect purchasing behavior 2. Beliefs about self-efficacy regarding purchasing positively affect perceived behavioral control, which in turn affects online purchasing behavior

		expectations of important others, and online purchasing behavior		
(Shih & Fang, 2004)	WWW	Study Internet banking in Taiwan	Decomposed TPB (comparing the TRA and pure TPB to a decomposed TPB)	1. Intention to adopt Internet banking can be explained by attitude in both models. However, in the decomposed TPB model, only relative advantage and complexity are related to attitude, while compatibility is not 2. The path from subjective norm to intentions ailed to achieve significance. People who are important to users of the do not influence their intention to adopt internet banking. The possible factors of influence could be other network characteristics, such as information quality and security 3. Self-efficacy is a significant determinant of PBC
(Workman, 2005)	Technology use, disuse, and misuse	Investigate the use, disuse, and misuse of an expert decision support (EDSS) technology	TPB	1. EDSS use was negatively related to errors 2. Misuse of EDSS was positively related to errors. 3. Positive attitudes and social influences led to increased EDSS use while perceptions of control had no effect 4. The interaction of social influences and attitudes had a significant nonlinear relationship with EDSS misuse
(Pavlou & Fygenson, 2006)	eCommerce	Understand and predict eCommerce adoption	Extension of the TPB	1. Importance of trust and technology adoption variables (perceived usefulness and ease of use) as salient beliefs for predicting ecommerce adoption, justifying the integration of trust and technology adoption variables within the TPB framework 2. In addition, technological characteristics (download delay, Website navigability, and

				information protection), consumer skills, time and monetary resources, and product characteristics (product diagnostic and product value)
(Truong, 2008)	WWW	Predict user acceptance of online video services	TPB	1. TPB model was viable in predicting user acceptance of online video services 2. Perceived behavioral control was the highest contributor to predicting intention to use online video services 3. Attitude toward use and subjective norm were found to have moderate predictive power
(Jeon et al., 2011).	community of practice (CoP) members' KS attitudes, intentions, and behavior	Identify factors and relationships which influenced "community of practice (CoP) members' knowledge-sharing attitudes, intentions, and behavior".	TPB	It was found that both intrinsic factors such as "enjoyment" and "need for affiliation" and extrinsic motivational factors such as "image" and "reciprocity" had positive effect on ATT toward KS. Also, communities of practice influenced KSB

APPENDIX C: SOCIAL COGNITIVE THEORY MAPPING WITHIN INFORMATION TECHNOLOGY /INFORMATION SYSTEMS

Reference	Context	Sample	Social/Environmental Variables	Individual Variables			Behavioral/ Dependant Variables
				Self Efficacy	Outcome Expectancy	Others	
Downey et al. (2008)	Computer use	310 Navy students	–	General computer self-efficacy, application-specific self-efficacy	–	Anxiety, affect, declarative knowledge	Overall computer competence, domain- specific competence (performance measure)
Fagan et al (2004).	Computer	978 students	Organizational support	Computer self efficacy -	–	Computer anxiety, computer experience	Computer use
George (2004)	Online shopping	193 students	Normative structure, subjective norms	Efficacy	–	Internet trustworthiness beliefs, unauthorized use beliefs, perceived Behavioral control, attitude toward online purchasing	Internet purchasing
Gong et al.	Web-based learning system	280 teachers and students	–	Computer self-efficacy, perceived ease of use	Perceived usefulness	Attitude	Intention to use

Guriting and Ndubisi (2006)	Online banking	133 individuals	–	Computer self-efficacy, perceived ease of use	Perceived usefulness	Prior computing experience	Behavioral intention
Hasan and Ali (2004)	Computer learning	151 students	–	Computer self-efficacy	–	Computer attitudes, computer Experience Computer experience	Learning performance
Hasan and Ali (2006)	Computer training	78 undergraduate students	–	General computer self-efficacy, system-specific computer self-efficacy, perceived ease of use	Perceived usefulness	–	Training effectiveness
Hasan (2006)	Computer training	78 undergraduates students	–	General computer self-efficacy, software-specific computer self-efficacy, perceived ease of use	–	Computer anxiety	Training effectiveness
Hasan (2007)	Editing application training	96 undergraduate students	–	Computer self-efficacy, ease of use	Usefulness	Attitude, perceived complexity	Intention
Havelka (2003)	Software use	324 students	–	Software self efficacy	–	Computer anxiety, computer experience, gender, ACT score	–

