THE INFLUENCE OFABSORPTIVE CAPACITY AND TECHNOLOGY PARK SERVICES ON THE RELATIONSHIP BETWEEN SOCIAL CAPITAL AND TECHNOLOGY TRANSFER PERFORMANCE

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THE INFLUENCE OFABSORPTIVE CAPACITY AND TECHNOLOGY PARK SERVICES ON THE RELATIONSHIP BETWEEN SOCIAL CAPITAL AND TECHNOLOGY TRANSFER PERFORMANCE

By

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ABSTRACT

The establishment of technology parks serves as a medium to promote the technology transfer processes in the high technology sector that plays a role to catalyze the productivity and growth of the national economy. Previous studies revealed that although there is anticipation of technology transfer activities among the companies within the technology parks, there is a limitation in the ability of local knowledge workers to produce new technology. Social capital and absorptive capacity were highlighted as essential in ensuring the success of technology transfer. This study examined the impact of technology park services on the relationships among social capital, absorptive capacity and technology transfer performance. It also focused on the influence of absorptive capacity on the association between social capital and technology transfer performance. A theoretical framework was constructed based on the perspective of the knowledge - based view theory to describe the relationships among these variables. Data was collected through a survey of 358 high technology companies operating in four selected technology parks in Malaysia. Out of the 97 questionnaires returned only 90 were usable bringing the response rate to about 25%. Using descriptive and inferential statistics, the data was tested and proven to support the research framework. Pearson correlation and regression analyses established that both social capital and absorptive capacity are essential to ensure high performance of technology transfer. There are mediating effects of absorptive capacity on the relationships between the dimensions of social capital and technology transfer performance. The results also demonstrated that technology park services have moderating effects on the strength of the relationships between the dimensions of social capital and technology transfer performance; as well as between absorptive capacity and technology transfer performance.

Keywords: technology transfer, social capital, absorptive capacity, technology parks, technology park services.

ABSTRAK

Penubuhan taman teknologi adalah untuk membantu dalam menggalakkan proses pemindahan teknologi dalam sektor berteknologi tinggi yang berperanan sebagai pemangkin produktiviti dan pertumbuhan ekonomi negara. Kajian-kajian lepas mendapati bahawa walaupun ada kemungkinan berlaku aktiviti pemindahan teknologi dalam kalangan syarikat-syarikat dalam taman teknologi, keupayaan pekerja-pekerja tempatan yang berpengetahuan dalam menghasilkan teknologi baharu adalah terhad. Modal sosial dan keupayaan menyerap digariskan sebagai penting bagi memastikan kejayaan pemindahan teknologi. Kajian ini menguji keberkesanan perkhidmatan taman teknologi ke atas hubungan antara modal sosial, keupayaan menyerap dan prestasi pemindahan teknologi. Ia juga memberi tumpuan kepada pengaruh keupayaan menyerap terhadap hubungan antara modal sosial dan prestasi pemindahan teknologi. Dalam usaha untuk menggambarkan hubungan antara pembolehubah - pembolehubah ini, kerangka kajian telah dibina berdasarkan perspektif yang merujuk kepada teori ‘Pandangan Berasaskan Pengetahuan’. Data dikumpul melalui kaedah kaji selidik ke atas 358 buah syarikat berteknologi tinggi yang beroperasi di empat buah taman teknologi yang terpilih di Malaysia. Daripada 97 borang soal selidik yang telah dikembalikan hanya 90 borang soal selidik yang boleh diguna pakai, dan memberikan kadar maklum balas sebanyak 25%. Data yang dikumpul telah diuji menggunakan statistik deskriptif dan inferensi, dan hasil analisis kajian terbukti menyokong kerangka penyelidikan. Korelasi Pearson dan analisis regresi mengesahkan bahawa kedua-dua modal sosial dan keupayaan menyerap adalah penting untuk memastikan prestasi pemindahan teknologi yang tinggi. Keupayaan menyerap mempunyai kesan perantara terhadap hubungan antara dimensi modal sosial dan prestasi pemindahan teknologi. Hasil kajian juga menunjukkan bahawa perkhidmatan taman teknologi mempunyai kesan moderasi terhadap kekuatan hubungan antara dimensi modal sosial dan prestasi pemindahan teknologi; serta antara keupayaan menyerap dan prestasi pemindahan teknologi.

Kata kunci: pemindahan teknologi, modal sosial, keupayaan menyerap, taman teknologi, perkhidmatan taman teknologi.

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LIST OF ABBREVIATION

10MP	Tenth Malaysia Plan
3OPP	Third Outline Perspective Plan
8MP	Eighth Malaysia Plan
9MP	Ninth Malaysia Plan
DV	Dependent Variable
GCR	Global Competitiveness Report
IASP	International Association of Science Parks
ICT	Information and Communication Technology
IJV	International Joint Venture
ISIC	International Standard Industry Classification
IV	Independent Variable
KBV	Knowledge-based View
KHTP	Kulim Hi-Tech Park
MOSTI	Ministry of Science, Technology and Innovation
MSC	Multimedia Super Corridor
NTBF	New Technology Base Firms
RBV	Resource-based View
SIRIM	Standard and Industrial Research Institute of Malaysia
TPM	Technology Park Malaysia
UNCTAD	The United Nation Conference on Trade and Development

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Technology is essential for business firms in order to remain competitive in energetic and dynamic business landscape today as it is a determinant of innovation and knowledge generation. As technological development is progressing rapidly, firms must respond quickly to the emergence of new technologies. For this reason, it is important for the firms to be involved in technology transfer, especially when firms' internal R&D is limited (Jagoda, Maheshwari, & Lonseth, 2010; Noor, 2010).

Technology includes more than machines, processes and inventions. It can be embodied in people, materials, cognitive and physical processes, equipment, tools and plant (Li-Hua & Lu, 2013). Mitelman and Pasha (1997) stated that technology transfer refers to activities that allocate the technology from the place where it was generated to other new place which involved adaptation to suit the new conditions. Technology transfer is the movement of physical structure, knowledge, skills, organization, values, and capital from the site of generation to the receiving site that should always involve modifications to suit new conditions (Choi, 2009).

The technology transfers challenge is whether they produce further innovations within the transferees. The transferees should be able to attain the transfer of technology that stimulates further innovations through an elaborate plan. The plan will be able to prompt willingness of both the recipient and donor sides and this would give rise to strengthening the collaboration for facilitating technology transfer.

As technology consists of both material and nonmaterial components, perceptions and assumptions about technology can and do affect the outcome of its transfer (Akubue, 2002; Rose, Uli, Kumar, & Wahab, 2009). The fundamental element of technology transfer process is knowledge transfer. It is crucial in the process of technology transfer as knowledge is the key to control technology as a whole (Li-Hua, 2006). This is supported by Choi (2009), who emphasized that the unseen aspects of technology, such as knowledge, skills, and organization, might be extra important compared to the physical aspects for the successful transfer of technology.

Garud and Nayyar (1994) revealed that technology as part of knowledge since technology is embedded in machines, manuals and technicians. This means, the transfer of technology includes the process of diffusing, assimilating, communicating and absorbing the knowledge into firms (Rose, Uli, Kumar &Wahab, 2009). The terms technology transfer and knowledge transfer are used interchangeably. However there are distinctive between the terms. These terms can be distinguished according to breadth of construct, observability, overlapping characteristics, management phases of most consequences, organizational learning and nature of interaction (Gopalakrisnan & Santoro, 2004).

In moving towards flexible transfer of knowledge and technology, the government has looked to the success of technology parks for innovation opportunities. Technology parks were developed as an evolutionary process and must be intertwined with the production-based economy. According to Sarif (2008), the government has established Malaysia technology parks through conventional planning process which then assimilates under the Eighth Malaysia Plan (2001-2005), the Third Outline Perspective Plan (2001-2010) and the Ninth Malaysia Plan (2006-2010) and Tenth Malaysia Plan (2011-2015).

Technology parks are areas developed and subdivided into plots or zones according to a detailed plan equipped with roads, transport and public utilities for the use of a group of industrialists. They are designed to meet compatible demands of different companies within one location. The comprehensive services provided will necessitate diversified effects on the surrounding region and finally, stimulate regional development. Accordingly, The Multimedia Super Corridor (MSC) program was launched in 1996 to encourage investment from global companies in the information and communication technology industry (Said *et al*., 2012).

The MSC included several technology parks. The (MSC) Central Incubator at Cyberjaya has been identified as the nucleus for the National Incubator network centers which include Technology Park Malaysia (TPM), UPM-MTDC Park and Kulim Hi-Tech Park (KHTP). The MSC concentrated on ICT-related products and services, which represents an extension of existing electronics and electrical products (Wahab, 2003). The foreign companies located and registered their operation in MSC zone are protected through its

‘Bill of Guarantees,’ a world-class infrastructure, the introduction of cyber laws, and the provision of investment incentives (financial and non-financial) (Multimedia Development Corporation Malaysia (MCDM), 2004).

Under the Eight Malaysia Plan (2001-2005), the issues of human resource development, science and technology, research and development, the information technology structure, and attracting venture capital for intensive industries were emphasized (Malaysia, 2000) to achieve Vision 2020. Therefore, the MSC as the pioneering initiative of the Malaysian Government to drive Malaysia into knowledge-based nation is expected to be a major catalyst to develop a mature and knowledge-rich society. The technology parks with MSC status are projected to attract a core group of world-class companies. These technology parks function as a unique, performance-oriented, and client-focused agency.

1.2 Technology Parks and High Technology Companies

The International Association of Science Parks (IASP) defines a technology park as a property based initiative which has formal and operational links with a university or other higher education institution or major centre of research. It is designed to encourage the formation and growth of knowledge-based businesses and other organizations normally resident on site. It has a management function which is actively engaged in the transfer of technology and business skills to the organizations on site. There are several inter-changeable terms (Table 1.1) for technology parks.

Table 1.1
Inter-changeable Terms of Technology Park

Industrial hi-tech parks	Industrial development zones
Industrial parks	Business Parks
Industrial districts	Science parks
Export processing zones	Science and research parks
Industrial clusters	Hi-tech centers
Industrial processing zones	Bio-technology parks

Source: Geng&Hengxin (2009)

The use of the terms often depends on the scope and type of operations of the incubation areas (Geng & Hengxin, 2009). According to Link & Scott (2002), although there are many terms used to describe the similar development, generally the concept of the parks includes three components:

(i) A real estate development,

(ii) An organizational program of activities for technology transfer, and

(iii) A partnership between academic institutions, government and the private sector.

Link and Scott (2002) describe a research park as the development of estate which considered a majority of tenants that are heavily engaged in basic and applied research and development while technology or innovation parks is the development of estate which household new start-up companies and incubator facilities. As well, a commercial or industrial park is defined as typically have tenants that add value to R&D-based products through assembly or packaging, rather than do R&D.

Despite the difference in names, the fundamentals are the same mainly to enhance small and medium-scale technology-based industries and propel them to greater contributions to the national economy. For this study the term “technology park” is identified as an area which allows benefits to individual firms located in the park (Saari & Haapasalo, 2012; Chan & Lau, 2005).It is an incubation area that hosts several types of tenants that includes public base tenant; matured firms; the incubators (eg. that developed by MIMOS and SIRIM); and new technology base firms (NTBF). Incubators in the technology parks incubation area are physical facilities that provide new firms with the supportive network necessary to increase their probability of survival during the early years when they are most vulnerable.

Typical activities in technology parks are high tech manufacturing; R&D and software; and IT services. In general, technology parks aimed at promoting innovation in new and emerging areas like information and communication technology (ICT), biotechnology, electronic device manufacturing, pharmaceutical industry, space flight industry, nanotechnology etc. Indeed there are also specialised technology parks that have been developed to cater the needs of specific industries. The establishment of technology parks enable the existence of high technology industries in constellation. All the high technology companies that set-up in the technology parks incubation areas can be considered as the incubating companies of the technology parks.

According to MOSTI (2010) the high and medium-high technology industries play an important role in Malaysian manufacturing trade (Figure 1.1). The sectors contribute close to 50% of Malaysia total manufacturing exports in 2009 (MOSTI, 2010). Table 1.2 shows the high-technology manufacturing exports for 2007 to 2009.

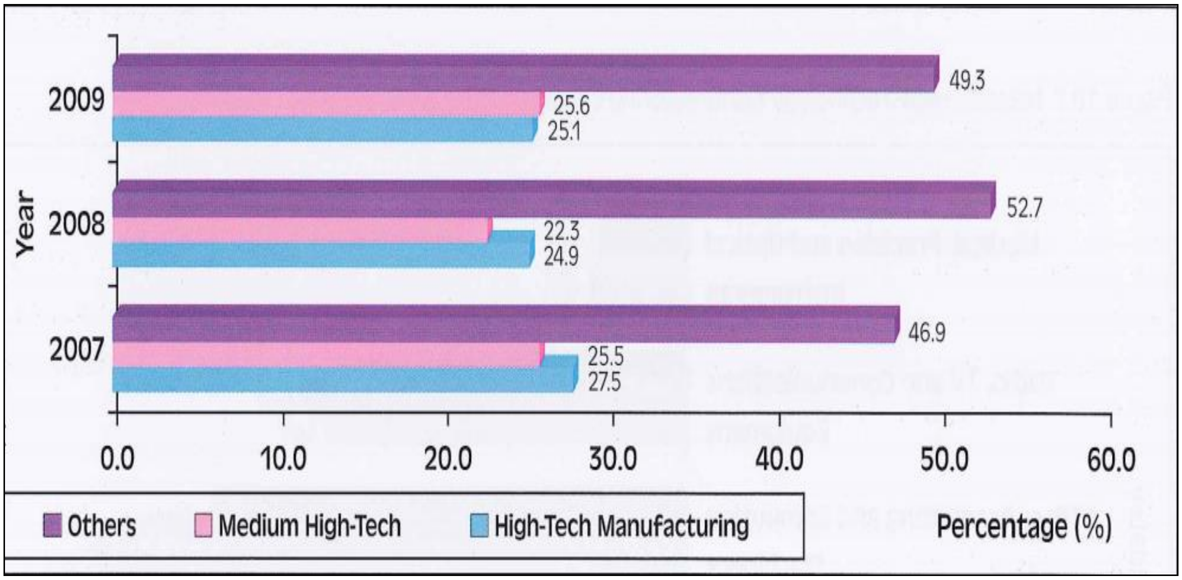

Figure 1.1
Malaysian Composition of Manufacturing Export

Table 1.2
High-Technology Manufacturing Exports by Industrial Sub-Sectors, 2007-2009

Industry	**RM Million**	**% Share**	**RM Million**	**% Share**	**RM Million**	**% Share**	**Growth Rate %**	
	2007		**2008**		**2009**		**2008**	**2009**
Office, Accounting and Computing Machinery	92,827.0	55.0	88,105.0	52.2	73,958.9	52.2	-5.1	-16.1
Radio, Television and Communications Equipment	56,132.6	33.2	59,429.8	35.2	48,694.6	34.4	5.9	-18.1
Medical, Precision and Optical Instrument	14,130.5	8.4	14,908.8	8.8	12,805.8	9.0	5.5	-14.1
Aircraft and Spacecraft	2,913.1	3.1	2,760.4	3.5	3,382.9	4.1	-5.2	22.6
Pharmaceuticals	564.1	0.3	450.4	0.3	503.1	0.4	-20.1	11.7
Total High-Tech Industry	166,567.3	100.0	165,654.4	100.0	139,345.3	100.0	-0.5	-15.9

Source: Retrieved from the World Trade Atlas Database (MOSTI 2010)

In the latest report of Malaysian Science and Technology Indicator, it is concluded that Malaysia's international competitiveness in international high-technology trade has improved over the years. However, Malaysia is a net importer of professional services due to dependence on foreign technologies and expertise.

