SOCIAL AND HUMAN CAPITAL COLLABORATOR SELECTION MODEL FOR EXPERT FINDING SYSTEMS IN RESEARCH UNIVERSITIES

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ABSTRACT

Due to the problem of information overload, users have a difficult time locating experts with the required expertise. Expert finding systems try to alleviate the information overload problem and recommend experts who can satisfy users' needs. In the context of research universities, expert finding systems support researchers in automatically locating research collaborators. However, there is a problem with the current expert finding systems, in which they retrieve experts based on the content of their documents, but neglect the human interaction perspective. The human interaction perspective comprises the factors that influence collaborator selection decisions in real life. Therefore, this study aims to examine the factors that affect researchers' decision to collaborate with a particular research collaborator in the research universities context. This study develops a model by integrating Scientific and Technical Human Capital (STHC) model and Social Capital Theory (SCT) to examine the human capital, social capital, and cultural capital factors that influence researchers' decision to collaborate with a particular research collaborator. In carrying out the study, the researcher conducted a systematic literature review to identify the human capital, social capital, and cultural capital factors that influence collaborator selection. The proposed model's fourteen hypotheses were then tested quantitatively by surveying 349 researchers from Malaysian research universities. Subsequently, an analysis with the use of SmartPLS based on Structural Equation Modelling (SEM) was performed to analyze all the survey data. The empirical results revealed that the significant factors that influence collaborator selection in the research universities context were as follows: cognitive accessibility, reliability, relevance, commitment, physical accessibility, cultural experiences, complementary skills, and research experience. Surprisingly, the results revealed that network ties, relational accessibility, and reputation were insignificant factors for collaborator selection. This study proposed a research model for collaborator selection in the research universities context, in which the research model can be utilized by expert finding systems designers, researchers, collaborators, and universities.

ABSTRAK

Akibat daripada masalah beban maklumat yang berlebihan, pengguna menghadapi kesukaran untuk membuat pencarian pakar dengan kemahiran yang diperlukan. Pembangunan sistem pencarian pakar diharapkan dapat membantu dalam mengurangkan masalah beban maklumat berlebihan dan mengesyorkan pakar mengikut keperluan pengguna. Dalam konteks universiti penyelidikan, sistem pencarian pakar digunapakai bagi memudahkan penyelidik mencari rakan kolaborasi yang sesuai secara automatik. Namun, sistem pencarian pakar sedia ada hanya mencari pakar berdasarkan isi kandungan dokumen mereka sahaja, tetapi mengabaikan perspektif interaksi manusia. Perspektif interaksi manusia adalah sangat penting kerana ianya merangkumi faktor yang dapat mempengaruhi pemilihan rakan kolaborasi secara langsung. Tujuan penyelidikan ini dijalankan dalam konteks universiti penyelidikan adalah untuk mengkaji faktor yang mungkin mempengaruhi keputusan penyelidik untuk bekerjasama dalam penyelidikan tertentu bersama dengan kolaborator yang lain. Kajian ini menggabungkan dua model Modal Insan Saintifik dan Teknikal (STHC) dan Teori Modal Sosial (SCT) untuk mengkaji faktor modal insan, modal sosial dan modal budaya yang mempengaruhi keputusan penyelidik untuk bekerjasama dengan kolaborator tertentu. Bagi menentukan faktor tersebut, satu tinjauan literatur secara menyeluruh telah dijalankan. Pendekatan secara kuantitatif telah dijalankan untuk menguji empat belas hipotesis model yang dicadangkan, di mana seramai 349 penyelidik telah dipilih dari universiti penyelidikan di Malaysia sebagai responden. Seterusnya, hasil tinjauan kajian ini telah dianalisis dengan menggunakan SmartPLS berdasarkan Pemodelan Persamaan Struktural (SEM). Hasil empirikal kajian ini mendapati antara faktor penting yang mempengaruhi pemilihan kolaborator adalah kebolehcapaian kognitif, kebolehpercayaan dan kesesuaian. Di samping itu, mereka juga mengambil kira komitmen, kebolehcapaian fizikal, pengalaman budaya, kemahiran pelengkap dan pengalaman dalam penyelidikan. Sebaliknya, hasil tinjauan juga menunjukkan hubungan rangkaian, kebolehcapaian hubungan dan reputasi sosial adalah faktor yang tidak relevan untuk diambilkira dalam konteks ini. Kajian ini mencadangkan model penyelidikan bagi pemilihan kolaborator dalam konteks universiti penyelidikan yang boleh digunakan untuk sistem pencarian pakar, penyelidik, kolaborator dan universiti penyelidikan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