Hayashi et al. (2004)	E-learning system	110 undergraduate students	–	Computer self-efficacy, perceived ease of use	Perceived usefulness	Satisfaction, confirmation	Continuance intention
Ranganathan and Jha (2007)	Online shopping	214 online customers	–	Computer self-efficacy	–	Past experience, customer concerns in online shopping, IT attitude, IT skills, privacy concerns, security concerns	Online shopping intention
Ratten and Ratten (2007)	Online banking	203 young people	Media, modelling	Self-efficacy	Outcome values, outcome expectancy	–	Behavioral intention
Reid (2008)	Banking information systems	374 bank customers	–	Computer self-efficacy, perceived ease of use	Perceived usefulness	Trust, gender, attitude toward using	Intention to use
Schen and Schen and Eder (2009b)	Virtual worlds	90 students	–	Computer self-efficacy, perceived ease of use	Perceived usefulness	Computer anxiety, computer playfulness, perceived enjoyment	Behavioral intention to use
Thompson et al. (2006)	Software training	193 students	Social factors	Computer self-efficacy, ease of use	Perceived usefulness	Innovativeness with IT, affect, perceived behavioral control	Future intention
Venkatesh, and Davis (1996)	Computer, software	108 students	Objective usability	Computer self-efficacy, perceived ease of use	Perceived usefulness	Direct experience	–

Wang and Wang (2008)	Online games	281 respondents	System characteristics: challenge, feedback, speed	self-efficacy		Perceived playfulness, gender, computer anxiety	Behavioral intention
Wang et al (2003).	Online banking	123 users	–	Computer self-efficacy	Perceived usefulness	Perceived ease of use, perceived credibility	Behavioral intention
Yi and Davis (2003)	Software training	95 students	Modelling-based training interventions	Software self-efficacy, (pre/post training)	–	Pre-training individual differences, motivation to learn, observational learning processes	Task performance
Yi and Im (2004)	Computer training	41 MBA students	–	Computer self-efficacy	–	Personal goal, age, prior experience	Computer task performance
(Tsai & Cheng, 2010)	KSB of software programmers	225 software engineers	Organizational climate	self-efficacy	outcome expectancy	-	Intention to share knowledge Knowledge sharing behavior

APPENDIX D SURVEY LETTER

Dear Participant,

My name is Rayhab Anwar and I am a graduate student at Universiti Tunku Abdul Rahman. For my research work, I am conducting a survey which examines" FRAMEWORK FOR THE IMPLEMENTATION OF KNOWLEDGE SHARING BEHAVIOR IN GLOBAL SOFTWARE DEVELOPMENT ORGANIZATIONS". You are invited to complete questionnaire survey. For all questions, you simply select a numbered response that best matches your opinion. The survey will take around 5-10 minutes to complete can be found at https://goo.gl/dFfZh9.

Who can fill this survey:

Respondents: (Software developers)
Experience: (Intern to CEO level)

If you don't fit into this category, please circulate this to anyone you know from GSDOs.

Please note that:

- Your answers will be treated confidentially and with anonymity.
- The questionnaire will not ask you to identify yourself, your co-workers, or the name of the matter or project you are referencing.
- No personnel records will be used, and no matching or personal characteristics will be made. Your identity will not be revealed in the reporting of the study's results.
- Only members of the academic research team will have access to this data.
- The researchers intend to publish the study's results in scholarly journals. In all publications, including the summary report, the identity of participants will remain confidential.

If you require additional information or have questions, please contact me at: rayhab.anwar@gmail.com

Sincerely,

Rayhab Anwar

APPENDIX E: QUESTIONNAIRE

We are conducting a research study that examines knowledge sharing behavior in global software development organizations. We are interested in the experiences you and other knowledge workers have with sharing knowledge during everyday activities. You are invited to complete questionnaire survey, which has two sections. The first is an individual section, which asks you to answer questions about yourself and your background; the second section requires you to answer questions regarding knowledge sharing. For all questions, you simply select a numbered response that best matches your opinion.

Please note that:

- Your answers will be treated confidentially and with anonymity.
- The questionnaire will not ask you to identify yourself, your co-workers, or the name of the matter or project you are referencing.
- No personnel records will be used and no matching or personal characteristics will be made. Your identity will not be revealed in the reporting of the study's results.
- Only members of the academic research team will have access to this data.
- The researchers intend to publish the study's results in scholarly journals. In all publications, including the summary report, the identity of participants will remain confidential.
-

A- Individual Section

Demographics - Please check the category that is most appropriate.