Noting that collaboration and effective sharing of knowledge are the key attributes of the high technology industry, the Malaysian technology parks are provided with advanced information and communication technology (ICT) facilities through the Multimedia Super Corridor (MSC) status to facilitate the transmission of knowledge, know-how and technology across national borders. With the services provided by the technology parks, the success of the technology transfer process is expected. Nevertheless, there is uncertainty about whether the technology parks are achieving their goal in enhancing the technology transfer processes.

1.3 Technology Transfer Performance in Malaysia

Malaysia is identified as relatively attractive place for investors for several reasons, including access to financing and efficient customs clearance. Doing Business 2014 report (2013) ranked Malaysia 6th out of 189 economies for "ease of doing business" in 2013. Nevertheless, based on the analysis by the World Economic Forum which captures the microeconomic and macroeconomic foundations of national competitiveness, Malaysia's position has been on a declining trend for three consecutive years from 21st position out of 134 countries in 2008-2009 to 24th position out of 133 countries in 2009 and to 26th position out of 139 countries in 2010 (World Economic Forum, 2010).

Over these years, the areas that affecting Malaysia’s performance are Higher Education and Training, Institutions, Technology Readiness and Labour Market Efficiency (World Bank, 2010). The criteria which Malaysia is assessed in terms of technological readiness are availability of latest technology, firm-level absorption, FDI and technology transfer, internet users, broadband internet subscribers and internet bandwidth (Table 1.3).

Table1.3
The Global Competitiveness Index

Indicator	Rank/139
9th pillar: Technological readiness	
Availability of latest technologies	35
Firm-level technology absorption	30
FDI and technology transfer	16
Internet users	62
Broadband internet subscriptions	41
Internet bandwidth	35

Source: World Economic Forum (2010)

Although most of the criteria for technological readiness are at the low positions, FDI and technology transfer is ranked 16th position out of 139 countries and is noted as the competitive advantages. Apparently, technology transfer is an important criterion that should not be overlooked. More effort is necessary to maintain and increase the technology transfer performance in order to improve the performance and competitiveness of the country.

From the perspective of technology recipient, the success of technology transfer consists of the ability to learn, acquire, absorb and apply new external technologies and knowledge embedded in product materials, physical assets, processes and production, and management capabilities and not limited to possessing the ability to operate, maintain or repair the machineries in the production level (Rose, Uli, Kumar &Wahab, 2009). Hence, it is expected that these firms are able to operate on their own and can produce using the advance technology after the technology provider left.

According to Schroer *et al*. (1995), when considering technology transfer performance, firms should focus on performance outputs that indicate effectiveness instead of efficiency. Generally, three common objectives that expected to be achieved from the transfer of technology are the introduction of new techniques, the formation of new knowledge and the upgrading of new techniques (Noor, 2010). Successful technology transfer enable firms to create products and services to achieve their business objectives. In addition, the transfer of technology will enhance the human resource capability that plays a critical role in the creation of a commercially feasible product, services or process.

However, based on the study by World Bank (2009), Malaysian manufacturing firms continue to function more as “adaptors” rather than “creators” of new technologies. Although R&D expenditures as a percentage of GDP increased from 0.5 percent to 0.6 percent and the number of researchers and technicians increased significantly from 279 to 509 per million people and from 40 to 64 per million people respectively from 2000 to 2004, roughly one-third of all manufacturing firms failed to upgrade their machinery or product lines or file a patent (World Bank, 2009).

1.4 Problem Statement

Technology transfer is the process through which one unit is affected by the experience of another unit (Argote & Ingram, 2000) where the unit can be individual or group within the organization, a division or a department of an organization, an organization itself or a group of organizations (Alexopoulos, 2008). The soft aspects of technology, such as knowledge, skills, and organization, might be much more critical than the physical aspects for the successful transfer of technology (Choi, 2009).

This is supported by Latif and Rahman (2009), that among the gaps across industrial sub-sector on various skills needed to create sustainable enterprise and entrepreneur development in Malaysia technology parks are cognitive, interpersonal, technological, intrapersonal, analytical, technological, acoustic, communication, conceptual, managerial and innovative. Tacit knowledge and personal experience is solely acquired individually in a tacit manner. Hence, social interaction is a very important factor to facilitate technological knowledge sharing among the units within an organization (Yang & Farn, 2009; Lee & Choi, 2003; Khan, Quaddas & Rowe, 2013). The prominent concept that provides a foundation for describing and characterizing the properties of relations between the units is social capital.

Social capital is a resource reflecting the character of social relation within a firm. It is a unique resource which cannot easily be acquired and exchanged from one organization to another and this makes social capital a potential source of a firm competitive advantage (Khan, Quaddas & Rowe, 2013; Rahmani & Mousavi, 2011). Within regional innovation systems or structure composed of companies like technology parks, social capital is vital to increase motivation and ability for flexible organizational forms such as teamwork, interactive learning, project and networking management, interdisplinary collaboration or intermediary institutions (see Asheim, Coenen & Henning, 2003; Cooke, 2008; Isaksen, 2009). Despite massive theoretical and developed findings in this area (e.g., Nahapiet & Ghoshal, 1998; Adler & Kwon, 2002), there is inadequate empirical research that examined the combined effect of distinct aspects of social capital on technology transfer (Levin & Cross, 2004) and no consensus on which dimensions are relevant (Adam, 2011). Thus, this study attempts to examine the influence of the three distinct aspects of social capital that is structural aspect, cognitive aspect and rational aspect.

Absorptive capacity is a useful conceptual device in order to understand technology transfer. The concept of absorptive capacity has been extensively explored empirically (eg. Lam &Tong, 2010; Noor 2010; Jurado, Gracia & Lucio, 2008) and theoretically (eg. Zahra & George, 2002; Lane *et al.* 2006; Volberda & Foss, 2009).These authors claims that, a firm must develop and sustain its ability to value, assimilate, and apply knowledge received from external sources to gain access and fully utilize the knowledge in productive manner. A framework develop by Zahra and George (2002) suggested considering absorptive capacity as consisting four dimensions of knowledge acquisition, assimilation, transformation and exploitation. A number of studies emphasized on the importance of absorptive capacities in ensuring the technology transfer performance (eg. Noor, 2010; Xu, Chen & Kwon, 2009; Awang, Hussain & Malek, 2008). However, it is noticed that the intra-organizational factors of absorptive capacity have received substantially less attention in the field. The focus of most empirical studies are primarily on prior related knowledge and have overlooked several internal mechanisms that can sway the level of a firm's absorptive capacity, for example, the structure of communication, the character and dissemination of expertise and knowledge within the organization (Camison & Fores, 2010; Volberda, Foss & Lyles, 2009).

In the direction of transforming Malaysian nation into knowledge-based economy, it is believed that technology parks play the special role in encouraging the transfer of knowledge and technology (Robani, 2008). According to Lai and Yap (2004) technology parks was established by the government to ensure a rapid transfer of R&D in high technology industries. The government plays the leading role by providing fund for infrastructure building and offering various tax incentives to the tenants. The technology parks incubating companies have various opportunities to tap into a larger knowledge resource base as they have formal and operational links with a university or other higher education institution or major centre of research (Link & Scott, 2002).

Agglomerations and particularly clusters of high technology industries in the technology parks form places in which 'close inter–firm communication, socio–cultural structures and institutional environment may stimulate socially and territorially embedded collective learning and continuous innovations' (Saari & Haapasalo, 2012; Asheim & Isaksen 2002; Phillimore 1999). Consequently, the existing literature gives support to a series of effects which technology parks have in the promotion of technology transfer within firms, and can be summed up in the well diffusion of technology, the presence of social capital and trust, and the extra efficient networking of firms.

Nevertheless, previous studies highlighted that although the establishment of technology parks had made a modest direct contribution to employment and generated productive synergies, it is difficult to figure out their contribution to technology transfer (Saari & Haapasalo, 2012; Storey & Tether, 1998; Sarif & Ismail, 2006). Sarif and Ismail, (2006) identified that local companies in Malaysian technology parks are unable to produce indigenous technology. Their work is supported by Malek, Awang and Hussain (2009). They concluded that although there are anticipation technology transfer activities from foreign companies to local companies in the technology park, the ability of local knowledgeable workers to produce new technology is limited. It was argued that the technology parks are not major sources of technology development, and geographical proximity seems to account for very little in promoting technology transfer. One of the roles of technology parks is to promote technology through the university industry interaction. However, it was found that synergies between on-park companies are limited only in commercial transactions and social interactions (Bakouros *et al*, 2002).

Based on the discussion, it appears that, although there are numerous literatures on the role of technology parks on technology transfer (Saari and Haapasalo, 2012; Robani, 2008; Vedovello & Judice, 2007; Inkpen & Pien, 2006; Storey & Tether, 1998; Sarif & Ismail, 2006; Lai &Yap, 2004; Chan & Lau, 2005; Chen & Huang, 2004 etc.) they are not unanimous. Indeed the literature on the performance of knowledge and technology transfer in technology parks is very limited. The role of technology parks and the factors that influence the transfer of technology in the incubation areas remains unclear. It is argued that there is unexpectedly weak and inconsistent relation between technology park services and technology transfer performance.

This study includes internal social capital that examines the "closure" or "bonding" that creates internal cohesion and absorptive capacity to understand the influence of these variables on technology transfer performance in the Malaysia technology parks incubating companies. Some studies propose that there are relationships between social capital and absorptive capacity and there are evidences of significant relationships between absorptive capacity and technology transfer performance (eg. Noor, 2010; Jurado *et al.*, 2008). This study is conducted based on several premises.

1. Yang and Farn (2009); Hoi and Lee (2003) in their studies indicated that social interaction is vital in ensuring that the transferred technology is well comprehended and bring benefits to the firms. Social interaction exists with the existing of relations between the individuals, units or organization. The prominent concept used to explain the properties of relations between the individuals, units, or organizations is social capital. Besides that, a number of studies (Noor 2010; Xu, Chen & Kwon, 2009; Awang, Hussain & Malek , 2008; Cohen & Levinthal, 1994; Madanmohan, Kumar, & Kumar, 2004) also discuss on the importance of absorptive capacity which is one of the factors that allow the transferred technology to be used in the firms. However, these two elements were not being integrated together which leave a gap in the study of technology transfer.

2. Several previous studies (Robani, 2008; Inkpen & Pien, 2006; Lai & Yap, 2004; Saari & Haapasalo, 2012) mentioned that technology parks services play a unique role in encouraging the transfer of knowledge and technology. Yet, previous studies on technology transfer have not covered the impact of technology park services per se as a factor that is able to moderate the technology transferred performance.
3. Studies by Malek, Awang and Hussain (2009) and; Sarif and Ismail (2006) highlighted that there are anticipation technology transfer activities among companies in the technology parks nevertheless the ability of local knowledge workers to produce new technology is limited. Among the gaps across industrial sub-sector on various skills needed to create sustainable enterprise and entrepreneur development in Malaysian technology parks are cognitive, interpersonal, technological, intrapersonal, analytical, technological, acoustic, communication, conceptual, managerial and innovative that is the soft part of the technology (Latif &Rahman, 2003).

To conclude, although there are studies on technology parks that explored the influencing factors of technology transfer performance (eg. Malek, Awang & Hussain, 2009; Latiff & Rahman, 2009; Sarif & Ismail, 2006), there are lack of consensus on appropriate operational of the discussed variables those are absorptive capacity and social capital. These motivate further investigation on the subject matter. If the present study was not conducted the tangible impact of technology park services on technology transfer performance would remain unclear and how social capital and absorptive capacity influence the success of technology transfer would not be discovered. Therefore, an empirical study is very important to provide empirical results which able to give direction to the stakeholders and policy makers of the technology park in their strategy to improve their performance in terms of quality of services and practices. The central aim of this study is to fill these research gaps by examining the combined impact of social capital and absorptive capacity on technology transfer performance. Further, it attempts to explain the effects of the technology parks services on technology transfer performance.

1.5 Research Questions

The purpose of this study is to systematically analyse the performance of technology transfer in technology parks and to provide a detailed picture on the influence of social capital, absorptive capacity and the contribution of technology parks services in enhancing the transfer of technology within the technology parks incubating companies. Specifically the study seeks to answer the following questions:

1. What is the effect of social capital on technology transfer performance in the technology park incubating companies?
2. What is the relationship between dimensions of social capital and dimensions of absorptive capacity?
3. What is the effect of absorptive capacity on technology transfer performance in the technology park incubating companies?
4. Does the absorptive capacity mediate the relationship between social capital and technology transfer performance?

5. Do the technology parks services moderate the relationship between social capital and technology transfer performance within technology park incubating companies?
6. Do the technology parks services moderate the relationship between absorptive capacity and technology transfer performance within technology park incubating companies?

1.6 Research Objectives

Based on the research questions, specifically the objectives of the study are as follows:

1. To determine the effect of social capital on technology transfer performance.
2. To determine the relationships between social capital and absorptive capacity.
3. To determine the effect of absorptive capacity on technology transfer performance.
4. To examine the mediating effect of absorptive capacity on the relationship between social capital and technology transfer performance.
5. To examine the moderating effects of the technology park services on the relationship of social capital and technology transfer performance.
6. To examine the moderating effects of the technology park services on the relationship of absorptive capacity and technology transfer performance.

1.7 Significance of the Study

Technology transfer system that ensures efficient transfer of knowledge and technology from the R&D system to the industry and business sectors is essential. Findings of this research help to clarify the issues of technology transfer performance in technology parks incubating companies and provide information that would be of assistance to all who engaged in technology transfer process in the technology parks (eg. the technology park administrator, the tenant and stakeholder). Generally, this study should be significant in the sense that it:

a) Provide useful knowledge on factors that might impact and contribute to the technology transfer performance.
b) Support and enrich theory and model of technology transfer in public organizations that have similarity in their nature of service with technology parks.
c) Generate greater awareness among stakeholders of the technology parks and companies on the importance of having a proper and practical technology transfer framework as a tool towards organizational effectiveness.

The theoretical contribution of this study lies in the domain of the relationship between intra-firms social relations and technology transfer performance. This study is developed to give an explanation on the micro-social foundations of technology transfer. A micro-level approach is advantageous for it disentangles the possible overlapping effects of the structural, relational and cognitive facets of social capital on technological knowledge transfer. The second contribution lies in the domain of relationship between absorptive capacity and technology transfer. Adopting the concepts of potential and realized absorptive capacities (Zahra & George, 2002), this study provides more information on this concept area.

1.8 Scope of the Study

The study is particularly concerned with the transfer of technology within the high technology industry for it is the core of technological change. High technology industry is one of the fastest growing industries in the world and plays an important role in contribution to other ‘low tech sector’ (Hughes, 2003). High technology companies are important national resources in view of the fact that they contribute to important technical change and industrial innovation that catalyze the productivity and growth of the national economy.

The designation of high technology sector among other industrial sectors of the economy provides a very useful analytic tool as high technology firms behave in a way that allows them to be understood as a group. In Malaysia, high technology companies have to ensure that the percentage of local R&D expenditure to gross sales should be at least 1% on an annual basis. These companies have three years from its date of operation or commencement of business to comply with this requirement (MOSTI, 2010). Apparently, technology transfer performance is very important for the high technology companies to remain innovative and competitive.

According to Bielawska (2009), the key features of high technology sectors that differentiate the sectors from the less technologically advanced industries are:

a) high demand for scientific research and intensity of R&D expenditure,

b) high level of innovativeness,

c) fast diffusion of technological innovations,

d) fast process of obsolescence of the prepared products and technologies,

e) high level of employment of scientific and technical personnel,

f) high capital expenditure and high rotation level of technical equipment, replaced by more modern and innovative devices,

g) high investment risk and fast process of the investment devaluation,

h) intense, strategic domestic and international cooperation with other high technology enterprises and scientific and research centres,

i) implication of technical knowledge in the form of numerous patents and licenses,

j) increasing competition in international trade

Based on these features, the most typical examples of high technology sectors are aerospace equipment sector, computers, telecommunication devices and technologies, advanced technologies sector based on computer aided manufacturing (CAM), computer aided design (CAD), computer integrated manufacturing (CIM), optical equipment, biotechnological sector, pharmaceutical industry, laser devices, nuclear sector, power and technical machines and equipment, etc. (OECD, 2009).