IR	-	Information Retrieval
SLR	-	Systematic Literature Review
KSCs	-	Knowledge Sharing Communities
SNs	-	Social Networks
ISCs	-	International Scientific Collaborations
UIC	-	University–Industry Collaboration
R&D	-	Research and Development
UM	-	Universiti Malaya
UKM	-	Universiti Kebangsaan Malaysia
UPM	-	Universiti Putra Malaysia
UTM	-	Universiti Teknologi Malaysia
USM	-	Universiti Sains Malaysia
TREC	-	Text REtrieval Conference
W3C	-	World Wide Web Consortium
CSIRO	-	Commonwealth Scientific and Industrial Research Organization
TU	-	Tilburg University
LExR	-	Lattes Expertise Retrieval
NER	-	Named Entity Recognition
MRR	-	Mean Reciprocal Rank
MAR	-	Mean Average Precision
P@N	-	Precision after Ranking N People
STEM	-	Science, Technology, Engineering, and Mathematics
SES	-	Socioeconomic Status
CVI	-	Content Validity Index
HTMT	-	Heterotrait-Monotrait
CI	-	Confidence Interval

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Overview

In the past few years, several organizations have realized that effective management of all knowledge assets could help them survive in a competitive business environment. Expertise is a vital knowledge asset and is often kept in people's minds. Therefore, it is difficult to codify, but it can be shared when people interconnect with one another Balog et al. (2012). The rapid evolution of the World Wide Web highly increases the amount of information and data. Therefore, it becomes more difficult for people to search for expertise (Nikzad–Khasmakhi et al., 2019). People need to consult an expert to determine ways to solve their problems. Although there is a massive volume of data available for solving the problems, people still look for an expert's services and guidance (Lin et al., 2017). Generally, important information is not accessible in a digital format, and it could be difficult to analyze or express in the form of a text. Therefore, experts help by answering the individual's questions and play an essential role in any organizational setting. For instance, conference planners usually search for a team of reviewers, students need appropriate supervisors for their projects, and consultants have to look for other consultants for reviewing their investigations (Balog et al., 2012). Expert has been identified by Weiss and Shanteau (2003) as an individual who has skills in his domain of expertise and can evaluate a particular domain topic.

Since the 1960s, studies have been carried out to seek expertise from experts efficiently (Menzel, 1960). Expertise seekers seek knowledge for specific purposes such as problem-solving, collaboration and supervision (Hertzum, 2014). Expertise seekers require comprehensive information about experts who can answer their questions. In the past, they look for experts from their colleges or people around them (Hertzum, 2014; Woudstra et al., 2012). In the era of multidisciplinary

research, it is difficult for expertise seekers to find an expert with complementary skills from their colleges (Wang et al., 2018). Besides, due to the availability of a massive volume of data, finding the right expert at the right time is a challenging problem (Neshati et al., 2017; Wang et al., 2017b). For example, the DBLP dataset (a collection of scientific publication records) has more than 4,419,797 publications and 2,205,56 researchers. This phenomenon creates a challenge in finding suitable academic research collaborators (Pradhan and Pal, 2020). Additionally, it is not practical to manually collect information about experts and research collaborators, specifically in widely distributed and large-scale organizations (Mangaravite et al., 2016; Yimam-Seid and Kobsa, 2003). Therefore, Information Retrieval (IR) techniques are used to facilitate the retrieval of experts. Such techniques could be used for finding experts using certain automated systems, namely expert locating (also known as expert finding or expertise retrieval) systems.

Expert finding systems are IR systems that can identify different candidate experts and ranking them based on their expertise in a given subject. Their expertise is usually extracted from the available evidence such as the candidate's publication, reports, projects, social network, online and actual activities (Balog et al., 2009; Stankovic et al., 2010). Expert finding system is useful for individuals and organizations, as it allows them to retrieve suitable experts automatically and provide them with personalized information services (Ehrlich, 2003; Pradhan and Pal, 2020).

Expert finding systems have been developed widely in different domains such as academia, enterprise, and social networks (Dorneles, 2019). For example, expert finding systems have been used in academia to find supervisors, paper reviewers, and research collaborators. According to a Systematic Literature Review (SLR) conducted in this study, expert finding systems were developed in six different domains. These domains are enterprises, academia, Knowledge Sharing Communities (KSCs), medicine, Social Networks (SNs), and online forums. Expert finding systems are mostly used in the academic domain for research collaboration tasks to find research collaborators.