Gender

☐ Male

☐ Female

Age Group

☐ Less than 25 years old
☐ 25 to 35 years old
☐ 36 to 40 years old
☐ Above 40 years old

Level of Education

☐ Diploma
☐ Bachelor's Degree
☐ Master's Degree
☐ Doctorate Degree
☐ Other – Please Specify_____

Experience

☐ Less than 5 years
☐ 5 to 10 years
☐ More than 10 years

Your Job Title: _____

Your Organization's Size (number of employees): _____

Question Section

Please indicate how strongly you agree or disagree with each statement by circling a number.
1= Strongly Disagree 5 = Strongly Agree

Attitude towards Knowledge Sharing

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1.	To me, sharing knowledge with my co-workers is good.	**1**	**2**	**3**	**4**	**5**
2.	To me, sharing software development knowledge with my co-workers is harmful	**1**	**2**	**3**	**4**	**5**
3.	To me, sharing software development knowledge with my co-workers is enjoyable experience.	**1**	**2**	**3**	**4**	**5**
4.	To me, sharing software development knowledge with my co-workers is valuable.	**1**	**2**	**3**	**4**	**5**
5.	To me, sharing software development knowledge with my co-workers is a wise move.	**1**	**2**	**3**	**4**	**5**

Subjective Norms

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	People who influence my behavior (e.g. boss, co-worker etc.) think that I should share my software development knowledge and expertise	**1**	**2**	**3**	**4**	**5**
2.	People who are important to me (e.g. boss, co-worker etc.) think that I should share my software development knowledge and expertise	**1**	**2**	**3**	**4**	**5**
3.	Generally speaking, I try to follow the CEO's policy and intention.	**1**	**2**	**3**	**4**	**5**
4.	Generally speaking, I accept and carry out my boss's decision even though it is different from mine.	**1**	**2**	**3**	**4**	**5**
5.	Generally speaking, I respect and put in practice my co-worker's decision.	**1**	**2**	**3**	**4**	**5**

Perceived Behavioral Control

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I have the ability to share my knowledge with my co-workers.	**1**	**2**	**3**	**4**	**5**
2.	I have the useful resources to share my knowledge with the other employees.	**1**	**2**	**3**	**4**	**5**
3.	Sharing my software development skills is currently within my control.	**1**	**2**	**3**	**4**	**5**
4.	Sharing my knowledge related to "software construction tools and	**1**	**2**	**3**	**4**	**5**

	technologies" is currently within my control.					

Social Interaction

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I maintain close social interaction with some of my co-workers.	**1**	**2**	**3**	**4**	**5**
2.	I spend a lot of time-sharing knowledge with some of my co-workers.	**1**	**2**	**3**	**4**	**5**
3.	I have frequent exchange of knowledge with some of my co-workers.	**1**	**2**	**3**	**4**	**5**
4.	I have frequent exchange of software development ideas with some of my co-workers	**1**	**2**	**3**	**4**	**5**
5.	I like to share my software expertise to some members whom I know on personal level.	**1**	**2**	**3**	**4**	**5**

Trust

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I believe that my co-workers can be trusted completely to share knowledge.	**1**	**2**	**3**	**4**	**5**
1.	I believe that my co-workers software development knowledge is reliable.	**1**	**2**	**3**	**4**	**5**
2.	I believe that my co-workers software development knowledge is useful.	**1**	**2**	**3**	**4**	**5**
3.	I believe that my co-worker software development knowledge is effective.	**1**	**2**	**3**	**4**	**5**

4.	I believe that my co-workers would not take advantage of my software development knowledge that we share.	**1**	**2**	**3**	**4**	**5**
5.	I believe that my co-workers can't be trusted completely to share knowledge.	**1**	**2**	**3**	**4**	**5**

Motivation

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1.	I enjoy sharing knowledge with my co-workers.	**1**	**2**	**3**	**4**	**5**
2.	It feels good to share my software development techniques with my co-workers to solve their work-related problems.	**1**	**2**	**3**	**4**	**5**
3.	Sharing knowledge with my co-workers gives me pleasure.	**1**	**2**	**3**	**4**	**5**
4.	Sharing my knowledge improves others recognition of me.					
5.	When I share my software development knowledge with my team members, my superiors respect me.	**1**	**2**	**3**	**4**	**5**