However, Bielawska (2009) emphasized that defining an enterprise as a company operating in a high technology sector is not sufficient and requires a wider approach. Such companies should be the source of new knowledge, inventions and innovations. It can be assumed that a high technology company should have the features of an innovative and knowledge based enterprise. Previous studies focus either on cross-country analyses (Argiles *et al*., 2011) or on one specific sector, mainly dealing with high-tech sectors such as the pharmaceutical or ICT-related sectors (Sarif & Ismail, 2006; Sarif, 2008). This study was based on firm-level data of all high-tech sectors operating in technology parks in Malaysia which have been established more than ten years. These technology parks were chosen due to the sufficient time they have to involve with technology transfer that enable them to provide the information needed.

The fundamental element of technology transfer process is the soft part of the technology or the knowledge transfer. It is crucial in the process of technology transfer as knowledge is the key to control technology as a whole (Li-Hua, 2006). This is supported by Choi (2009), who highlighted that the invisible aspects of technology, such as knowledge, skills, and organization, are much more critical than the physical aspects for the successful transfer of technology. Technological knowledge is knowledge that describes the function and interactions of functions and interactions of natural and artificial things (Hitt et al 2000).The element of technology to be focused in this study is knowledge as the level and the quality of technological knowledge inside the corporation have been related to its ability to achieve product and process innovations and then to its future economic performance (McGrath *et al*., 1996; Hitt *et al*., 2000).

This research focuses on the study of the relationships among social capital, absorptive capacity, technology park services and technology transfer performance. With the intention of fulfilling the objectives of this study, the scope is limited to high technology companies that are found in Malaysian technology parks for these companies have the criteria to be examined in the research.

1.9 Operationalisation of Variables in the Study

This section consists of the definitions of a few key terms that have been used throughout this study. These terms are further elaborated under the literature review.

a) **Technology:** Technology is the theoretical and practical knowledge, skills and artifacts that are used to develop a product as well as the production and delivery systems in an entrepreneurial way. It can be embodied in people, materials, and physical processes.

b) **Technology transfer:** Technology transfer is a process that allows the flow of technology from a source to receiver whereby the receiver will incorporate this new knowledge into its way of doing things.

c) **Technological Knowledge:** refers to a body of experience, contextual information and techniques that accompanies hard technology used in the development, design, production and application of processes, procedures, systems and services

d) **Knowledge Transfer:** refers to a process through which organizations learn from other organizations' experience and the eventual utilization of all or some of the knowledge that is acquired on the part of the adopter.

e) **Technology transfer performance:** Technology transfer performance is meeting the objectives of the specific technology transfer. The focus is on performances outputs which depend on the objectives, goal and mission of the technology transfer.

f) **Product and process performance:** The changes in the product defect rate such as the increased number of products made in-house; the improved product quality and performance

g) **Business performance:** The aspects of commercialisation of new product and market development

h) **Human resource capability:** Observable behaviors that demonstrate knowledge and skills and make a difference in performance

i) **Social Capital:** Social capital is conceptualized as the network of associations, activities or relations that bind people together as a community via certain norms and psychological capabilities, notably trust, which are essential for civil society and productive of future collective action or goods.

j) **Structural social capital:** involves various forms of social organization, including roles, rules, precedents and procedures as well as a variety of networks that contribute to co-operation. Structural Attachment refers to ties between exchange partners manifested at an organizational level.

k) **Cognitive social capital:** includes norms, values, attitudes and beliefs. It can be described by view of ambitions, collative goals, language or narratives. Structural and cognitive social capitals are complimentary: structures help translate norms and beliefs into well-coordinated goal-orientated behavior.

l) **Relational social capital:** refers to assets that are rooted in relationships, such as trust and trustworthiness

m) **Absorptive capacity:** a set of organizational routines and strategic practices to acquire, assimilate, transform and exploit external knowledge to assist organizations in moving forward.

n) **Acquisition:** the ability to recognize, value, and acquire external knowledge that is critical to a firm's operations. Depends on the following: prior investments, such R&D, prior knowledge, intensity in terms of the capability to develop new connections, speed of a firm's efforts to acquire external knowledge, and strategic direction.

o) **Assimilation:** a firm's routines and processes that allow it to understand, analyze, and interpret information from external sources

p) **Transformation:** the firm's ability to develop routines that facilitate combining existing knowledge with newly acquired and assimilated knowledge.

q) **Exploitation:** a firm's ability to apply new external knowledge commercially to achieve organizational objectives. Also refer to the routines that allow firms to refine, extend, and leverage existing competences or create new ones by incorporating acquired and transformed knowledge into its operations.

r) **Technology parks:** a property based initiative which has formal and operational links with a university or other higher education institution or major centre of research; is designed to encourage the formation and growth of knowledge-based businesses and other organizations normally resident on site and

s) **Technology park services: T**echnology park services are structural elements provided by the technology park e.g. infrastructure and supporting facilities.

t) **Basic structural support:** basic structural support (e.g business assistance, rental breaks, access to capital etc).

u) **Technology specific structural support:** (e.g. laboratory & workshop facilities, R&D activities, etc.).

1.10 Organization of the Thesis

This thesis is presented in five chapters. This chapter revealed the background of this study and the outline of the thesis. It deliberates the problem statement of the study, research questions and research objectives. To sum up, studies on technology transfer have identified several elements such as infrastructure, firms' innovativeness, the culture of the firms, level of trust and learning ability that influence transfer performance. While previous studies looked at the variables separately and few attempts were made to link social capital, absorptive capacity and technology transfer performance, this study integrate the role of absorptive capacity and social capital as they are considered vital in ensuring the transferred technology is well practiced. In addition, this study also introduces technology park services as the moderating variable.

The next chapter discussed the prior literatures which focus on factors related to technology transfer performance. This section draw attentions to the summary of previous studies on technology transfer, the concept of social capital and absorptive capacity and role of technology park in enhancing technology transfer. Subsequently, this chapter explains on four major constructs of this study: technology transfer; social capital; absorptive capacity and technology park services.

Chapter three deals with the development of research framework, hypotheses and methodology that being implemented for this study. This chapter explains in depth on the operational definition for each variable and measurement, population and sample, research instruments used, scale of measurement, data collection method and statistical testing and analysis method.

Chapter four provides the empirical result and the summary of tested hypotheses. It describes the key findings of the study. Finally, chapter five discusses on the influence of social capital and absorptive capacity on technology transfer performance; the mediating effect of absorptive capacity on the relationship between social capital and technology transfer performance; the moderating effect of technology park services on relationship between social capital and technology transfer performance; and the moderating effect of technology park services of the relationship between absorptive capacity and technology transfer performance. Above and beyond, this chapter also presents the contribution of the study; and the limitation of the study which could be useful for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoretical and empirical literatures which are most related to this investigation, development of research framework and hypotheses. It reviews on related areas of the current study. The discussions in sequence with an overview on technology transfer, the evolution of models on technology transfer and overview on technology transfer in Malaysia. The chapter also deliberates on the variables examined in this study which include social capital, absorptive capacity and technology park services.

2.2 An Overview on Technology Transfer

Technology is part of knowledge as it is embedded in machines, manuals and technicians (Garud and Nayyar, 1994). Hence, the transfer of technology includes the process of diffusing, assimilating, communicating and absorbing the knowledge into firms. The terms technology transfer and knowledge transfer are used interchangeably. However there are distinctive between the terms. Gopalakrisnan and Santoro (2004) distinguished the terms according to breadth of construct, observability, overlapping characteristics, management phases of most consequences, organizational learning and nature of interaction.

2.2.1 Definition of Technology

Defining technology is important in studying the phenomena related to technology transfer for technology means different thing to people and organization as it related to situation and value specific (Choi, 2009). The United Nation Conference on Trade and Development (UNCTAD) explicate that technology is bought and sold as capital goods. It includes machinery and productive systems; human labour that is usually skilled manpower; management and specialized scientists; information of both technical and commercial character; including that which is readily available, and that subject to proprietary rights and restrictions (Li Hua & Khalil, 2006).

In the past, technology was considered in terms of tangible objects like working machinery and artifacts that give little significance to knowledge and related aspects (Ford & Seren, 1996) and work on technology transfer focus on technology as a thing (Bozeman, 2000). An alternative concept introduced by Sahal (1981; 1982) refers technology as “configurations”, observing the transfer object, the “technology”, must rely on a subjective determined but specifiable set of processes and products. According to Li-Hua (2004) technology is the combination of human understanding of natural laws and phenomena accumulated since ancient times to make things that fulfill our needs and desires or that performs certain functions.

From the production perspective, the purpose of technology is to transform available inputs (natural resources and semi-finished goods) into desirable outputs (consumer goods, semi-finished goods and capital goods). Sharif and Ramanathan (1991) defined technology as the totality of means employed for production that has four embodiment forms (Table 2.1) which interact dynamically. They are complementary and are required simultaneously in any production transformation operation.

Table 2.1
Components of Technology

i) Object	embodied physical facilities (eg. equipment. Machines, factories) called *technoware*, which changes through process of substitution and diffusion
ii) Person	embodied human abilities (eg. skill, expertise, proficiencies), called *humanware*, which changes through a process of upgradation
iii) Record	Embodied document facts (eg. specifications, designs, manuals), called *infoware*, which changes through a process of revision and addition
iv) Institution	Embodied organizational frameworks (eg. linkages, practices, techniques), called *orgaware*, which changes through a process of evolution

Source: Sharif and Ramanathan (1991)

In studying transfer and diffusion of technology it is not sufficient to focus only on the product. When the technological product is transferred, it is not transferred alone, the knowledge of its composition, use and application are also transferred. This approach approves that technology and knowledge transfer is intact or not separable. Another approach by Khalil and Li-Hua (2006) emphasize the concept of technology consisting of four closely inter-linked elements that are techniques, knowledge, the organization of the production, and the product. Table 2.2 provides the explanation of the elements.

Table 2.2
Elements of Technology

Elements	Explanation
Technique	Technique covers the instruments of labour (machinery and tools), materials and the way they are brought into function by labour in the working process. Both social dynamic (working process) and social contradictions (e.g. between machinery and labour) are inherent in this element of the technology as in each of the sub-concepts.
Knowledge	Knowledge consists of three principal categories: applied science, skills and intuition. The weighting between these categories of knowledge is changing historically, but in every case an adequate combination of types of knowledge must be presented.
Organization	Technique and knowledge must be organized before they can bring results. Organization is, therefore, an integral part of technology. Organization of a working process of technique and knowledge into a product may have technical causes, but mostly the actual choice of organization will rest widely on social-economic causes and reflect the general social structure of society.
Product	The ultimate purpose of bringing technique, knowledge and organization together is, of course, to obtain a product. Without including this goal, it is in fact, difficult to understand the other three elements properly.

Source: Khalil and Li-Hua (2006)

Obviously there are various elements, features, scopes, aspects and factors that are used to define technology and properties. Nevertheless, most of the definitions confirm that technology is not only tools or machinery but it is very broad as it covers the tangible and intangible aspects including the technical and managerial knowledge of performing, creating and manufacturing products (Akubue, 2002; Noor, 2010). For the propose of this study, technology is defined as the theoretical and practical knowledge, skills and artifacts that is used to develop a product as well as the production and delivery systems (Eridilek, 1986). It can be embodied in people, materials, and physical process.

2.2.2 Definition of Technology Transfer

Technology transfers in manufacturing industries are subjected to regular empirical examination because they allow more direct observation of the knowledge transfer that occurred (Sarif, 2008). According to Teece (1977), a technology is transferred in two basic forms: “the physical item” and “nonphysical items”. Teece’s distinction between costs of transfer associated with the transfer of “physical items” and “nonphysical items”, such as knowledge to utilize the physical items effectively, was reflected in Szulanski’s work. Szulanski was interested in the latter part of technology transfer, in particular the transfer of “best practice”, because this can help organizations to enhance productivity by adopting a “template” or “working example” (Szulanski & Jensen, 2004). Szulanski (1996) argued that the transfer of “best practice” was a practical way for an organization to improve its performance and it reflected the efforts of firms to copy others to improve their competitiveness. Szulanski (1995) used “practice” to include the “tacit” dimension of organizational knowledge, which is contained partly in individual skills and partly in organizational arrangements.

The transfer of knowledge in organizations can be at multiple analytical levels as ‘the process through which one unit (e.g., group, department, or division) is affected by the experience of another’ (Argote & Ingram, 2000). Dierick and Cool (1989) suggest that a firm's accumulated skills, expertise and talent can be viewed as knowledge stocks. In contrast, knowledge flows include the transfer of new knowledge across organizational boundaries as well as the transfer of underutilized knowledge within organizational boundaries. While knowledge stocks provide the basis for a firm's core competencies (e.g., Grant, 1996), knowledge flows are vital for the refinement, modification, renewal and expansion of knowledge stocks (Teece *et al*., 1997).

The distinction between knowledge stocks and knowledge flows signifies that without continual knowledge flows to enhance and renew their strategic value, knowledge stocks can sometimes cause core rigidity (Kang *et al*., 2007). The performance benefits of knowledge transfer have been documented both in the manufacturing (e.g., Galbraith, 1990) and service sectors (e.g., Baum & Ingram, 1998), as well as both at intra-organizational (e.g., Epple, Argote & Murphy, 1996) and inter-organizational levels (e.g., Dyer & Nobeoka, 2000). While beneficial to the organization, the transfer of knowledge is nevertheless found to be far from frictionless (e.g., Nonaka, 1991; Hippel, 1994; Zander & Kogut, 1995; Szulanski, 1996).

2.2.3 Mechanism of Transfer

Firms used many ways to transfer technology in both intra- and inter- firm transfers. Whether it is through intra or inter-firms transfers, firms generate knowledge through the "replication of organizational routines", which refers to the activities that firms undertake to attain their desired goal (such as profit) (Nelson & Winter, 1982). Nelson and Winter explain that, notion of “replication” indicates that firms copy and repeat the actions and “know-how” of other firms that have already been successful in maximizing their profits while repeating the practice of other firms are “diffuse” knowledge between firms.

Knowledge transfer within organization can occur when it tries to develop a firm standard for how things are to be expected. This approach is called “replication”. Szulanski & Jensen (2006,) asserted that firms can “adapt” knowledge acquired from other firms either through a “traditional adaptation approach” or through a “presumptive adaptation approach”. When firms use the “traditional adaptation approach,” they modify the original practices so that they fit the context of the firm seeking to adopt those practices. The “presumptive adaptation approach,” involves firms “cautiously” and “gradually” integrating external knowledge to the firms’ existing practices (Szulanski & Jensen, 2006).

Szulanski and Jensen (2006) argued that the “traditional adaptation approach” can result in remarkably greater rates of knowledge transfer than the “presumptive adaptation approach”. Arrow’s (1962) notion of “learning by doing” and Nelson and Winter’s (1982) “remember by doing” emphasized the action of “doing”, refers to activities that can be copied and practiced in a new context. Winter and Szulanski (2001) are convinced that the organizational knowledge that results from “doing” is replicable and can be worth replicating. Szulanski & Jensen (2006) extends Arrow’s concept of “learning by doing” and Nelson and Winter’s “remember by doing” because “replication” (Szulanski & Jensen, 2006) is about acquiring knowledge from the accumulation of the experiences of firms. Their “repetition” of the tasks regularly carried out within other firms allows firms to create a “working example” or “template” that they can be used to transfer knowledge within a firm or from one firm to another.