Increasing knowledge production growth contributes to their competitiveness and specialization (Iglič et al., 2017). Recently, the productivity of scientific research in universities has been one of the most significant concerns for economic policy (Carillo et al., 2013). Universities continually need to adjust their research approach to enhance scientific productivity and impact to achieve high-quality outcomes at the national and international levels. The research performance in universities is considered an indicator of national and international ranking criteria (Liu and Cheng, 2005). Moreover, universities consider research collaboration as a technique to solve complicated and challenging problems and to improve competitive power (Waruszynski, 2017). Additionally, the rise of multidisciplinary and interdisciplinary research necessitates new research and collaboration mechanisms to conduct research effectively (Ceballos et al., 2018).

Effective research collaboration mainly depends on the skills and personality of the research collaborators (Waruszynski, 2017). Researchers may appear to collaborate, but the challenge concerns the individuals they collaborate with (O'Leary et al., 2012). The increasing development of researchers' communities, a huge number of individuals, and the volume of available data on the web create significant obstacles for collaborator seekers to find a suitable research collaborator (Silva, 2014). As defined by Katz and Martin (1997), research collaborators are researchers who work together to advance scientific knowledge in research projects, scientific papers, or some other key aspects of scientific research. Selecting an effective research collaborator influences the efficiency of research collaboration. Therefore, selecting a suitable research collaborator is a fundamental problem in research collaboration in universities, as it determines the success of collaboration (Iglič et al., 2017; Johnston and Huggins, 2018; S. Kaplan, 2019; Stvilia et al., 2017).

1.2 Problem Background

According to the SLR that has been conducted in this research, expert finding systems have been developed widely to find research collaborators in the university context. Expert finding systems involve developing systems for identifying a set of

people who possessed the necessary expertise for a specific query based on the documents related to the candidate expert (Balog et al., 2012; Choi et al., 2021; Neshati et al., 2017; Rampisela et al., 2020; Roozbahani et al., 2020; Wang et al., 2017b). Currently, research in expert finding systems depends on a system-centered perspective, which concentrates on identifying good matches between the user query and content of documents related to experts (Moreira et al., 2015; Neshati et al., 2014b; Rampisela et al., 2020; Roozbahani et al., 2020; Xu et al., 2012). For example, Elsevier Expert Lookup and Scopus help people to find researchers based on the match between the user query and the researchers' published manuscripts. The main challenge in the current expert finding systems is that they retrieve experts like documents, although experts are not like documents, and they are not directly represented as retrievable elements (Balog et al., 2012; Faisal et al., 2017; Lin et al., 2017; Wang et al., 2017b; Wang et al., 2018; Xu et al., 2016b).

An expert's representation based on the strength of association between a topic and an expert's documents is called a documents-based representation (Balog et al., 2012; Lin et al., 2017). However, there are limitations to this representation. Firstly, the occurrence of a person several times with a topic does not always mean he/she is a real expert (Liu et al., 2015; Wang et al., 2017b). Secondly, the repetition of an expertise topic in a document does not necessarily point to a solid association between the topic and the document (and a similar rationale holds for the person-document association) (Balog et al., 2012). Thirdly, expert finding systems need to go beyond document retrieval, as they are required to retrieve entities (experts) instead of documents, and the process of expertise exchange is a social process (Balog et al., 2012; Dorneles, 2019; Liu and Belkin, 2015; Nahapiet and Ghoshal, 1998; Wang et al., 2018). However, the awareness of "who knows what" is not enough to find the actual access to expertise, and it should be supported by strong relationships between expert and expertise seekers (Roozbahani et al., 2020; Yuan et al., 2010a). Thus, in addition to the awareness of the expert seeker with the potential experts, other factors such as expert age, education, personal information (Pradhan and Pal, 2020), availability of expert, a degree of trust, and willingness of an expert to share their expertise and engage in problem-solving, all play an essential role in determining whom to select (Cross and Borgatti, 2004; Fazel-Zarandi et al., 2011; Fidel and Green, 2004; Zimmer and Henry, 2017). Additionally, to find the