Technological Support

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1.	Whenever I want to share knowledge, I can easily access tools and technology in our organization.	**1**	**2**	**3**	**4**	**5**
2.	In our organization, tools and technology for sharing knowledge are reliable.	**1**	**2**	**3**	**4**	**5**

3.	Tools and technology for sharing knowledge can be customized to fit individual needs.	**1**	**2**	**3**	**4**	**5**
4.	I share knowledge by inputting it into knowledge repository/company databases (containing existing expertise, lessons learned, best practices etc.).	**1**	**2**	**3**	**4**	**5**
5.	I use discussion forum (using tools like electronic bulletin board, chat room etc.) to share knowledge with my co-workers.	**1**	**2**	**3**	**4**	**5**
6.	I use videoconferencing to share knowledge with my co-workers.	**1**	**2**	**3**	**4**	**5**

Organizational Support

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1.	"Knowledge sharing culture" is of great value in my organization.	**1**	**2**	**3**	**4**	**5**
2.	My organization encourages knowledge sharing activities (workshops, trainings, group discussions, seminars, visits etc.) for new opportunities.	**1**	**2**	**3**	**4**	**5**
3.	The management awards employees for taking part knowledge sharing activities.	**1**	**2**	**3**	**4**	**5**
4.	The management develops adequate plans and schedules for the implementation of knowledge sharing activities.	**1**	**2**	**3**	**4**	**5**
5.	My organization puts much value on sharing knowledge and taking risks even if that turns out to be a failure.	**1**	**2**	**3**	**4**	**5**

Knowledge Sharing Intention

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	If given opportunity, I will always share my work reports and official documents with members of my organization more frequently in the future.	**1**	**2**	**3**	**4**	**5**
2.	If given opportunity, I will always share my manuals, methodologies and models for members of my organization.	**1**	**2**	**3**	**4**	**5**
3.	If given opportunity, I will always share my know-where or know-whom at the request of other organizational members.	**1**	**2**	**3**	**4**	**5**
4.	If given opportunity, I will always share my expertise from my education or training with other organizational members in a more effective way.	**1**	**2**	**3**	**4**	**5**
5.	If given opportunity, I will share my experience or know-how from work with other organizational members more frequently in the future.	**1**	**2**	**3**	**4**	**5**

Knowledge Sharing Behavior

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I frequently participate in knowledge sharing activities in my organization.	**1**	**2**	**3**	**4**	**5**
2.	I frequently spend a lot of time conducting knowledge sharing activities in my organization.	**1**	**2**	**3**	**4**	**5**

3.	I frequently share my software development knowledge with others.	**1**	**2**	**3**	**4**	**5**
4.	When discussing a complicated issue, I am frequently involved in the subsequent knowledge sharing interactions.	**1**	**2**	**3**	**4**	**5**
5.	I frequently involve myself in discussions of various software development topics rather than specific topics.	**1**	**2**	**3**	**4**	**5**
Software Development Knowledge Sharing Behavior						
6.	I frequently share my knowledge related to "software construction fundamentals" with others.	**1**	**2**	**3**	**4**	**5**
7.	I frequently share my knowledge related to "managing software construction" with others.	**1**	**2**	**3**	**4**	**5**
8.	I frequently share my knowledge related to "practical software considerations" with others.	**1**	**2**	**3**	**4**	**5**
9.	I frequently share my knowledge related to "software construction tools and technologies" with others.	**1**	**2**	**3**	**4**	**5**

Linguistic Distance

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1.	Most people in my organization can communicate well in English.	**1**	**2**	**3**	**4**	**5**
2.	Differences in language makes it difficult to share knowledge.	**1**	**2**	**3**	**4**	**5**
3.	Linguistic diversity can make it difficult to communicate and collaborate across borders.	**1**	**2**	**3**	**4**	**5**

4.	I believe linguistic distance affects quality of knowledge sharing.	**1**	**2**	**3**	**4**	**5**
5.	I believe my co-workers have to spend some time thinking about my software development knowledge to understand my real meaning.	**1**	**2**	**3**	**4**	**5**
6.	Linguistic diversity in our organization opens up cross-border software knowledge sharing opportunities.	**1**	**2**	**3**	**4**	**5**