2.3 The Evolution of Models on Technology Transfer

Technology transfer is not a new concept; it is different depending on one’s perception. A historical review on technology transfer was conducted by Segman (l989), that traced the process of technology transfer from the Neolithic times, transferring technologies from East to the West through the Arabs activities and the success of American textile industry in the 18th and 19th centuries due to the transfer of English textiles expertise which allow the knowledge migration. It is shown by previous studies that certain industries collapsed due to industry resistance to the opportunities of technology transfer (Irwin & Moore, 1991). The vital impact of technology transfer gain interest from numerous scholars. Accordingly, various theories and models were developed.

Technology transfer models have started to absorb the principles of the organization development movement in the late 1980s and early 1990s (Sazali et. al, 2009). This was initiated with the Diffusion Model which suggests the importance of technology or innovation to be diffused to the potential users by the experts (Rogers, 1983). This theory was then followed by the Knowledge Utilization Model developed in the late 1980s. It focuses on how to organize knowledge to effective use in the technology user site (Gibson & Slimor, 1991; Backer 1991). However, there are limitations of these models in terms of their limited application in transferring technology across organizational boundaries (Tenkasi & Mohrman, 1995). Consequently, a number of researchers suggested the communication model as a replacement of the former technology transfer model. This model distinguishes technology transfer as a communication and information flow process.

The communication is understood to be concerned with full exchange and sharing of meanings. Williams & Gibson (1990) proposes technology transfer as an on-going process which involves a two-way interactive process (non-linear) by incessantly and simultaneously exchanging ideas among the individuals involved. Irwin and Moore, (1991) mention that the model encompasses characteristics such as two-way communication, interactive, interpersonal or organizational communication. The communication model assists in enlightening the failures of former technology transfer strategies which originated from one-way unidirectional communication and diffusion models. Although the communication model shows an appreciation of the complexities of technology transfer, in the perspective of knowledge transferred through cooperative learning it is not capable to provide clarification on the complexities of technology transfer in terms of the subjectivity of knowledge and the need for contextual adaptation, dialoging at the level of values, assumption, and beliefs that takes on more acute proportions with soft or disembodied technologies (Tenkasi & Mohrman, 1995).

A model proposed by Sung and Gibson (1991) provides an expansion and improvement.

Several models developed after 1990s (Gibson & Slimor, 1991; Sung & Gibson, 2000; Rebentich & Ferretti, 1995) have put emphasis on the fundamental element of communication between the technology developer and the receiver or between different organizations; the levels of technology transfer; the factors which affect technology transfer and knowledge transfer; and the technology transfer processes in international joint venture (IJV).

In early 1990s it comes the era of knowledge-based economy, which emphasizes on the production, distribution and use of knowledge and information, knowledge has been considered as the catalyst of organizational competitiveness. In response to the change in environment, Knowledge-Based View (KBV) which considers knowledge as the most important strategic resources has been developed. KBV is originally developed from resource-based view (RBV) which focuses specially on the resources and capabilities of the firms. From the perspective of KBV, human resource plays an important role in the process of knowledge creation, knowledge transfer and acquisition within organization, therefore the mainly concern in KBV is human resource than other physical resources of the firms (Kogut & Zander, 1996). Hence this study used the KBV model to support the research framework as it could help to explain the role of knowledge underlying technology as the organizations' strategic asset in intra and inter-firm technology transfer.

2.4 Technology Transfer Performance

Research on technology transfer is rapidly increasing, and yet our understanding of its factors remains unclear. The success of knowledge and technology transfer often depends on many factors. The complex and universal nature of technology transfer is such it requires different approaches for different setting (Spann, Adams & Souder, 1995). The various roles in technology transfer may be driven by different goals of the individuals and organization. A technology transfer process has different and multiple outcomes at each stage and it involved various actors who may value different outcomes at each stage based on their particular role in their organization. The confusion over how to measure transfer progress, final success and overall effectiveness occur because of the differences in perspectives, goal and roles of the actors (Sung & Gibson, 1991).

The technology transfer process includes the transfer of technology from R&D to commercialization and beyond. However, there is specific concentration on the boundary of R&D offered by different parties such as university, research center, government laboratory and, corporate unit and commercialization which often sought for by private companies (Noor, 2010). A technology is fully transferred when this technology is commercialized into an invention that is sold in the marketplace. An effective technology transfer will satisfy several criteria such as economic sustainability, social acceptability, environmental abatement or mitigation sustainability, and technological sustainability (Amin, 2005).

2.4.1 Technology Transfer Indicator

According to Pi and Li-Hua (2006), a firm's ability to achieve its goals or objective is an indication of technology transfer performance and success. Accordingly, Rose *et al.* (2009) emphasize that technology transfer success is not only limited to having the ability to operate, sustain the machineries in the production level but also take account of the ability to learn, acquire, absorb and utilize new external technologies and knowledge entrenched in the product materials; physical assets; processes and production; and management capabilities.

A number of researchers undertake technology transfer as process and identify the stages of technology transfer in an organization. For example, Souder and Padmanabhan (1989) suggested a model that includes four stages namely prospecting, developing, trial and adoption. While, a study by Szulanski (1995) also suggests stages of technology transfers, the stages are initiation, application, ramp-up and integration. This approach evaluates the performance of technology transfer all the way through the four stages. Several measurements of technology transfer performance introduced by researchers are provided in Table 2.3.

Table 2.3
Measurement of Technology Transfer Performance

Researcher	Measurement
Geringer& Heber (1991)	Firms' survival, stability and duration (objective measure), perceptual measure of satisfaction with performance (subjective measure)
Schroer, et. al (1995)	Number of jobs created, the increase in revenue, decrease in operating costs, introduction of new products, process improvement and royalties(output measurement)
Bozeman (2000)	"out the door". Market impact (sales and profitability), economic development, political reward, opportunity costs (cost-benefit analysis) and scientific and technical human capital (increment in capacity to do R&D)
Whangthomkum, et. al (2006)	Product performance, process performance and human resources capabilities
Noor (2010)	Evaluates the performance of technology transfer all the way through initiation, implementation, ramp-up and integration

The various roles in technology transfer may be driven by different goals of the individuals and organization. In other words, these various perspectives generated a large number of potential measures. According to Spann *et al.* (1995), an effective management of transfer programs may depend on some degree of convergence among transfer players on the goal of their transfer efforts. All parties must work together to achieve the goal of their transferring technology while each party achieves its individual goals as well. However the adopter's goal and measures must be central to the transfer process. The overall effectiveness only can be improved by satisfying the adopter's goals and recognizing the adopter's measure of success.

According to Schroer *et al.* (1995), when considering technology transfer performance, firms should focus on performance outputs that indicate effectiveness instead of efficiency. Generally, three common objectives that expected to be achieved from the transfer of technology are the introduction of new techniques, the improvement of new techniques and the generation of new knowledge (Li-Hua, 2006; Noor, 2010). Successful technology transfer enables firms to create products and services to achieve their business objectives. In addition, the transfer of technology will enhance the human resource capability that plays a critical role in the creation of a commercially feasible product, services or process. Therefore, the proposed study adopted measurement introduced by Whangtomkum (2006) which includes three dimensions in order to determine the performance of technology transfer in particular, product and process performance, business performance, and human resource performance.

(i) Product and process performance

The purposes of a company conducting the transferring of new technology are either to produce a product or to create the process required to produce a product. Hence, both are important outcomes of the technology transfer. Product and process technology transfer performance can be measured by examining changes in the rate of product defects such as increasing the number of products made in-house; better product quality and performance (Wong *et al.*, 1999).

(ii) Business performance

Technology transfer involves the acquisition and processing of equipment, technical information, and knowledge, which is necessary but not sufficient for creating value (Camp & Sexton, 1992). According to Whangtomkum (2006), the use of technology to generate profit in the market is essential hence the aspects of commercialisation, such as new product and market development should be involved in assessing transfer performance. For that reason, commercial success is the dimension related to business performance of technology transfer.

(iii) Human resource capability

To improve business involves human resources. Human resource is an important aspect for a firm to ensure the ability of a firm in making a product or establish the production process. As technology transfer encompasses product and process, embodied technology and all the peripherals of disembodied knowledge related with such a task, it relies on human resource input. In any technology transfer efforts it is the people who need to be taught the way of using the technology (Akinyemi, 2001). Therefore, the success of transferring the technology possibly will result in improved human resource capability.

2.5 Obstacles in Technology Transfer

According to Odigie and Li-Hua (2008), some of the barriers of technology transfer faced by the developing countries includes; potential loss of intellectual properties, potential exploitation of indigenous employees, lack of infrastructures, problems with employees attitudes, lack of government policy or legal protection, appropriate geographical location, conducive environment, etc.

There are two major barriers that impede technology transfer, the nature of the knowledge (knowledge characteristics) and the context to which the knowledge is to be transferred (situation characteristics) (Szulanski, 1995). The first barrier derives from the uncertainty that firms can use the information they have gained to achieve immediate benefits from it. Uncertainty with respect to their capacity to derive from information, which has been acquired at some cost, causes firms to resist spending money to acquire such knowledge.

The second barrier relates to the contexts to which knowledge is to be transferred. Szulanski (1995) clarify that there are several characteristics of the contexts into which knowledge is to be transferred that affect its transfer. These include the willingness of those who hold the knowledge to transfer it, the perception of the quality of the knowledge on the parts of those who are to receive it, a lack of interest on the parts of the intended "recipients" of knowledge, a lack of "absorptive capacity" on the part of intended recipients, a lack of ability to absorb and retain knowledge on the part of intended recipients, a lack of ability to absorb and retain knowledge on the part of intended recipients, a lack of support from the management of the organizations involved, and communication breakdowns between the "sources" and "recipients" of knowledge.
Simonin (1999a), examined the difficulties associated with transferring marketing knowledge and identified a number of factors that impede knowledge transfer. These include the nature of the knowledge to be transferred, the willingness of the "source" and "recipients" to engage in transfer, the contexts into which the knowledge is to be

transferred and received, and the quality of the relationship between the “source” and the “recipients” of the knowledge.

Considering the barriers, it is essential to comprehend the understanding on the social interactions of organizational actors and their ability to value, assimilate, and apply knowledge received from external sources to gain access and fully utilize the knowledge in productive manner. Two prominent concepts that provide a foundation for describing and characterizing the issues are social capital and absorptive capacities. These two concepts are further discussed in the next sections.

2.6 Social Capital

Social capital is a concept that has significant implications for enhancing the quality, effectiveness and sustainability of operations, particularly those that are based on community action. Putnam (2000) put forward social capital as the network of relations, activities or associations that bind people together as a community through certain norms and psychological capabilities particularly trust which are essential for civil society, and productive of future collective action or goods. In 1990s there is passionate development in social capital. Nahapiet and Ghoshal (1998) define social capital as the resources available and potentially available from the network of relationships found in the individual or community. Although the concept of social capital has found widespread recognition, there remains widespread ambiguity about its meaning and effects (Koka & Prescott, 2002).

As has been deliberated by a number of scholars (Coleman, 1988; Putnam, 1995; Nahapiet & Ghoshal, 1998, etc.) social capital is not a one-dimensional concept. Social capital has many attributes associated with complicated social context. It covers many aspects of the social context such as social ties, trusting relationships, value systems that facilitate actions of individuals, it is therefore important to clarify the dimensions of social capital (Tsai & Ghoshal, 1998).

Nahapiet and Ghoshal (1998) propose three dimensions of social capital which are structural, relational, and cognitive aspects. This three-dimensional framework was used to examine the relationship between social capital and inter-organization phenomena, like the establishment of intellectual capital (Nahapiet & Ghoshal, 1998), the interchange of resources between divisions (Tsai & Ghoshal, 1998), and organizational citizenship behavior (Bolino *et al* ., 2002). Table 2.4 summarizes the components of social capital in the three-dimensional framework employed by former scholars.

Table 2.4

The Summary of Components of Social Capital

Origin	Structural dimension	Relational dimension	Cognitive dimension
Coleman (1988)	The information potential and the authority relationships	Trust, norms, punishment mechanisms, obligations and expectations	—
Tsai & Ghoshal (1998)	Social interaction	Trust and dependency	Common vision
Gulati et. al (2000)	Mosaic structure	Mosaic relationship	—
Nahapiet & Ghoshal (1998)	Network connectivity, network patterns, organization relationships	Trust, norms, obligations, recognition	Common coding and language, common narrative
Adler & Kwon (2000)	Network	Norms, rules, trust	Faith

Source: Li and Zhu (2009).

The effect of social capital on various aspects of performance were examined at various levels and settings from either the effectiveness of the group (Oh, Chang & Labianca, 2004), the exchange of resources between units and product innovation (Tsai & Ghoshal 1998; Hansen, 1999), access to opportunities employment and career advancement of individuals and small groups (Burt 1992), job satisfaction (Requena, 2003), and employee commitment (Watson & Papamarcos, 2002). Three common benefits of social capital that has been identified in the literature:

(i) information channels provide accessibility to appropriate, unique and diverse information and know-how (Coleman, 1988; Burt, 1992);

(ii) influence and control, including power and prestige (Lin, 2001); in terms of structural relationship and

(iii) solidarity, defined as the ‘degree of mutual trust and commitment among [actors] that is independent of any specific transaction’ (Sandefur & Laumann, 1998).

Social capital helps in reducing malfeasance; encourage trustworthy information to emerge; resulted in agreement that are respected; enable employees to share information and make the negotiators implicitly interact on the same wave-length, therefore the firm in the community with a large stock of social capital will always have a competitive advantage (Rahmani & Masouvi, 2011).

Basically, firm is viewed as collective community concedes the social embeddedness of work organizations, and for that reason, the role of social relations is influencing their exchange activities (Granovetter, 1992). Accordingly, corporate community cooperation built by individuals whose actions are both enabled and restricted by the structure and resources available in the social networks in which it embedded (Granovetter, 1992). Consequently, one of the key challenges for contemporary firms is argued to be their capability to develop and sustain ongoing, mutually beneficial relations among their members. That is, to develop and sustain their social capital which, subsequently, can facilitate the effective transfer of knowledge through the engagement of their members in purposeful and highly interdependent work tasks (Adler & Heckscher, 2006). Some of recent studies that highlighted the importance of social capital in facilitating knowledge transfer are provide in Table 2.5.

Table 2.5

Study on Social Capital and Knowledge Transfer

Author	Objective and Methodology	Findings
Yang et al. (2011)	Investigates the relationships among social capital, knowledge transfer and absorption and team performance in the selling center context. This study provides a relatively complete picture of selling center performance and adds knowledge to the field.	Building upon social capital literature and team literature, the authors propose that selling center performance is influenced by its internal and external social capital. Social capital influences selling center performance through facilitating knowledge transfer and absorption within and across the selling center
Gooderham et al. (2011)	Extend social capital approaches to knowledge transfer by identifying governance mechanisms that promote or undermine the development of social capital. A survey conducted on individuals in two companies in Denmark.	Social capital has a positive impact on knowledge transfer. The implication is that the 'goodwill' that makes organizational resources available for individual use (i.e. the core intuition of social capital) is of substantial significance for the transfer of knowledge.
Bosen& Gang (2010)	Introducing transactive memory system (TMS) as a medium variable, to study whether and how team's social capital affects team knowledge transfer through TMS.	Suggest that in order to transfer knowledge more effectively, teams should take measures to build social capital thus to promote the development of TMS

Table 2.5 Continue

Jansen et. al. (2009)	Develop moderated mediation model on social capital, knowledge transfer and performance. Argue that knowledge transfer is a necessary step in converting potential benefits of social capital into organizational outcomes. Meta-analysis study on 117 studies.	Found that organizations need to carefully consider both the structural position in a network and the strength of individual ties if they seek to enhance their performance by transferring knowledge.
Li & Zhu (2009)	Summarize the theoretical viewpoint of social capital, and incorporate the important ideology of social network theory	The study constructed a theoretical model that examine the influence of mechanisms of social capital to informal knowledge transfer among individuals, and explain separately the way to improve effectively informal knowledge transfer among individuals to enhance organization performance from the three dimensions of social capital.