appropriate experts, system designers need to focus on the perspective of a user's needs (Pradhan and Pal, 2020). Hence, besides the degree of expertise that extracted based on the relevance of documents, other important factors should be taken into account for expert finding. For example, human-interaction factors that identified in expertise seeking domain (Balog et al., 2012; Hofmann et al., 2010; Neshati et al., 2014b; Rampisela et al., 2020; Roozbahani et al., 2020; Wang et al., 2017b). Expertise seeking can be described as the activity that involves selecting an expert as a consultation source based on information needs. It needs further human-based knowledge (Berendsen et al., 2013). Expertise seeking helps develop models that identify expert selection determinants based on a human-interaction viewpoint (Hertzum, 2014). Integrating human-interaction factors with expert finding systems can improve their effectiveness (Balog et al., 2012; Hertzum, 2014; Hofmann et al., 2010; Kong et al., 2017; Liu and Belkin, 2015; Paul, 2016; Roozbahani et al., 2020; Xu et al., 2012). Several recent studies tried to combine human interaction factors with expertise retrieval systems (Hofmann et al., 2010; Liu et al., 2013; Liu et al., 2015; Paul, 2016; Silva, 2014; Silva et al., 2013; Smirnova and Balog, 2011; Sun et al., 2015; Wang et al., 2017b) (for more details about these studies see Table 2.8). Additionally, ResearchGate combined research interest with areas of expertise to find research collaborators, but there is still a limitation in combining human-interaction factors with expert finding systems.

Furthermore, current studies in expert finding systems retrieve collaborators based on the relevance between the user query and collaborators related documents and considered relevance as the most critical factor for collaborator selection (Liu et al., 2013; Silva et al., 2013; Wang et al., 2017b). In document retrieval, Xu and Chen (2006) found that cognitive accessibility and reliability are also determinants of relevance. No previous study examined the effect of collaborators' reliability and cognitive accessibility on relevance.

Moreover, expertise seeking models focused on the general notion of an expert. Whereas in the university context, expert finding systems focused on the specific notions of experts. For example, expert finding systems have been developed to find a research collaborator, a paper reviewer, or a supervisor (Smirnova and

Balog, 2011; Xu et al., 2012). Thus, an expert is a research collaborator, supervisor, or paper reviewer. Therefore, it is not suitable to combine human-interaction models that have been identified in expertise seeking with expert finding systems in university (Neshati et al., 2014b; Xu et al., 2012). According to the conducted SLR, expert finding system designers need to consider a personalized view of expertise based on user-specific information requirements. It is difficult to develop one theoretical model to examine the factors that influence all university tasks. Therefore, research is needed to develop models based on a theoretical foundation that could examine the factors that influence expert selection for each university task (Balog et al., 2012; Lin et al., 2017; Roozbahani et al., 2020). Thus, different theoretical models should be developed, for example, a collaborator selection model, reviewer selection model, and supervisor selection model. All these theoretical models should be integrated with documents-based expert finding system in university to improve its effectiveness (Hofmann et al., 2010; Neshati et al., 2017; Wang et al., 2017b). According to the conducted SLR, most of expert finding systems were developed to find research collaborators for research collaboration task. Therefore, this study focuses on the expert finding system in academia (universities) for research collaboration. The expert here will be a research collaborator.

In research collaboration, it is challenging to select whom we collaborate with (Flores et al., 2020; Pradhan and Pal, 2020; S. Kaplan, 2019). However, Waruszynski (2017) argued that human resource issues and selecting the right collaborator highly influence effective collaboration. Furthermore, Mat et al. (2009) stated that selecting collaborators for collaborative projects is a critical problem that people and organizations encounter before achieving research collaboration advantages. Moreover, Collins et al. (2003) proposed that "Good science can only happen with good scientists." Currently, most of the research on research collaboration looks at collaboration effectiveness, productivity, and outcomes rather than selecting a research collaborator (Al-Tabbaa and Ankrah, 2019; Flores et al., 2020; Pradhan and Pal, 2020; Williamson et al., 2016). Therefore, there are limited studies on how collaborators seekers select individual collaborators, what factors influence their decision-making, and how collaborators seekers prioritize those factors (Bozeman et al., 2013; Bozeman et al., 2015; Corley and Sabharwal, 2010; Gunawardena, 2013; Stvilia et al., 2017).

Moreover, previous studies on collaborator selection have examined personal factors (Bozeman et al., 2013; Bozeman et al., 2015; Corley and Sabharwal, 2010; Gunawardena, 2013; Stvilia et al., 2017), three human capital factors (Bozeman et al., 2013), three task-related factors, (Gunawardena, 2013; Stvilia et al., 2017), and two institutional factors (Bozeman et al., 2015; Stvilia et al., 2017) (see Table 2.10). Iglič et al. (2017) stated that for research collaboration, human capital is essential; thus, the influence of additional human capital factors on collaborator selection should be examined. Furthermore, research collaboration is about knowledge exchange which is a social process that needs individual interactions (Al-Tabbaa and Ankrah, 2019; Yuan, 2009). However, personal relationships are crucial for information exchange. Hence, social capital is essential for successful collaboration (Steinmo and Rasmussen, 2018). The influence of social capital factors on collaborator selection in the university context was not studied in the previous studies. In addition to human capital and social capital, cultural capital appears to play a vital role in selecting collaborators. It has an essential role in research collaboration (Corley et al., 2017), and it is the most challenging barrier to overcome (Waruszynski, 2017). No previous study examined the effect of cultural capital on collaborator selection in the universities context.