Geographic Distance

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1.	When working with cross-border co-workers, we incur losses due to ineffective knowledge sharing.	**1**	**2**	**3**	**4**	**5**
2.	When working with cross border developers, I lose time trying to figure out who to share knowledge regarding my work.	**1**	**2**	**3**	**4**	**5**
3.	When working with cross border developers, there have been times when I was accidently excluded from valuable knowledge which was shared by my co-workers.	**1**	**2**	**3**	**4**	**5**
4.	When working with cross border developers, it becomes difficult for me to find right people to whom I have to share my knowledge.	**1**	**2**	**3**	**4**	**5**
5.	I believe geographic distance affects quality of knowledge sharing.	**1**	**2**	**3**	**4**	**5**

Time Zone Difference

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I believe time zone difference affects quality of knowledge sharing.	**1**	**2**	**3**	**4**	**5**
2.	I believe time zone difference affects quality of software product development.	**1**	**2**	**3**	**4**	**5**
3.	I believe time zone difference affects productivity of knowledge sharing.	**1**	**2**	**3**	**4**	**5**
4.	I believe time zone difference causes communication overhead.	**1**	**2**	**3**	**4**	**5**
5.	When working with cross border team, I experience difficulty in scheduling schedule common meeting times in order to share my knowledge with my co-workers.	**1**	**2**	**3**	**4**	**5**