Rottman (2008)	Explore the supplier network at three levels (structural, cognitive, and relational). Present eight proven practices for creating, managing, and exploiting social capital within strategic alliances. Used formal interviews, document collection, informal interactions interpretation of participants' interviews, and participant feedback on data analysis.	In the case of US Manufacturing, while the nurturing of social capital was not a sufficient lever for success, it was a necessary one. Additional research is needed to determine how various social capital and knowledge transfer practices are generalizable across firms and industries; the current study does show the importance in understanding both successful and unsuccessful offshore engagements through the lens of social capital.
Alexopoulos (2008)	Developed an integrated theoretical model to expand understanding of the mechanisms for and the conditions under which social relations can be converted into useful, actionable knowledge. Survey on 135 knowledge workers from three Irish-based organizations.	At the interpersonal level of investigation, the effective transfer of knowledge centers upon the extent to which individuals share a common lexicon for communication and trust each other, both professionally and personally.
Inkpen & Tsang (2005)	Examine how social capital dimensions of networks affect the transfer of knowledge between network members.	Propose a set of conditions that promote knowledge transfer for the different network types. Call for more research on the outcomes of social capital. Shows that each network type has distinct social capital dimensions.

Within regional innovation systems or structure composed of companies like technology parks, social capital is essential to increase motivation and ability for flexible organizational forms (Asheim, Coenen & Svensson-Henning, 2003; Cooke, 2008; Isaksen, 2009). Social capital plays important role in enhancing the creation of good teamwork, interactive learning, project and networking management, interdisplinary collaboration or intermediary. Adopting the definition of social capital proposed by Inkpen and Tsang, (2005) and; Nahapiet and Ghoshal, (1998) this study define social capital as the combination of resources embedded within, available through, and derived from the network of relationships possessed by an individual or organization. Based on this view, the central intention of social capital is networks of relationships become a valuable resource for the individual or organization. To ensure a successful transfer of tacit knowledge between network members, individual and organizational social capital must be developed, because the transfer normally requires intimate personal interactions. Nevertheless, the introduction of social capital variables into the analysis of networks and knowledge transfer adds a level of complexity, that has not yet been examined empirically (Inkpen & Tsang , 2005).

2.7 Absorptive Capacity

Absorptive capacity is a useful conceptual device in order to understand technology transfer as technology transfer involved the process of transmission and absorption of knowledge (Duchek, 2013; Camison & Fores, 2010;Sazali *et al*., 2009).The concept first emerged as significant in the 1980s, with the acquisition and application of new knowledge as the fundamental role in business competitiveness. The contribution by Cohen & Levinthal (1990) is generally accepted as the founding paper. They define absorptive capacity as “the ability of a firm to recognize the value of new external information, assimilate it, and apply it to commercial ends”. In the context of technology transfer, Kedia and Bhagat (1988) related the absorptive capacity to firm’s receptiveness to technological change. Van den Bosch et al. (1999) propose that the firm’s knowledge settings could influence the growth of its absorptive capacity. They established that the cyclical process through which absorptive capacity stimulates learning was regulated by the firm’s competitive setting.

Besides that, Zahra & George (2002) defined absorptive capacity as a dynamic capacity embedded in routine and processes. They grouped four dimensions of absorptive capacities into two main categories those are; potential capacities (knowledge acquisition and assimilation) and realized capacities (transformation and exploitation of knowledge). The extended model of absorptive capacity by Zahra and George (2002) maintained that former knowledge, which is corresponding to a firm's experience, is essential to develop absorptive capacity. Moreover, they put emphasis on other factors, for example external knowledge sources and corresponding external knowledge, are equally important.

Absorptive capacity encompasses individuals, groups, and organizational levels. Individuals involved in the knowledge sharing and recognition aspects. While, routines, histories and stories, documentation, procedures, heuristics and know-how are important in creating shared understandings of the knowledge at the organizational level, (Matusik & Heeley, 2005). According to Zahra and George (2000), potential absorptive capacity is the first two dimensions of absorptive capacity which is ability to identify and assimilate new external knowledge, while realized absorptive capacity is the other two dimensions, which refer to ability to transform and exploit new knowledge. Using the explanation of potential absorptive capacity and realized absorptive capacity, they proposed that transformative capacity played a role in reducing the gap between the potential absorptive capacity and the realized absorptive capacity. The definition of the study on potential absorptive capacity and realize absorptive capacity by Zahra and George (2000) was adopted in this study. The followings are some related studies on absorptive capacity and technology transfer (Table 2.6).

Table 2.6

Studies on absorptive capacity and technology transfer

Author	**Methodology**	**Findings**
Sarala & Junni (2013)	Test the hypotheses using data from two surveys on a sample of domestic and foreign acquisitions conducted by Finnish companies,	Established a positive relationship between the absorptive capacity of the recipient firm and knowledge transfer. In terms of knowledge transfer from the acquirer to the target and in terms of knowledge transfer from the target to the acquirer.
Selmi (2013)	Explain the challenging dealing with the constraints of the performance of technology transfer process to developing countries by combining theoretical approach	Identifies absorptive capacity as prerequisites for all developing countries which wish to optimize the transfer of technology.
Han & Lee (2012)	Used the event study Methodology (gathering technology transfer announcement for Korea from 2001 to 2009) to better understand the nature of successful technology transfer in Korea	Technology transfer announcements significantly increase the market value of firms in Korea, however unable to determine whether the impact of high levels of absorptive capacity is significantly different from that of low levels of absorptive capacity.

Table 2.6 Continue

Zonooz et. al. (2011)	proposed model to extend some of the frameworks to understand better the relationship between absorptive capacity and combinative capabilities and knowledge transfer	Indicate that two dimensions of absorptive capacity, available complementary knowledge and prior related experience, are both important antecedents of knowledge transfer.
Noor (2010)	Study on the absorptive capacity, technology capability as the factors of technology transfer. Surveyed on Electronics and Electrical firms.	Found several significant relationships between absorptive capacity dimension and technology compatibility dimension.
Lam & Tong (2010)	Survey on China Private finance initiative projects, 602 respondent	Found significant and positive relationship between Tacit knowledge and Organizational Distance. Strategic Similarity is significantly and positively related to Partner Protectiveness while

		Strategic similarity is positively related to partner protectiveness. Asset Specificity is significantly and positively related to Experience.
Volberda et. al (2009)	To advance understanding of absorptive capacity, its underlying dimensions, in multi-level antecedents. Map the existing terrain of research through a bibliometric analysis.	Found that most attention so far has been focused on the tangible outcomes of absorptive capacity. Organizational design and individual level antecedents have been relatively neglected. The emergence of absorptive capacity from the actions and interactions of individual, organizational and inter-organizational antecedents remains unclear.
Othman et. al. (2009)	Survey on Malaysian Automotive component manufacturers, 45 respondent	the knowledge base and commitment in applying the knowledge focused more on detail design phase up to production ramp-up
Islam (2009)	Survey cross country. 55 countries (23 high income OECD & 32 low and medium income) R&D scientist	Differences in domestic research intensity can account for the differences in TFP growth. Distance to technology frontier is negatively related to TFP growth
Jurado et. al. (2008).	Survey on SME in industrial estates in The Province of Velencia, 84 firms responds.	Significant relationship bet Organizational knowledge & AC
Whangthomkum et. al. (2006)	Investigate the relationships of absorptive capacity on technology transfer effectiveness in the flexible packaging industry in Thailand.	Technology transfer performance is related to all absorptive capacity elements, but not all to the same degree.

2.8 Technology Parks Services

Technology parks are used to encourage innovation in the high tech sector. It needs input from all active industry participants and other institution in order to achieve high performance. Technology parks are a networking that includes independent firms operating in the same interrelated market segment and a shared geographic locality, benefiting from external economies of scale and scope agglomeration (Ikpen & Tsang, 2005). Technology parks are thought to encourage innovation, support business adaptableness, and facilitate endogenous provincial development in an increasingly global market place (Staber & Morrison, 1999). A further developed circulation of knowledge and spillovers do indeed encourage the diffusion of innovations in thick regional concentrations of corporations (Glaeser *et al.* 1992; Pavitt 1987). For this study, the technology parks are discussed as specific instruments to enhance the technology transfer in the firms.

Bellandi (1992) highlighted that the establishment of these technology park areas explained by the district theory which proposed a classification of localisation economies in four different categories, which are respectively characterised by the following criteria:

a) Higher specialisation, built on the division of labour,

b) Larger flows of information,

c) More highly–trained labour force, and finally,

d) Greater innovation capacity

The incubating firms are able to develop externalities from the central pooling of resources in the technology parks.The cluster theory prolongs the argument that high-tech firms of identical characteristics and within the value chain would be driven into the same cluster together in the science park and therefore, gradually develop as a strong allied group complementary to each other. Clusters, industrial districts or particularly technology parks are indeed known as places in which ‘close inter–firm communication, socio–cultural structures and institutional surroundings may stimulate socially and territorially embedded collective learning and continuous innovations' (Asheim & Isaksen 2002). It is found that literature gives support to a series of effects which technology parks have in the promotion of innovation within firms, and which can be summed up in the better diffusion of knowledge, the presence of social capital and trust, and the more efficient networking of firms (Swann *et al*., 1998, Noteboom 2006). Table 2.7 shows the studies on technology parks that related to technology transfer.

Table 2.7
Studies on Technology Parks and Technology Transfer

Author	**Methodology**	**Findings**
Belussi & Sedita (2010)	Analyzed the emergent and deliberate structures that favour knowledge transfer at the local and distance level. Interview (qualitative) case study, Kenya	Illustrates district-learning dynamics through two mechanisms. - Exploitation of local knowledge structures. - Exploration of distant knowledge structures. Emphasize that further research is necessary to provide more empirical evidence and allow generalization of the research results.
Latif & Rahman(2009)	Using secondary data and Survey on Automotive SMIs around Kulim High Tech Park areas, Malaysia	Found that there are gaps across industrial sub-sectors in term of various skills needed to create sustainable enterprise and entrepreneur development. Those gaps are cognitive, interpersonal, technical, creativity, computation, communication, intrapersonal, conceptual, managerial, analytical, technological, acoustic, design, self-management, innovative, basic managerial, supervisory, and marketing.
Sarif (2008)	Examined the concept of stickiness in knowledge transfer among ICT firms at "macro" and "micro" level in Malaysian technology parks.	Found that at "macro" level stickiness, the government cannot exclude previous policy documents that contained; national unity, foreign direct investment and sound economic growth to

	Interviewed 50 informant included policy makers, government officers, and executives of ICT firms.	formulate policy for Malaysian technology parks, which solely not encourage knowledge transfer for the policy documents, permitted short term profit taking by ICT firms. Found cost as the barriers that impede ICT firms from participating in technology transfer at "micro" level.
Sarif & Ismail (2006a)	Explore the views of key ICT stakeholders on the role of technology parks in promoting innovation via knowledge transfer. Interview with 12 informants.	Observed that Malaysia's technology parks have played minor role in encouraging knowledge transfer.

From the review of the literature, it is suggested that social capital, absorptive capacity, and technology parks services are important as it enhance firms' technology transfer performance. Absorptive capacity was proposed as a mediating variable based on the nature of this variable which has significant relationship with both independent variable and dependent variable (Baron and Kenny, 1986). This is based on the suggestion of previous studies (Rahmani & Masouvi, 2011; Ziam, Landry & Amara, 2009) which highlighted that social capital and absorptive capacity has significant relationship. Besides, absorptive capacity also was found to have significant influence on technology transfer (Noor, 2010; Zonooz et. al., 2011). Therefore, absorptive capacity may hypothetically function as mediating variable to the extent that it accounts for the relation between social capital and technology transfer performance.

Technology park services was suggested to have positive influence on technology transfer performance (Saari & Haapasalo, 2012; Asheim & Isaksen 2002; Phillimore

1999), however, some studies argue on the significance influence of this variable (Latif & Rahman, 2009; Malek et al., 2009; Sarif and Ismail, 2006). Considering the nature of this variable, technology parks service was proposed as moderating variable in the research framework for this study. Based on the definition of moderating variables suggested by Baron and Kenny (1986), the moderating variable in this study can be is explain as a subjective variable (eg. level of benefit) which effects the direction and/or strengthen of the relationship between independent variable and dependent variable. The framework proposed in this study attempts to explain on how the direct effects of social capital and absorptive capacity on technology transfer performance moderated by technology park services.

2.9 Summary of the Chapter

The literature review has presented the topics that are related to this research. They include the definition of technology, technology transfer, social capital, absorptive capacity, technology park services, related theory and models and research framework. Through the review of the literature, a research framework has been developed to understand the performance of technology transfer in the incubating companies in Malaysian technology parks. The investigation on technology transfer performance in this study includes social capital as the independent variable and absorptive capacity as the mediating variable. This study also attempts to examine technology park services as the moderating variable. Although the factors had been investigated in some of the past studies they were studied separately and some of the studies on these factors were not empirically tested thus, evident that there are gaps in the study on technology transfer performance. These gaps are brought forward in this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The main purpose of this chapter is to discuss the method applied and to provide a better understanding of the direction of this study. This is essential for the reason that the validity of the findings depend on how the data are collected and analysed. This chapter highlights the assumptions used to obtain the findings and their limitations. The chapter starts with a description of the process that provides the outline of the work. It discusses the conceptual framework of the research and the process of selecting respondents. Accordingly, it describes, the research design, the research hypotheses and outlines the appropriate organized approaches applied to portray certain conclusions for the study.

3.2 Research Framework

The vital impact of technology transfer has gain interest from numerous scholars. Accordingly, various theories and models were developed such as models developed after 1990s (Gibson & Slimor, 1991; Rebentich & Ferretti, 1995; Sung & Gibson, 2000) which have highlighted on the important element of communication among the technology developers and the receivers or between different organizations; the levels of technology transfer; the factors which influence technology transfer and knowledge transfer; and the technology transfer processes in international joint venture (IJV). Nevertheless, the emergence of knowledge-based economies has driven gradual development in technology transfer models, which improved to further explain the dynamic role of knowledge underlying technology and Knowledge-Based View (KBV) has been developed.

From the perspective of KBV, human resource plays an important role in the process of knowledge creation, knowledge transfer and acquisition within organization therefore the main concern in KBV is human resource than other physical resources of the firms (Kogut & Zander, 1996). Therefore, the underpinning theory used to support the framework of this study is the Knowledge-Based View (KBV). This theory can be seen as a natural evolution of the resource-based approach (Alexopoulus, 2008). The knowledge-based theory of the firm sees knowledge as the most strategically significant resource of the organizations. This knowledge is embedded and carried through multiple entities including organizational culture and identity, policies, routines, documents, systems, and employees (Li-Hua, 2006). The knowledge-based theory's proponent argues that knowledge-based resources are usually difficult to imitate and socially complex, therefore, diverse knowledge foundations and capabilities among firms are the main determinants of sustained competitive advantage and higher corporate performance.

From the strategic management literature, this Knowledge-Based View (KBV) perspective builds upon and extends the resource-based view of the firm (RBV). The RBV initially promoted by Penrose (1959) and later expanded by others (Wernerfelt, 1984; Barney, 1991; Conner, 1991). Based on the resource-based approach, competitive advantage is contingent upon the extent to which the firm possesses bundles of valuable, rare, imperfectly imitable, and imperfectly substitutable resources including physical assets, human resources, and organizational processes (Barney, 1991). According to Noor (2010), the inputs into organizations are considered as the resources which could either be knowledge-based resources or property-based resources. The property-based resources refer to tangible input resources such as materials while the knowledge-based resources are the ways firms combine the tangible inputs.

Even though resource-based view of the firm recognizes the important role of knowledge in firms in achieving a competitive advantage, the proponents of the knowledge-based view argue that the resource-based perspective does not go far enough (Alexopoulus, 2008). Spender (1994) has expressed the view that the resource-based approach may be too narrow in its scope by concentrating on the protection of key resources, and by overlooking through how those resources are coordinated, integrated, and applied. The resource based approach seems to adopt an all-encompassing definition of resources without, however, examining how resources are obtained or interact with each other towards contributing to the firm’s competitive advantage (Priem & Butler, 2001). Spender (1996) further argues that a knowledge-based theory of the firm can yield insights beyond the production-function and resource-based theories of the firm. Figure 3.1 shows the research framework of this study.