In conclusion, there is a need to develop a theoretical model to examine the influence of human capital, social capital, and cultural capital factors on collaborators seekers' decision to select their collaborators and prioritize these factors of potential collaborators in the universities context. This theoretical model should be integrated by expert finding systems designers with the current expert finding system in universities to improve collaborator selection.

1.3 Problem Statement

Expert finding systems are mostly used in the universities context to find research collaborators. According to the previous discussion in problem background, most of current experts finding systems retrieve peoples like documents. In fact, people are not like documents, and they are not directly represented as retrievable

elements. Most of the models discussed so far only focus on the topical matches (document-based expert finding systems) and neglect human-interaction factors that play a role in the real-world expert finding process. In research collaboration, selecting a suitable research collaborator is a crucial decision, and it determines the success of the collaboration. Most research in research collaboration looks at collaboration effectiveness, productivity, and outcomes rather than selecting research collaborators. Human capital, social capital, and cultural capital factors are important for collaborator selection, but they are neglected in previous research. Therefore, this study's main problem is: "expert finding systems designers need a human interaction-collaborator selection model that includes human capital, social capital, and cultural capital factors to be integrated with current expert finding systems in universities context."

1.4 Research Questions

Based on the problem statement, this study's main research question is: How to develop a model that recognizes human capital, social capital, and cultural capital factors influencing collaborator selection to facilitate designers when developing an expert finding system in the universities? Based on this main question, three sub-questions have been formulated as follow:

RQ (1): What are the human capital, social capital, and cultural capital factors that influence collaborator selection for research collaboration in the research universities?

RQ (2): What is the mediating role of relevance and physical accessibility on collaborator selection?

RQ (3): How can a collaborator selection model be developed to incorporate the human capital, social capital, and cultural capital factors influencing collaborator selection for research collaboration in the research universities?

1.5 Research Objectives

This study aims to develop a theoretical model to examine human capital, social capital, and cultural capital factors that influence collaborators seekers' decision to select their collaborators in the research universities context, to be integrated with current expert finding systems to improve their effectiveness. Accordingly, the objectives of this research are:

1. To identify the human capital, social capital, and cultural capital factors influencing collaborator selection for research collaboration in the research universities.

2. To examine the mediating role of relevance and physical accessibility on collaborator selection.

3. To develop a collaborator selection model that includes human capital, social capital, and cultural capital factors in the research universities context.

1.6 Research Scope

This research mainly focuses on investigating the factors influencing collaborator selection for research collaboration in the university context to be integrated with the current expert finding systems. Therefore, the scope of this study is only research universities in Malaysia, which are: Universiti Malaya (UM), Universiti Putra Malaysia (UPM), Universiti Kebangsaan Malaysia (UKM), Universiti Teknologi Malaysia (UTM), and Universiti Sains Malaysia (USM). Accordingly, the context of this study is Malaysia, and the population for primary data collection is the academic researchers in Malaysian research universities who have experience in research collaboration. Research universities in Malaysia have been selected because research universities are different from non-research

universities in Malaysia in their concentration on research and commercialization activities. The main concerns for Malaysian research universities are the quantity and quality of researchers and research, the number and quality of postgraduate enrolments, innovation, professional facilities and networks. Thus, they have the priority in the grants allocation for research from the government (Abu Said et al., 2015). Moreover, the Ministry of Higher Education in Malaysia attempts to enhance research and innovation by providing technologies that facilitate research collaboration among academic researchers as the productivity of scientific research is linked to high levels of collaboration (Lewis et al., 2012). Thus, two Malaysian research universities, namely UM and UTM, adopted expert finding system, which will enhance the process of collaborators finding. Section 4.4.2.1 gives more details on the reasons for selecting research universities in Malaysia. The data has been collected using an online survey and analyzed using the structural equation modelling (SEM) technique and SmartPLS v 3.2.9 software.

1.7 Research Significance

Effective research collaboration mainly depends on selecting suitable research collaborators. Choosing a collaborator by little or no forethought reflection or considering the consequences influences research collaboration success. Therefore, selecting an appropriate research collaborator is a crucial decision in research collaboration in the university. This study provides a model for collaborator selection in the research universities; this model should be integrated with the current expert finding system in universities to provide a more effective mechanism for recommending research collaborators. This study contributes to the literature of expert finding systems, research collaboration, and collaborator selection. It also has implications for expert finding systems designers, researchers, research collaborators, and universities. Its contributions are divided into theoretical and practical perspectives.