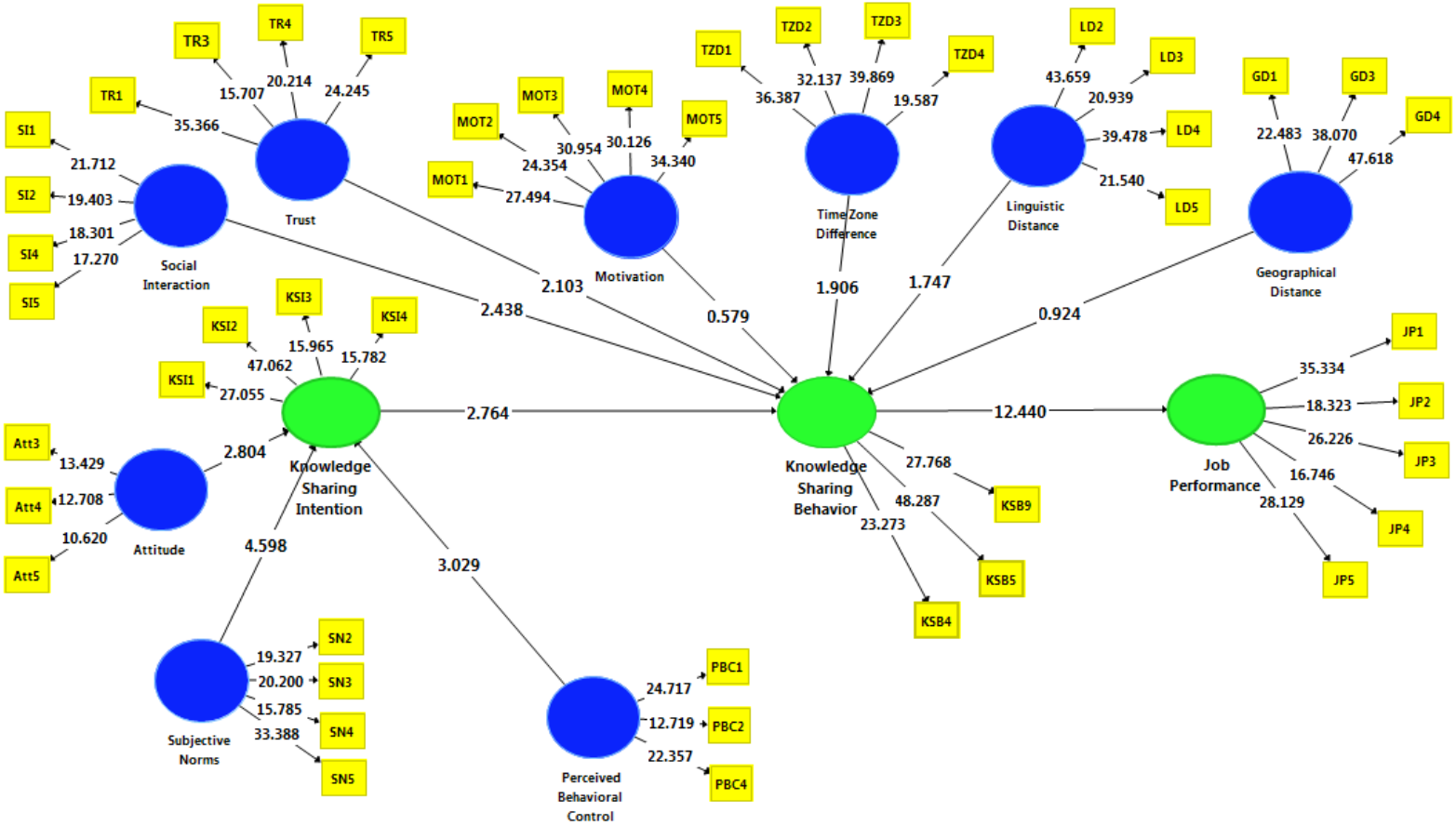
Job performance

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I think that my ability to perform my job duties has improved as a result of knowledge sharing activities.	**1**	**2**	**3**	**4**	**5**
2.	I think that my job-related communications have improved as a result of knowledge sharing activities.	**1**	**2**	**3**	**4**	**5**
3.	I think that the reliability of my job performance has improved as a result of knowledge sharing activities.	**1**	**2**	**3**	**4**	**5**

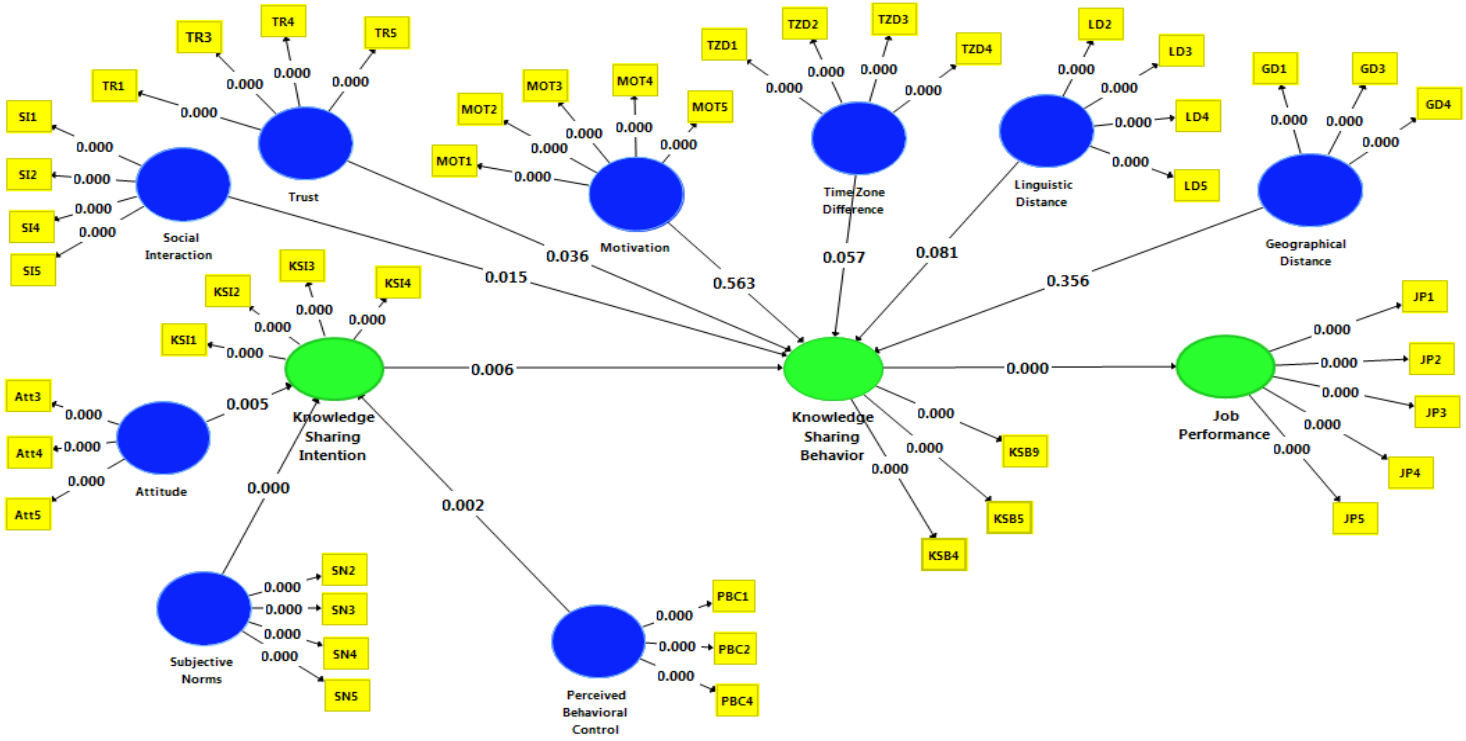
4.	I think that knowledge-sharing activities have allowed me to properly play the roles given to me.	**1**	**2**	**3**	**4**	**5**
5.	I think that knowledge sharing activities have helped me to achieve the job duties that are required of me.	**1**	**2**	**3**	**4**	**5**