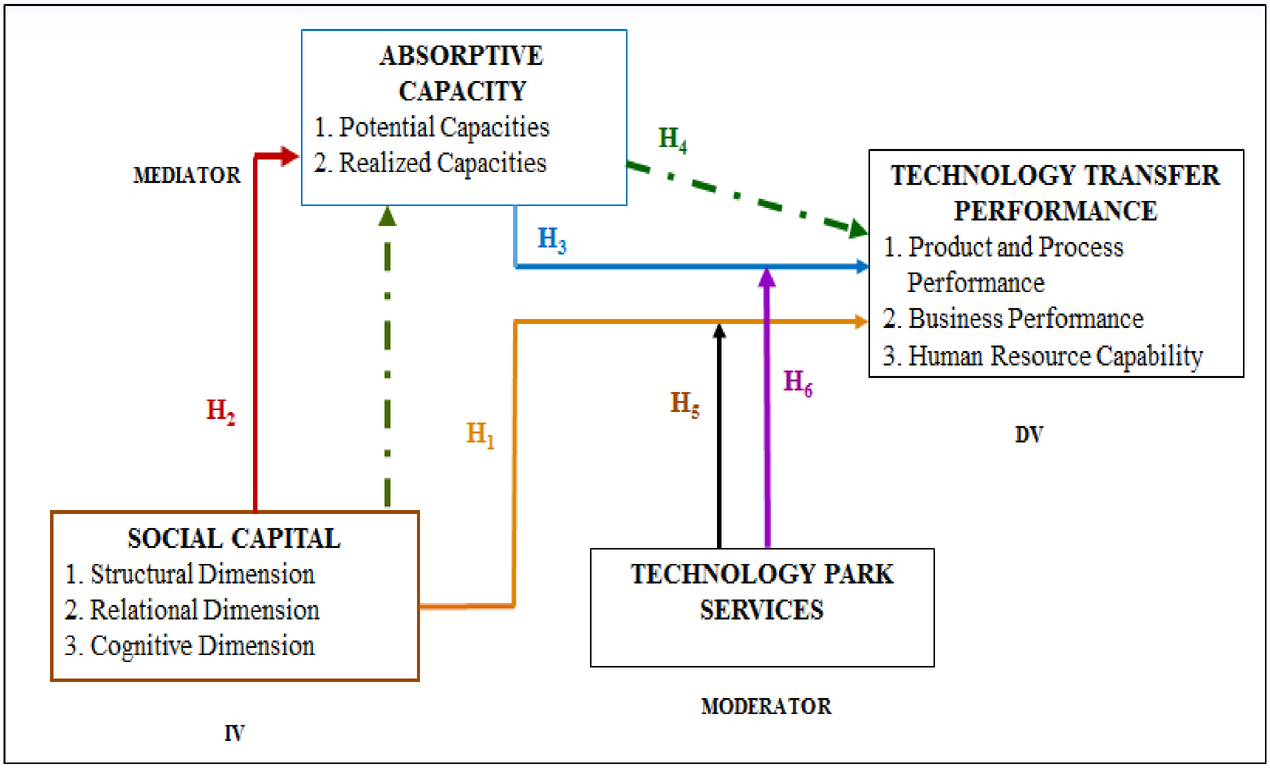

Figure 3.1
Research Framework

3.3 Research Hypotheses

There are various studies on absorptive capacity and technology transfer, although studies on the combination of social capital and absorptive capacity in technology transfer were written by only a small number of authors. Few studies suggested absorptive capacity as a mediator in technology transfer success while others identified the role played by research and development in improving absorptive capacity that lead to transferred technology. Findings from previous research showed that the increase in social capital and absorptive capacity were positively related to the rate of technology transfer. However, the study on social capital and absorptive capacity are diverse and some of the studies are on conceptual bases that require empirical study. Therefore, this study attempts to provide empirical verification on the relationships of the three variables. In addition, technology park service was introduced as the moderating variable. Based on the research framework, the following hypotheses are formulated.

3.3.1 Hypotheses for Direct Effect

H_1 Social capital has significant positive influence on technology transfer performance.

H_{1A1} Structural dimension has significant positive influence on product and process performance.

H_{1A2} Structural dimension has significant positive influence on business performance.

H_{1A3} Structural dimension has significant positive influence on human resource performance.

H_{1B1} Cognitive dimension has significant positive influence on product and process performance.

H_{1B2} Cognitive dimension has significant positive influence on business performance.

H_{1B3} Cognitive dimension has significant positive influence on human resource performance.

H_{1C1} Relational dimension has significant positive influence on product and process performance.

H_{1C2} Relational dimension has significant positive influence on business performance.

H_{1C3} Relational dimension has significant positive influence on human resource performance.

H_2 Social capital has significant positive influence on the absorptive capacity.

H_{2A1} Structural dimension has significant positive influence on potential capacity.

H_{2A2} Structural dimension has significant positive influence on realize capacity.

H_{2A3} Cognitive dimension has significant positive influence on potential capacity.

H_{2B1} Cognitive dimension has significant positive influence on realize capacity.

H_{2B2} Relational dimension has significant positive influence on potential capacity.

H_{2B3} Relational dimension has significant positive influence on realize capacity.

H_3 Absorptive capacities has positively influence technology transfer performance

H_{3A1} Potential capacity has significant positive influence on product and process performance.

H_{3A2} Potential capacity has significant positive influence on business performance.

H_{3A3} Potential capacity has significant positive influence on human resource performance.

H_{3B1} Realized capacity has significant positive influence on product and process performance.

H_{3B2} Realized capacity has significant positive influence on business performance.

H_{3B3} Realized capacity has significant positive influence on human resource performance.

3.3.2 Hypotheses for Mediating Effect

Mediating hypotheses assist in understanding on how the relationship occurs by treating potential capital and realized capital as the mediating variable. Based on the definition of mediation proposed by Baron and Kenny (1986), the variables may be said to function as mediator to the extent that they accounts for the relation between social capital and technology transfer performance. The hypotheses for mediating effect are as follows.

H_{4A} ***The mediating effect of potential capacity on the relationship between social capital and technology transfer performance***

H_{4A1} Potential capacity mediates the relationship between structural dimension and product and process performance

H_{4A2} Potential capacity mediates the relationship between structural dimension and business performance

H_{4A3} Potential capacity mediates the relationship between structural dimension and human resource performance

H_{4A4} Potential capacity mediates the relationship between cognitive dimension and product and process performance

H_{4A5} Potential capacity mediates the relationship between cognitive dimension and business performance

H_{4A6} Potential capacity mediates the relationship between cognitive dimension and human resource performance

H_{4A7} Potential capacity mediates the relationship between relational dimension and product and process performance

H_{4A8} Potential capacity mediates the relationship between relational dimension and business performance

H_{4A9} Potential capacity mediates the relationship between relational dimension and human resource performance

H_{4B} The mediating effect of realized capacity on the relationship between social capital and technology transfer performance

H_{4B1} Realized capacity mediates the relationship between structural dimension and product and process performance

H_{4B2} Realized capacity mediates the relationship between structural dimension and business performance

H_{4B3} Realized capacity mediates the relationship between structural dimension and human resource performance

H_{4B4} Realized capacity mediates the relationship between cognitive dimension and product and process performance

H_{4B5} Realized capacity mediates the relationship between cognitive dimension and business performance

H_{4B6} Realized capacity mediates the relationship between cognitive dimension and human resource performance

H_{4B7} Realized capacity mediates the relationship between relational dimension and product and process performance

H_{4B8} Realized capacity mediates the relationship between relational dimension and business performance

H_{4B9} Realized capacity mediates the relationship between relational dimension and human resource performance

3.3.3 Hypotheses for Moderating Effect

Moderating hypotheses assist in understanding on how the relationship occurs by treating technology park services as the mediating variable. Based on the definition of mediation proposed by Baron and Kenny (1986), a variable may be said to function as moderator if it effects the direction and strength of the relation between the independent variable and dependent variable. The hypotheses for moderating effect are as follows.

H_5 The moderating effect of technology parks services on the relationship between social capital and technology transfer performance

H_{5A} Technology park services moderate the relationship between structural dimension and product and process performance.

H_{5B} Technology park services moderate the relationship between structural dimension and business performance.

H_{5C} Technology park services moderate the relationship between structural dimension and human resource performance.

H_{5D} Technology park services moderate the relationship between cognitive dimension and product and process performance.

H_{5E} Technology park services moderate the relationship between cognitive dimension and business performance.

H_{5F} Technology park services moderate the relationship between cognitive dimension and human resource performance.

H_{5G} Technology park services moderate the relationship between relational dimension and product and process performance.

H_{5H} Technology park services moderate the relationship between relational dimension and business performance.

H_{5I} Technology park services moderate the relationship between relational dimension and human resource performance.

H_6 The moderating effect of technology parks services on the relationship between absorptive capacity and technology transfer performance

H_{6A} Technology park services moderate the relationship between potential capacity and product and process performance.

H_{6B} Technology park services moderate the relationship between potential capacity and business performance.

H_{6C} Technology park services moderate the relationship between potential capacity and human resource performance.

H_{6D} Technology park services moderate the relationship between realized capacity and product and process performance.

H_{6E} Technology park services moderate the relationship between realized capacity and business performance.

H_{6F} Technology park services moderate the relationship between realized capacity and human resource performance.

3.4 Research Process

Research process is a flow of activities in a step-by-step linear process that has to be followed by researchers, whether the research is conducting for applied research or basic research. The process involves two distinct aspects, the process of developing conceptual framework and hypotheses, and the design of research such as selection of sample, data collection method and method for analysis data (Sekaran, 2003). Figure 3.1 shows the research process of the present study.

The initial phase is a foundation for a research which is including literature survey and observation, identifying the research problem, and developing theoretical framework as well as hypotheses. Literature review is the documentation of a comprehensive analysis of the published and unpublished work from secondary sources of data in the areas of interest (Sekaran, 2003). The literature survey is to identify critical variables that will give impact on the research problem and to ensure that the variable is not being left out of the study. In addition, literature survey facilitates in developing theoretical framework and hypotheses. Thus, information is gathered from journals, books, and on-line information.

The second phase is developing a preliminary survey. Pre-test and pilot-test were performed to test the validity and reliability of the questionnaires. After collecting the pilot-test results, modification on the questionnaires was done when necessary. Then, sample size was determined for distributing the questionnaires. Distribution of questionnaires was done through post mail and online survey. Each respondent was sent a questionnaire, a cover letter and stamped self-addressed envelopes. Final phase consists of data analysis. The quantitative data was analyzed by using Statistical Package for Social Science (SPSS).

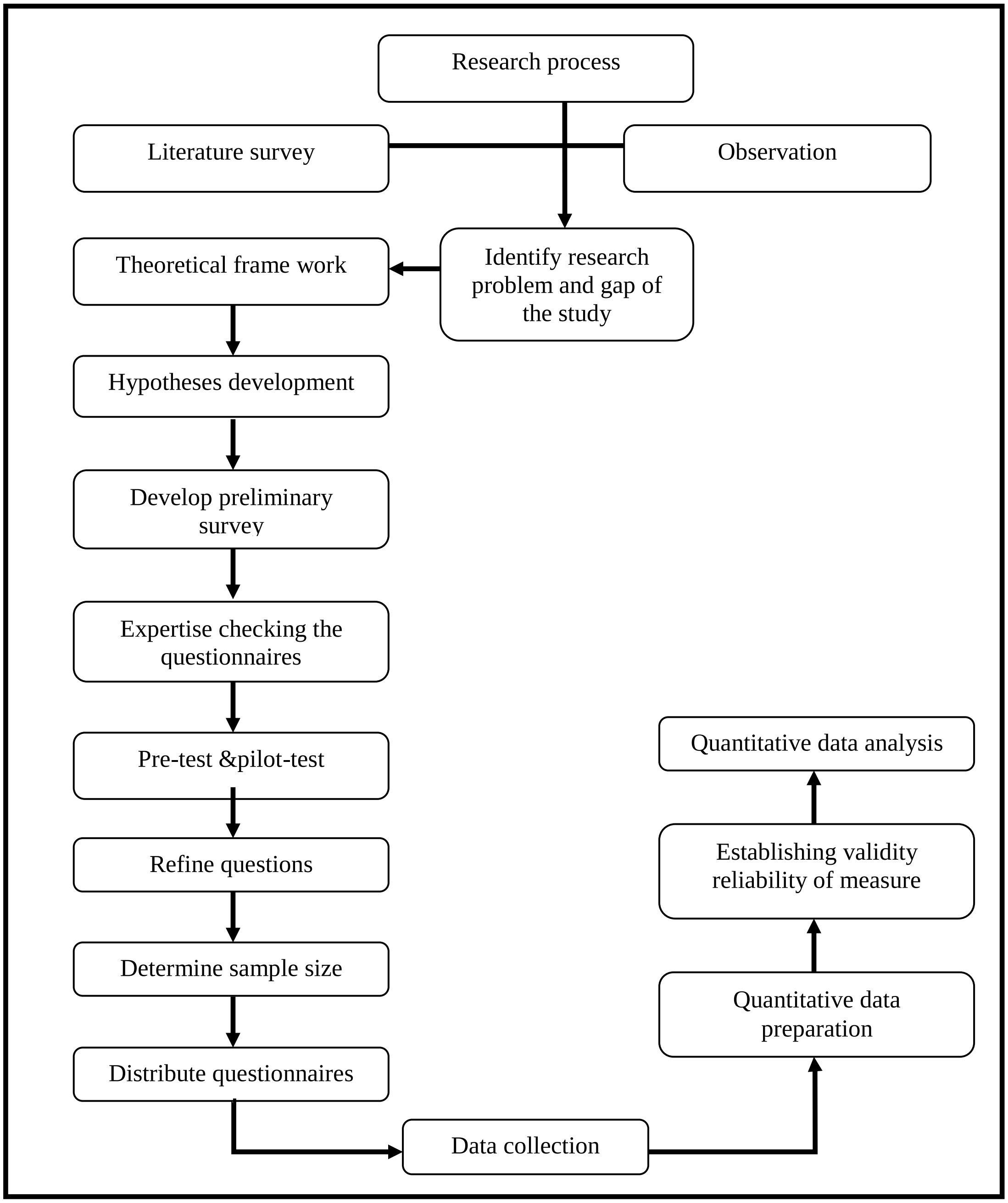

Figure 3.2
The Research Process of the Study

3.4.1 Research Design and Method

Research design consists of a series of rational decision making choices. It deals with at least four problems: research questions, relevant data, kind of data to be collected, and analysis of data (Philiber, Schwab, & Samsloss, 1980). This study focused on investigating the respective level of social capital, absorptive capacity within an organization and technology park services received by the organization which will affect the performance of technology transfer. The observations on these variables were done by adopting and adapting instruments developed by previous scholars. Therefore it was decided to adopt a quantitative method for data collection techniques. Qualitative method was not chosen as it could not provide the intended data to achieve the objectives of the study.

The research is designed after considering a number of criteria including the degree of fit among research objectives, methodological choices available to the researcher, and appropriate type of data required to fulfill the objectives, practical issues such as time constraint and available resources. The research design which is adopted from Sekaran (2003) represented in Figure 3.2.