Theoretically, this study provided a collaborator selection model for expert finding systems in the research universities. The proposed research model integrates

the STHC model and social capital theory, contributing to a better understanding of collaborator selection criteria that influence collaborator seekers' decision to collaborate with a particular collaborator. The extensive literature review showed that integrating these theoretical models has not been applied in either expert finding systems or collaborator selection research. Although numerous studies investigated research collaboration, far less attention has been paid to collaborator selection with a strong theoretical underpinning model. Since theoretical development is scarce in this context, proposing a collaborator selection model for expert finding systems in the research universities based on the STHC model and social capital theory is a significant contribution.

Moreover, this research is considered one of the first studies focusing on human capital, social capital, and cultural capital factors influencing collaborator seekers' decision to select a particular collaborator in the research universities context. Furthermore, current studies in expert finding systems retrieve collaborators based on the relevance between the user query and collaborators' related documents. In document retrieval, Xu and Chen (2006) found that cognitive accessibility and reliability are also determinants of relevance. Therefore, no previous study examined the effect of collaborator's reliability and cognitive accessibility on relevance. This study examined the mediating effect of relevance on the relationship between reliability and cognitive accessibility and collaborator selection. The results showed that collaborator's reliability and cognitive accessibility significantly affected relevance, and 36% of the variance in relevance was explained by cognitive accessibility and reliability. Moreover, this study is the first one that examined the mediating role of physical accessibility on the relationship between network ties and collaborator selection in the research universities context. Additionally, the proposed model can help IS researchers and become a starting point to develop additional theoretical models for expert finding systems in the university, such as supervisor selection model and paper reviewer model. These models should be integrated with the current expert finding systems in the universities.

Practically, this study provides several practical implications for expert finding systems designers, research collaborators, researchers, and research

universities. For designers of expert finding systems, the research model can be integrated with current expert finding systems to improve their effectiveness in selecting the appropriate collaborator. Recommendations about how to combine the influential factors were also provided. The designers of expert finding systems mainly depend on the relevance between collaborator documents and user query. This model discovered that relevance also depends on the cognitive accessibility and reliability of collaborators. Additionally, this research model can help academic researchers by providing criteria about whom they can collaborate.

Furthermore, the proposed model can motivate academic researchers to give feedback and rate a collaborator's competence levels after collaboration to enhance collaborators retrieval with expert finding systems. Moreover, this model can encourage researchers to update and share their expertise information to increase their selection opportunity by other researchers to participate in research collaboration. Finally, this research provides universities with criteria for research collaborator selection. These criteria will improve the process of collaborator selection and accordingly research productivity in the universities.

1.8 Definitions of Terms

To simplify the terminologies that have been used throughout this study, Table 1.1 provides the symbols and definitions for the terms that have been used.

Table 1.1 Definitions of terms

Term	Definition
Human capital	It represents the knowledge, experience, and skills gained from academic study, research and work, commitment and reputation (Iglič et al., 2017; Manzari et al., 2012).
Social capital	It represents the direct person-to-person connection, broadening the social horizon and available resources for an individual scientist (Iglič et al., 2017).
Cultural capital	It includes cultural experiences that are gained from the interaction with people from different cultural backgrounds (such as gender, race, SES, nationality, and discipline) (Iglič et al., 2017).

Scientific and Technical Human Capital	STHC is defined as the sum of an individual researcher's professional network ties, technical knowledge and skills, and resources broadly defined (Bozeman et al., 2001).
Social Capital Theory	It is defined as the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit (Nahapiet and Ghoshal, 1998).
Systematic Literature Review	SLR is a process used to identify, evaluate, and interpret all available research studies related to the area of study, research questions, and a new research trend.
Structural Equation Modelling	It supports researchers to test the overall fit of the model and examine the relationships between the constructs of the conceptual model together(Hair et al., 2012).
Important Performance map Analysis	It is an advanced test in SmartPLS software, used to identify the important factors in the model.