Thank you for taking time out to participate in our survey. We truly value the information you have provided.

APPENDIX F: BOOTSTRAPPING (T VALUES)



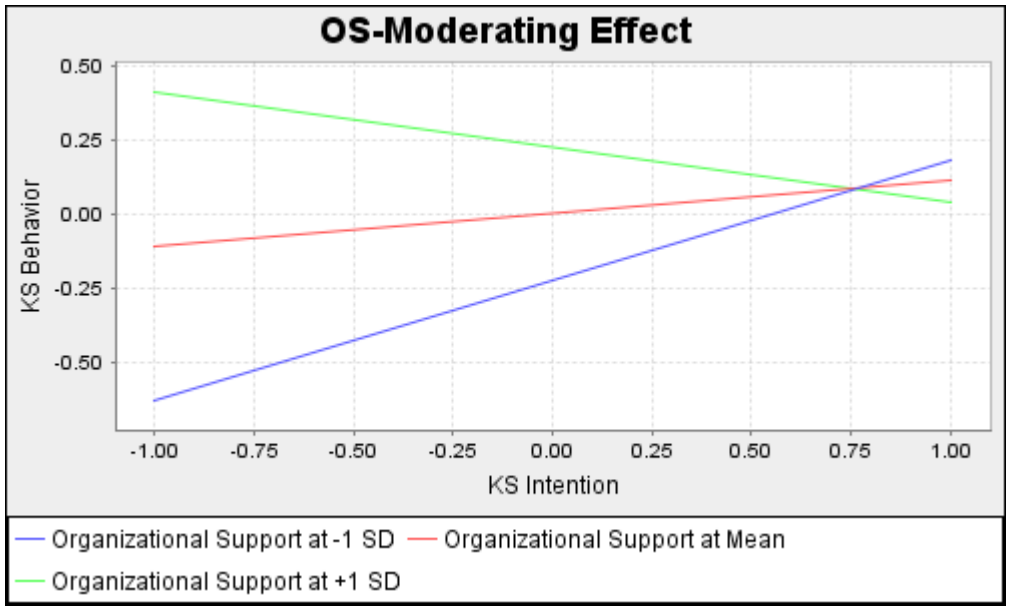
APPENDIX G: BOOTSTRAPPING (P VALUES)