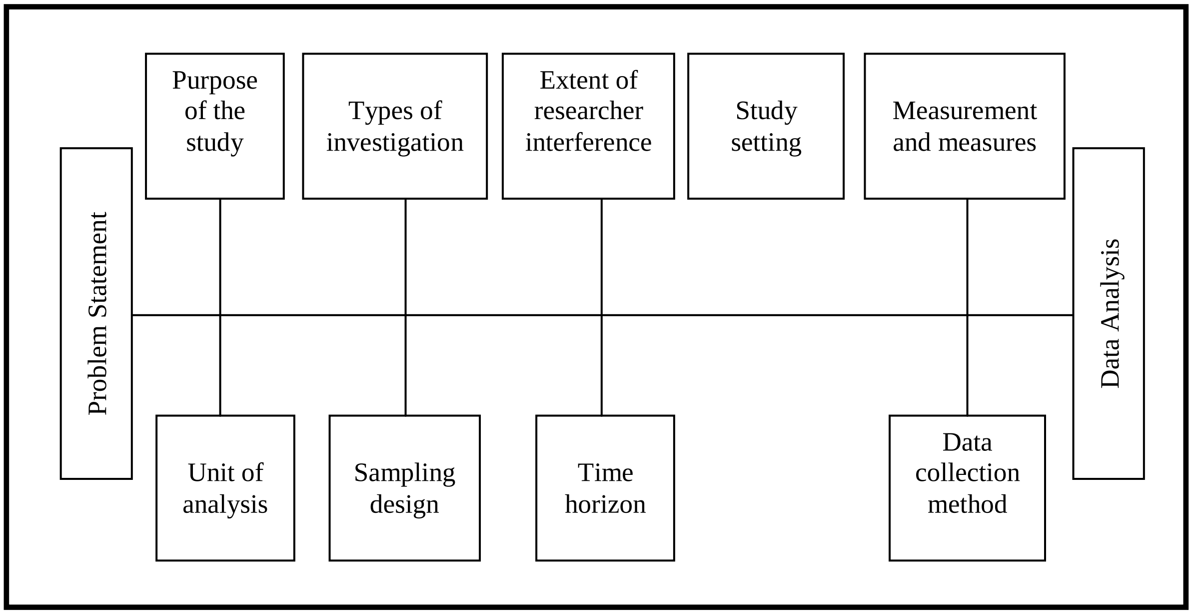

Figure 3.3
Research Design Source: Sekaran (2003)

3.4.2 Quantitative Method

Quantitative data are measurements in which numbers are used directly to represent characteristics and use statistical analysis procedures (Hair, Money, Samouel, & Page, 2007). However this method has its strengths and weaknesses, as shown in Table 3.1.

Table 3.1
Strengths and Weaknesses of Quantitative Method

Strengths	*Weaknesses*
i. Testing already constructed theories about how phenomena occur *ii. Allow generalizations when research has been replicated on different populations* *iii. Useful for obtaining data that allow quantitative predictions to be made,* *iv. Eliminates the confounding influence of many variables allowing assessments of cause-and-effect relationships* *v. Results are relatively independent of the researcher* *vi. Useful for studying large numbers of people*	*i. The researchers' theories and categories that are used may not reflect local constituencies' understandings* *ii. The researcher may miss out on phenomena occurring because of the focus on theory or hypothesis testing rather than on theory or hypothesis generation (i.e., confirmation bias)* *iii. Knowledge produced may be too general and abstract for direct application to local contexts, settings, and individuals*

Adopted from Alexopoulos (2008)

The research design included a self-report questionnaire survey. This study utilizes descriptive and explanatory studies as it aims to describe the issue of technology transfer performance, social capital, absorptive capacity, and technology park services. It is classified as correlation research as it attempts to ascertain the relationship between these variables. The research is a field study and conducted in a non-contrived setting with minimal interference.

3.5 Data Collection and Sampling Method

The main discussion in this section is on the data collection and sampling method applied in this study.

3.5.1 Unit of Analysis

The unit of analysis is referred as the type of unit a researcher uses when measuring the variables (Neuman, 1997). It is used to explain the units themselves, which refers to what is being analyzed in the study. This study is conducted to determine the level of transferred technology using the firms' own unique ability and situation. It involved high technology firms. The data was collected using survey method while the unit of analysis chosen is the company, whereby the data was only collected from the target respondents at the managerial level such as managers, directors, executives, engineers and CEOs. These people were chosen because they were directly involved in the decision- making related to the transfer of technology and they also involved in employee development. Furthermore, the sample of respondents, such as project or product managers, in this study is similar to samples used in prior studies on innovation (Noor, 2010; Sarif 2008).

3.5.2 Population and Sample

The population for this study consists of all the high technology industries in the Malaysia technology parks located in Peninsular Malaysia. High technology industries are defined by comparing industry R&D expenditures or the number of technical people employed with industry production or value added (OECD). While, high technology products refer to the products that embody advanced technologies and that have the level of R&D intensity (MOSTI, 2010).

A high technology company is a company engaged in promoted activities or in the production of promoted products in areas of new and emerging technologies. Cordes, Hertzfeld and Vonortas (1999) state that, there are no definitive criteria for differentiating between firms that are high technology and those that are not. Not all products in "high technology industry" necessarily have high technology content as manufacturing processes and increasingly the delivery of many services require the application of sophisticated technologies; it might appear that the term "high tech" could apply to many firms in many different industries.

International Standard Industry Classification Rev. 2 (ISIC Rev. 2) approaches for identifying high-technology sectors introduced four categories of manufacturing industries:

a. high-technology,
b. medium high-technology,
c. medium low-technology and
d. low - technology.

It was based on an evaluation of the ranking of three indicators of technology intensity, reflecting to different degrees, the "technology-producer" and "technology-user" aspects:

i. R&D expenditures divided by value added;
ii. R&D expenditures divided by production; and
iii. R&D expenditures plus technology embodied in intermediate and investment goods divided by production (OECD, 2002).

By means of these criteria, after updated calculations in ISIC Rev. 3, five groups were classified as high-technology:

a. aircraft and spacecraft;
b. pharmaceuticals;
c. office, accounting and computing machinery;
d. radio, television and communications equipment; and
e. medical, precision and optical instruments.

However, the technology-intensity classification is relative, by looking at direct R&D intensities it is classified according to relative recent R&D performance and individual countries may have slightly different classifications using same method and compromise on level of industrial detail (OECD, 2011). Based on the criteria accentuated by OECD in the updated calculation in ISIC Rev. 3, this study considered all the companies related to the five classified groups those operating in technology parks as the appropriate target population for this study.

There are many technology parks that had been developed in Malaysia, however, some are recently set up and have been in operation for not more than ten years which is not appropriate for study. The focus of analysis in this study is on the technology transfer within the firms that operating in technology parks. Hence, for the purpose of the study, companies which located in technology parks that have been operating in the country for more than ten years were selected. Table 3.2 shows a list of technology parks that have been in operation for more than ten years.

Table 3.2
The numbers of companies in Malaysian Technology Park

Technology parks	Location	Size (acres)	Year set up	No. of firms	Technology focus
Cyberjaya	Cyberjaya Selangor	6,960.69	1997	240	IT and multimedia (ICT industry knowledge-based enterprise)
Technology Park Malaysia	Bukit Jalil, Kuala Lumpur	211	1996	181	ICT, Biotechnology (knowledge-based enterprise)
UPM-MTDC	Serdang, Selangor	39	1997	44	IT and Multimedia
Kulim Hi-Tech Park (KHTP)	Kulim, Kedah	3,481	1996	53	High-tech manufacturing (advanced electronics, semiconductors etc.)
Perak Hi-Tech Park	Seri Iskandar, Perak	n.a	1998	n.a	ICT- based industry
Johor Technology Park	Johor Baru, Johor	456	1994	n.a	A centre that links university (UTM) to industry, research-based institutions and government

Among the listed technology parks, only Cyberjaya, Technology Park Malaysia, UPM-MTDC and Kulim Hi-Tech Park seemed suitable for study as it seems that these technology parks fulfill the criteria defined in this study as, furthermore there are sufficient information of the companies operating in the technology parks.

In order to select the number of respondents Roscoe (1975) proposes the rules of thumb for determining sample size that is sample sizes larger than 30 and less than 500 are appropriate for most research. According to Van Dalen (1979), three factors that need to be considered to determine the size of an adequate sample as (l) the nature of the population, (2) the type of investigation, and (3) the degree of precision desired. The formula for estimating the sample size and a table for determining the sample size based on confidence level needed from a given population was provided by Krejcie and Morgan (1970).

$$S = \frac{X^2 NP(1-P)}{d^2 (N-1) + X^2 P(1-P)}$$

where

S =required sample size

N = population size

P = population proportion that for table construction has been assumed to be .50, as this magnitude yields the maximum possible sample size required

d = the degree of accuracy as reflected by the amount of error that can be tolerated in the fluctuation of a sample proportion p about the population proportion P. the value for d being .05 in the calculations for entries in the table.

X^2 = table value of chi square for one degree of freedom relative to the desired level of confidence, which was 3.841 for the .95 confidence level represented by entries in the table.

The sample size in this study was determined by using the table provided by Krejcie and Morgan (1970). In order to get results that reflect the target population with the sample proportion *p* will be within ± .05 of the population proportion *P* with 95 percent of confidence level. The sampling frame for this study was drawn from the directories of the technology parks corporation itself. Since the target population is widely dispersed geographically, cluster random sampling was utilized. Based on the information gathered, the total companies located in the four selected technology parks give a target population of 518 companies. From the target population, desired sample size was determined. Within each cluster, a simple random sample of the companies was selected.

3.5.3 Samples Selection

With sample random sampling, each unit of the frame is numbered from 1 to *N* (where *N* is the size of the population). Next, a table of random numbers or a random number generator is used to select *n* items into the sample. A random number generator is a computer program that allows computer-calculated output to yield random numbers. The sampling procedure assures that each company has equal chance of being chosen as the sample.

The target is to distribute 358 questionnaires with the target response rate of more than 25 percent. The questionnaires that were distributed and expected number of response back is shown in Table 3.3.

Table 3.3
Questionnaires Distributed and Expected Number of Response

Technology Park	Population	Questionnaire Distributed	Expected (25%)
Cyberjaya	240	148	37
Technology Park Malaysia	181	123	31
UPM-MTDC	44	40	10
Kulim Hi-Tech Park (KHTP)	53	47	12
Total	**518**	**358**	**90**

3.6 Research Instrument

The main research instrument in this study is the questionnaire. Preliminary data collections were obtained from literature review and three serial interviews with the experts in the subject matter. Then, based on the information gathered from the preliminary data collection, a set of questionnaire was designed to measure the variables of interest.

Before planning a pilot census, the conduct of a series of pre-test surveys is highly desirable. The objective of the pre-testing should be confined mainly to the formulation of concepts and definitions, census questionnaires, instruction manuals, etc., and also is to evaluation of alternative methodologies and data collection techniques. Pre-test surveys differ from the pilot census in that they are usually relatively small-scale exercises and the selection of respondents is often not on a random basis. Instead, in a pilot census a good cross-section of respondents is chosen in a systematic manner with consideration being given to ease of enumeration and quality of response. The purpose of the pilot study is to validate the research instruments, provide preliminary results and the improvements of the final research instruments. While, the primary data collection is a field survey that was conducted using the designed and validated questionnaire to gain the necessary information in order to accomplish the research objective.

The questionnaire of the study incorporated a number of instruments through which quantitative data will be collected on all the variables of interest. It consists of a variety of both previously validated instruments and measures developed specifically for the purposes of the study. All measures involve self-report perceptions where respondents quantify whether and how intensively they experience the phenomena being studied. The questionnaire of the study consists of 79 questions which divided into five major parts to fulfill the following purposes:

i. Section 1: To obtain background information of the company.
ii. Section 2: To evaluate the technology transfer performance of the company.
iii. Section 3: To evaluate the social capital of the company.
iv. Section 4: To evaluate the absorptive capacity of the company.
v. Section 5: To evaluate the technology park services

The number of items or statements was carefully formulated using a seven-point scale. Seven-point scale is used as it contains more points that are able to give more precision with regard to the extent of the agreement with the statement (Hair et. al., 2007). The scales are used to measure a wide variety of latent constructs, particularly in social science research. Respondents were asked to indicate their agreement or disagreement with statements regarding the processes that are currently practised in the organization.

The important concepts to be considered in this study are social capital, absorptive capacity, and technology park services. These concepts cannot be physically measured by calibrated instruments since they are abstract and nebulous. The reduction of abstract concepts to render them measurable in a tangible way is called operationalizing the concepts (Sekaran, 2003). Operationalisation is done by looking at the behavioral dimension, facets, or properties denoted by the concept. These are then translated into observable and measurable elements so as to form an index of measurement for the concept.

3.6.1 Measurement Item

Building on the previous knowledge transfer and technology transfer studies, the questionnaire adapts a multi-item scales which have been modified accordingly to suit the context of the study. This process resulted in multiple item measures for each construct. Table 3.4 shows the measure items for dependent variable, Table 3.5 shows the measure items for independent variables, Table 3.6 shows the measure items for mediator variable and Table 3.7 shows measure items for moderator variables.

Dependent Variable - Technology Transfer Performance

Table 3.4
Measure Items for Dependent Variable

No	Items	References
Product and Process Performance (PPP)		
1	Produced the expected product	Chen (1997); Whangthomkum et al. (2006)
2	Increased technological capabilities	Whangthomkum et al. (2006)
3	Achieved the required quality level	Wong et al. (1999); Whangthomkum et al. (2006)
4	Met production efficiency targets	Wang et al. (2001); Whangthomkum et al. (2006)
5	Increased the number of new products (increase innovation rate)	Chen (1997); Whangthomkum et al. (2006)
Business Performance (BP)		
6	Achieved target costs	Wong et al.(1999); Whangthomkum et al. (2006)
7	Marketed product on time	Lyles and Salk (1996); Whangthomkum et al. (2006)
8	Shorten product development cycle time	Lyles et al. (1997); Whangthomkum et al. (2006)
9	Achieved company growth target	Lane et al. (2001); Whangthomkum et al. (2006)
10	Achieved planned goals	Lane and Lubatkin (1998); Whangthomkum et al. (2006)
11	Increased market share	Lin et al (2002); Whangthomkum et al. (2006)
12	Increased profitability	Whangthomkum et al. (2006)
Human Resource Capability (HRC)		
13	Able to manage the acquired technology	Chen (1997); Whangthomkum et al. (2006)
14	Increased the ability to manage future new technology transfer	Lyles and Salk (1996); Whangthomkum et al. (2006)
15	Received training from equipment or know-how vendor	Lyles et al. (1997); Whangthomkum et al. (2006)
16	Increased management skills and capabilities	Wang et al. (2001); Whangthomkum et al. (2006)

Independent Variable – Social Capital

Table 3.5
Measure Items for Independent Variable

No	Items	References
Structural social capital		
1	The colleagues in the firm know what knowledge they need.	Hooff and Huysman (2008)
2	We know what knowledge could be relevant to which colleague.	
3	When a customer client has a question, we know which colleague or department will be able to help.	
4	Within our department, we know who has knowledge that is relevant to us at their disposal.	
5	Outside the department, we know who has knowledge that is relevant to us at their disposal.	
6	The colleagues in the firm know what knowledge they have at their disposal	
7	We are regularly in contact with the firm's colleagues who have knowledge that is relevant to us.	
Cognitive social capital		
8	The firm's colleagues/We speak the same 'technical' language.	Hooff and Huysman (2008)
9	Sometimes we do not understand some of the firm's colleagues when they tell us something about their work (reverse coded).	
10	Often we only need 'half a word' when we are talking about work with our colleagues.	
11	Sometimes we have difficulty formulating what we know in such a way that our colleagues can understand (reverse coded).	
Relational social capital		
12	We feel connected to each other (the firm's colleagues)	Hooff and Huysman (2008)
13	We view this organization as a group we belong to.	
14	We can rely on each other when we need support in our work.	
15	We completely trust the skills of our colleagues	
16	When one of us tells someone what he/she knows, he/she can count on it that the other will tell he/she what they know.	