1.9 Conceptual Framework

This research aims to develop a collaborator selection model for expert finding system for research collaboration in the research universities context. Based on an extensive review of the literature, the STHC model and social capital theory have been selected as a theoretical foundation for this research. STHC is "the sum of human capital, social capital, and cultural capital needed to participate in science" (Corley et al., 2017). Therefore, it can be used as a theoretical lens to identify the human capital, social capital, and cultural capital factors required for research collaborators to participate in research collaboration. The social capital dimension of STHC relates to network ties, which is essential but not sufficient for research collaboration to develop knowledge. Nahapiet and Ghoshal (1998) developed social capital theory, arguing that the dimensions of social capital facilitate the development of knowledge by enabling information exchange. Information exchange consists of access to information and the other party (for example, collaborator) and anticipation of the value of the exchange (information quality). Thus, in their model Woudstra et al. (2012) distinguishes two conditions for information exchange, access to others, and the value (or quality) of their information.

Moreover, in their model, they divided accessibility into three dimensions (physical, cognitive, and relational accessibility) and information quality into two dimensions (relevance and reliability). Research collaboration is a process of information exchange. Therefore, in addition to the importance of an individual's network ties in the social capital of the STHC model, information quality and accessibility also appear to be important. Thus, to examine the research collaborator's social capital characteristics, Woudstra et al. (2012) social capital model has been integrated with the STHC model. Based on the integration of STHC and social capital theoretical models, this study will examine the influence of three categories of factors, which are human capital, social capital, and cultural capital factors. Human capital factors are research experience, commitment, complementary skills, and reputation. Whereas, social capital factors are network ties, physical accessibility, relational accessibility, cognitive accessibility, relevance, and reliability. Finally, the cultural experience was selected as a cultural capital factor. For more details about the selected theories and factors, see Section 2.8. The conceptual framework based on these theories is presented in Figure 1.1.

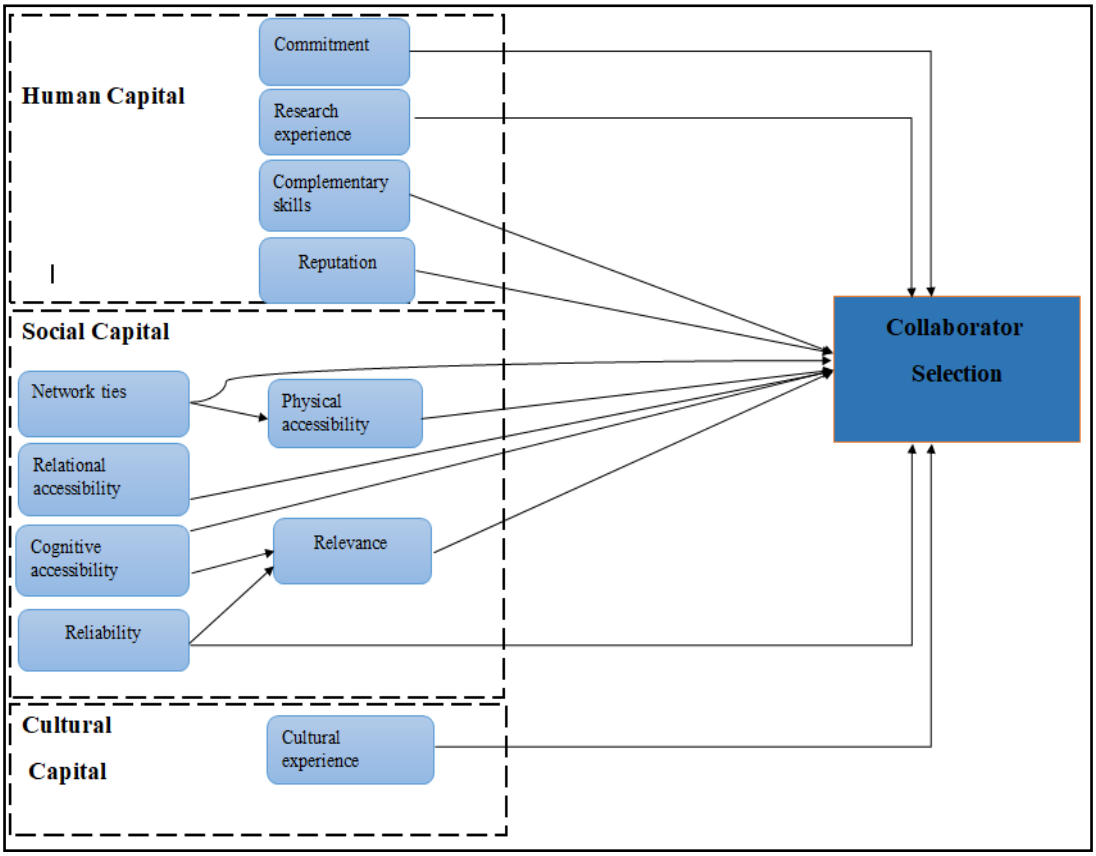

Figure 1.1 The Conceptual Framework

1.10 Organization of the Thesis

This thesis is divided into six chapters described in Figure 1.2.