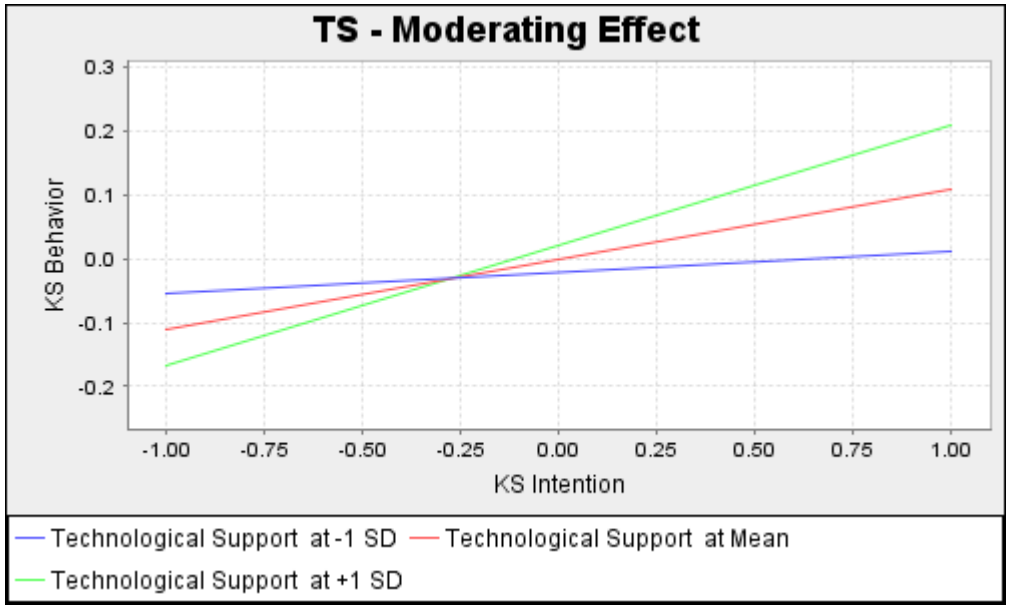
APPENDIX H: T STATISTICS AND P VALUES AFTER MODERATION

	T Statistics	P Values
Attitude -> Knowledge Sharing Intention	2.786	0.005
Geographic Distance -> Knowledge Sharing Behavior	2.570	0.010
Knowledge Sharing Behavior -> Job Performance	12.279	0.000
Knowledge Sharing Intention -> Knowledge Sharing Behavior	1.761	0.078
Linguistic Distance -> Knowledge Sharing Behavior	1.085	0.278
Motivation -> Knowledge Sharing Behavior	0.935	0.350
Organizational Support -> Knowledge Sharing Behavior	2.979	0.003
Organizational Support - Moderating Effect -> Knowledge Sharing Behavior	4.412	0.000
Perceived Behavioral Control -> Knowledge Sharing Intention	2.953	0.003
Social Interaction -> Knowledge Sharing Behavior	2.482	0.013
Subjective Norms -> Knowledge Sharing Intention	4.622	0.000
Technological Support -> Knowledge Sharing Behavior	0.325	0.745
Technological Support - Moderating Effect -> Knowledge Sharing Behavior	1.119	0.263
Time Zone Difference -> Knowledge Sharing Behavior	1.811	0.070
Trust -> Knowledge Sharing Behavior	3.061	0.002

APPENDIX I: OS MODERATING EFFECT



APPENDIX J: TS MODERATING EFFECT



APPENDIX K: COLLINEARITY TESTS

	Attitude	Geographic Distance	Job Performance	KS Behavior	KS Intention	Linguistic Distance	Motivation	Organizational Support	Perceived Behavioral Control	Social Interaction	Subjective Norms	Technological Support	Time Zone Difference	Trust
Attitude		1.509	1.443	1.497	1.504	1.498	1.565	1.474	1.490	1.535	1.478	1.562	1.481	1.462
Geographic Distance	4.160		4.345	4.266	4.200	4.033	3.778	3.499	3.909	4.174	4.117	4.173	3.309	4.283
Job Performance	3.082	3.273		2.798	3.110	3.145	3.145	3.286	2.950	3.204	3.101	3.281	3.053	3.203
KS Behavior	2.717	2.638	2.485		2.699	2.721	2.735	2.523	2.721	2.646	2.567	2.700	2.737	2.654
KS Intention	1.949	1.828	1.964	1.998		1.946	1.929	1.574	2.062	1.946	1.882	1.964	1.997	2.038
Linguistic Distance	2.762	2.804	2.851	2.933	2.904		3.065	3.056	2.719	2.901	2.608	2.757	2.925	2.962
Motivation	2.958	3.027	2.963	3.038	3.046	3.129		3.077	2.949	2.936	1.514	2.107	3.052	2.776
Organizational Support	2.171	1.966	2.241	2.133	1.831	2.256	2.290		2.109	2.234	2.150	2.312	2.210	2.244
Perceived Behavioral Control	2.369	2.115	2.415	2.450	2.487	2.410	2.300	2.153		2.292	2.372	2.327	2.357	2.379
Social Interaction	4.470	3.934	4.455	4.399	4.248	3.906	3.279	4.061	4.088		3.607	3.536	4.261	4.222
Subjective Norms	2.503	2.402	2.607	2.661	2.538	2.286	1.258	2.432	2.520	2.032		1.907	2.515	2.423
Technological Support	3.346	3.280	3.333	3.390	3.333	3.093	2.296	3.406	3.290	3.353	2.393		3.374	3.388
Time Zone Difference	3.136	2.598	3.240	3.391	3.470	3.426	3.059	3.204	3.315	3.348	3.410	3.382		3.272
Trust	2.549	3.194	2.929	2.787	2.933	3.225	2.861	3.303	2.677	2.863	2.401	3.267	3.106	