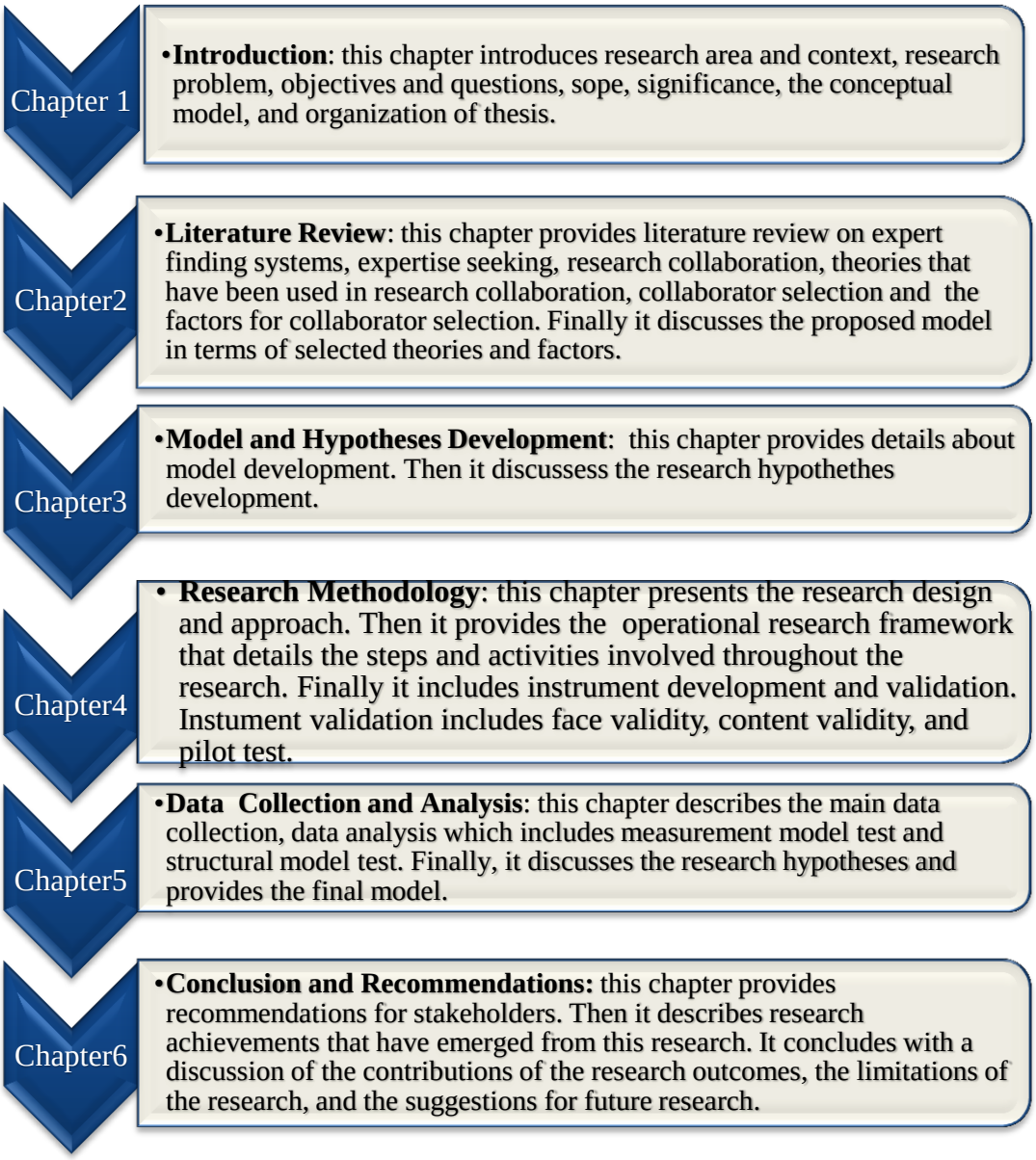

Figure 1.2 Organization of the thesis

1.11 Summary

This chapter provides an overview of expert finding systems and research collaboration, followed by a discussion on the problem background that highlights the current gaps. Accordingly, the research problem, questions, and objectives were identified. Then, the research scope, significance, definitions of terms, and the conceptual model are presented. Finally, the organization of the thesis was introduced. The next chapter will give an extensive literature review on the area of study.

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