Mediator Variable – Absorptive Capacity

Table 3.6
Measure Items for Mediating Variables

No	Items	References
Acquisition (Potential)		
1	Close personal interaction between the units/departments in the firms (interaction).	Barrionuevo, et al. (2010)
2	The relation between the units/departments is characterized by mutual trust (trust).	
3	The relation between the units/departments is characterized by mutual respects (respect).	
4	The relationship with the units/departments is one of personal friendship (friendship).	
5	The relationship between the units/departments is characterized by a high level of reciprocity (reciprocity).	
Assimilation (Potential)		
6	The members of the units/departments share their own common language.	Barrionuevo, et al. (2010)
7	There is high complementary between the resources and capabilities of the units/departments.	
8	The main capabilities of the units/departments are very similar/overlap.	
9	The organizational cultures of the two organizations are compatible.	
10	The operating and management styles of the two organizations are compatible.	
Transformation (Realized)		
11	There are many informal conversations in the organization that involve commercial activity.	Barrionuevo, et al. (2010)
12	Interdepartmental meetings are organized to discuss the development and tendencies of the organization.	
13	The different units publish informative document periodically (reports, bulletins, etc.).	
14	The important data are transmitted regularly to all units.	
15	When something important occurs, all units are informed within a short time.	
Exploitation (Realized)		
16	The organization has the capabilities or abilities necessary to ensure that knowledge flows within the organization and is shares between the different units.	
17	There is a clear division of functions and responsibilities regarding use of information and knowledge obtained from outside	Barrionuevo, et al. (2010)
18	There are capabilities and abilities needed to exploit the information and knowledge obtained from the outside.	

Moderator Variable – Technology Parks Services

Table 3.7
Measure Items for Moderating Variables

No	Items	References
1	Organise staff training and development	Chen & Huang, (2004); Doutriaux, (1987).
2	Assists the firm with the ability to share laboratory facilities	Bakouros et. al., (2002); Vedovello (1997).
3	Assists the firm by providing equipment/machinery to maintain efficient operation.	
4	Assists the firm with the ability to share product testing equipment.	Lindelof &Lofsten (2002)
5	Assists the firm with the ability to share administrative support (e.g. meeting room, library, reception area)	
6	Assists the firm in knowledge sharing	Chan & Lau, (2005); Brown, (1985); Mian. (1997).
7	Assists the firm in knowledge dissemination	Chan & Lau (2005); Chen & Huang (2004)
8	Support development of a pool of skilled labours	Bakouros (2002); Vedovello (1997).
9	access the research centre (Sirim, MIMOS etc)	
10	access the universities	Lindelof &Lofsten (2002); Smirlor (1987).
11	access externalities from supporting network (e.g. complementary industry)	
12	Organise marketing events	
13	Provide consulting services to assist this firm with legal provision	(Bakouros, 2002)
14	Provide consulting services to assist this firm in accounting	
15	Provide consulting services to assist this firm in running business	(Lindelof & Lofsten, 2002)
16	Provide technical advices at low cost (or free-of-charge)	(Chan & Lau, 2005)
17	Offers rental subsidies for start-up firms	(Bigliardi et al, 2006)
18	Provide subsidies on telecommunication (network access)	
19	Provide other subsidies related to cost reduction (lower cost production)	
20	Assists the firm to access banking facilities	

3.7 The validity and reliability of research instrument

In the questionnaire development, a qualitative pilot work to examine the concepts involve in detail had been carried out. A series of interviews were conducted with the administrator officer of one of Malaysian technology parks. The experts are a vice president of industrial development and research department, a technical manager, a marketing manager. In the first phase interviews, the concept of technology parks services and technology transfer performance were discussed in detail. The experts assessed the proposed measures for the various dimensions. The proposed measure also had been reviewed by three academic experts. Based on the comments and suggestions obtained a draft questionnaire was then developed.

The second phase interviews were conducted with three flexible experts included who were directly involved in new technology projects to test the construct's validity. In the interviews a draft questionnaire instrument developed from the first interviews and literature were presented to be verified by the experts. The experts include a senior director of fabrication operation, and two senior manager (human resource) of the companies located in one of the Malaysian technology parks. They were asked to evaluate and give comments and suggestions to improve the questionnaires. Each part of the questionnaire designed involved substantial rewriting in order to get the questionnaire right. In designing and administering the questionnaire for this study, the various information, suggestions and comments for improving response rate were included to meet the objectives of this research. The instrument can be considered as having validity if it is indeed evaluated by a group of expert judges (Kidder & Judd, 1986).

The pre-test survey is particularly important for the formulation and wording of the questionnaires. The pilot census, unlike the pre-test surveys, is a 'dry run' for the main census but on a limited scale. It should evaluate all aspects of the census operation including the concepts and definitions, the adequacy of the questionnaires, the training of field enumerators and supervisory staff, field organization, census methodology, sampling design and estimation procedure, data processing and data tabulation. The results should be used when drawing up the final plans for the census and to provide a basis for the final calculations of resource requirements for the census. Detailed feedback was received and the actions taken are summarized in Table 3.8.

Table 3.8
Pre-testing the Questionnaire (Content validity)

Issue	Comment	Action taken
Questionnaire content	- Some of background information is not relevant (Section 1)	- Should be omitted
Simplify the question	- Confusion on the terms used and the reason of the question.	- Should improve clarity of the guidance by providing definition of the terms.
	- The questionnaire is quite lengthy (Section 2, Section 3, Section 4 and Section 5)	- Should rephrase instruction to clearly indicate requirements for respondent to assess the aspects of social capital, absorptive capacity and technology park services.

After the pre-testing procedure, the questionnaire was piloted into the real research setting to assess the instrument's accuracy and reliability (Straub, 1989). According to Cooper and Schindler (2003), samples for pilot testing should be between 12 and 100. For this study fifty companies (50) were randomly selected to take part in a survey as a pilot. The target persons included business owners, managers and executives who work in high technology manufacturing firms of various sizes. Thirty two (32) respondents (64%) completed the questionnaires. Appropriate test was performed to investigate the validity and reliability of the questionnaire.

The internal consistency and reliability of the items within each scale were determined based on the value of Cronbach's Alpha. Cronbach's Alpha is computed in terms of the average inter-correlated among the items measuring the concept. It is a reliability coefficient that reflects how well the items as a set are correlated to one another. The closer the Alpha value is to 1, the higher the internal consistency reliability. Alpha values greater than 0.60 are suggested as being adequate for testing the reliability of factors (Sekaran, 2003). Using the data from the pilot survey the Alpha value ranged from 0.849 to 0.958, which showed high internal consistency. The statistical summaries for each scale of the pilot analysis are shown in Table 3.9. Therefore, no items were deleted.

Table 3.9
Statistics Summary for Each Scale on Pilot Analysis

Variables/scales	Number of Items	Alpha
Technology Transfer Performance (DV)		
Product and process performance	5	0.958
Business performance	7	0.941
Human resource performance	4	0.935
Social Capital (IV)		
Structural	7	0.929
Cognitive	4	0.849
Relational	5	0.884
Absorptive Capacity (Mediator)		
Potential capital	10	0.904
Realize capital	8	0.785
Technology Park Services (Moderator)	20	0.933

Based on the pilot test responses, the following improvements were performed (final version of the questionnaire provided in Appendix 1):

a) Review all the questions and improve the line spacing format in presenting questions as it was notified that several respondent unintentionally skipped some questions

b) Provide hyperlink for online survey option. Providing of multiple response channels would help to increase the response rate.

3.8 Method of Data Analysis

Several methods were used to analyze the data. Primarily, data screening and cleaning was performed to check on missing data and any abnormalities. These procedures were easily performed by using software Statistical Package for the Social Sciences (SPSS). After that, the data was analyzed using descriptive statistics such as the percentage of firms according to their location, the number of employees and time the companies operate in the technology parks. The purpose was to summarize the data and to get to distinguish the data. Then, validity, reliability and appropriate measurement were implemented to reduce measurement error. Furthermore, this research also used the literature review together with experienced or knowledgeable peoples to support in content validity. While the implementation of factor analysis provided criterion validity.

3.8.1 Examine the Accuracy of Entered Data

Descriptive statistics involve transformation of raw data into a form that would provide information to describe a set of factors in a situation (Sekaran 2003). Descriptive statistics are analyzed using the histogram or bar chart, measures of the central tendency (include the mean, the median and the mode), and dispersion (include the range, the standard deviation and the variance). In this study, the descriptive statistics are used to check the data set for errors, to describe the characteristics of samples under study and to check the variables used in this study for any violation of the assumptions underlying the specific statistical techniques that have been used to address the research questions.

Factor analysis was used in order to assess construct validity, which means the extent to which a scale is an appropriate operational definition of an abstract variable. In the analysis, each factor was assumed to be a separate constructs. The basic purpose of conducting factor analysis in this study is

1. To find out how many factors underlie a number of measured variables.
2. To describe what these factors really are based on the factor loading.

Principal component analysis was performed to determine the factors of the construct or the set of underlying dimensions (Hair et. al., 2010). Factor analysis was also utilized to reduce a vast number of variables to an interpretable, meaningful and manageable set of factors.

The inferential statistic will be used in order to achieve the objective of this study. In investigating the relationships between two or more variables, Pearson's correlation is used to test the relationship between two equal interval numeric variables (Sekaran, 2003). Multiple regression analysis is employed to test the simultaneous effects of several independent variables on a dependent variable that is an interval scaled.

3.8.2 Correlation Analysis

Correlation analysis is used to describe the strength and direction of the linear relationship between two variables. The results of correlation analysis reveal the variables that correlate with dependent variable and occurrence of multicollinearity before performing multiple regression analysis. The rule of thumbs provided in Table 3.7 below shows that the larger the correlation coefficient the stronger the level of association either positive or negative relationships (Hair, et al., 2007).

Table 3.10
Rules of Thumb of Correlation Coefficient Size

Coefficient range	Strength of association
±0.91 - ±1.00	Very strong
±0.71 - ±0.90	High
±0.41 - ±0.70	Moderate
±0.21 - ±0.40	Small but definite relationship
±0.00 - ±0.20	Slight, almost negligible

Source: Hair et al. (2007)

3.8.3 Regression Analysis

Regression is a statistical tool that enables researcher to predict the value of one continuous variable from one or more other variables (DeCoster, 2004).

3.7.4.1 Linear Regression

Linear regression analysis allows researchers in establishing the direct relationship between an independent variable and the dependent variable and to identify the direction. It can be used to predict the value of a single continuous dependent variable from a single continuous independent variable (Pallant, 2011). General linear regression equation:

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$$

Where Υ_i is the value of the dependent variable for case i,

X_i is the value of the independent variable for case i,

β_0 and β_1 are constants.

β_0 is the intercept and β_1 is the slope that indicates how much we expect Υ to change when X is increased by a single unit. ε_i is the error in the prediction for case i.

3.7.4.2 Multiple Regressions

Multiple regression analysis was performed to establish the relationship between multiple independent variables and the dependent variables; it can also be used to identify the direction between them. Multiple regressions provide information on how well a set of variables is able to predict a particular outcome. General multiple regression equation:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_k X_{ik} + \varepsilon_i$$

The elements in this equation similar to the elements in linear regression except for the value *k*, where *k* refers to the number of independent variables that we have in our model.

3.7.4.3 Regression analysis for mediating effect

Preacher et. al. (2007) established that the mediator and dependent variables can be estimated either simultaneously using structural equation modeling (SEM) or separately using regression models. In testing for mediation, significant correlations among all three constructs are required. Theoretically, the mediating construct facilitates the relationship between independent variable and dependent variable (Figure 3.4).

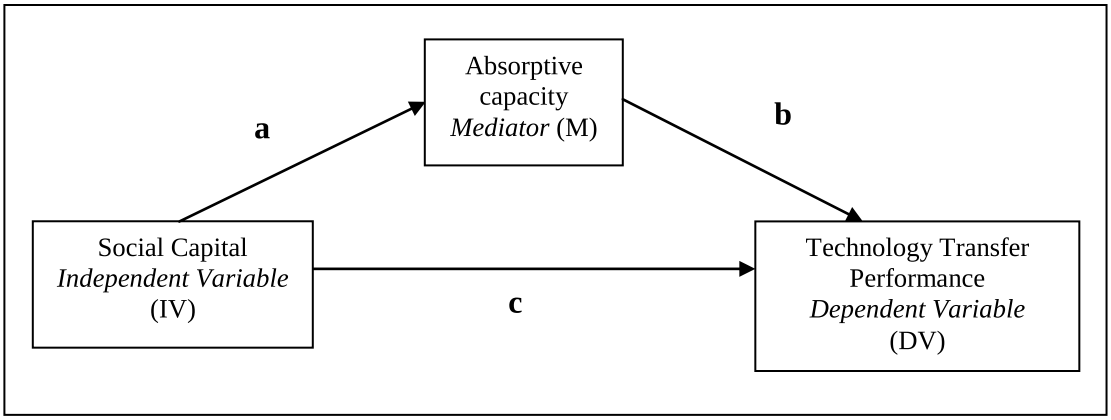

Figure 3.4
The Mediating Effect of Absorptive Capacity on the Relationship between Social Capital and Technology Transfer Performance

In order to evaluate mediation, a series of steps need to be followed because relationships are not always clear. Based on Figure 3.3, the steps are:

1. Establish that the necessary individual relationships have statistically significant relationships:
   - i. IV is related to DV (the direct relationship does exist)
   - ii. IV is related to Mediator (the mediator is related to the 'input' construct)
   - iii. M is related to DV (the mediator is related to the outcome construct)
2. Estimate an initial model with only the direct effect (**c**) between IV and DV. Then estimate a second model adding in the M and the two additional path estimates (**a** and **b**). Then the extent of the assessment is as follows:
   - i. If the relationship between IV and DV (**c)** remains significant and unchanged once M is included in the model as an additional predictor, then the mediation is not supported.

ii. If (c) is reduced but remains significant when M is included as an additional predictor, then partial mediation is supported

iii. If (c) is reduced to a point where it is not statically significantly after M is included as a mediating construct, then full mediation is supported.

3.7.4.4 Hierarchical Regression analysis for moderating effect

In order to assess the moderating effect, hierarchical regression analysis can be applied. Hierarchical regression analysis is one of the types of multiple regression analysis. It can be used to determine whether independent variables are significantly adding to the variance explained in the dependent variable, apart from a set of factors (Sekaran, 2003).

Figure 3.5 presents the moderating effects of the technology park services with dimensions of social capital as independent variables and technology transfer performance as dependent variables.

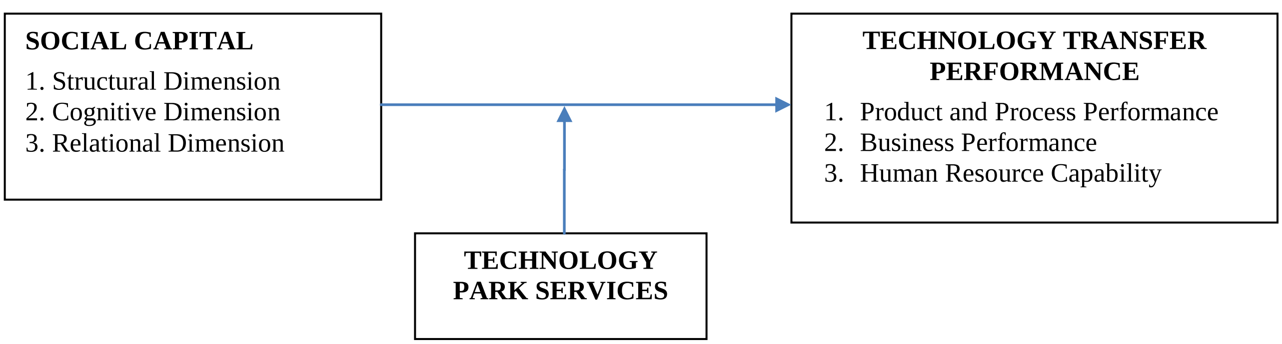

Figure 3.5
The Moderating Effect of Technology Park Services on the Relationship between Social Capital and Technology Transfer Performance

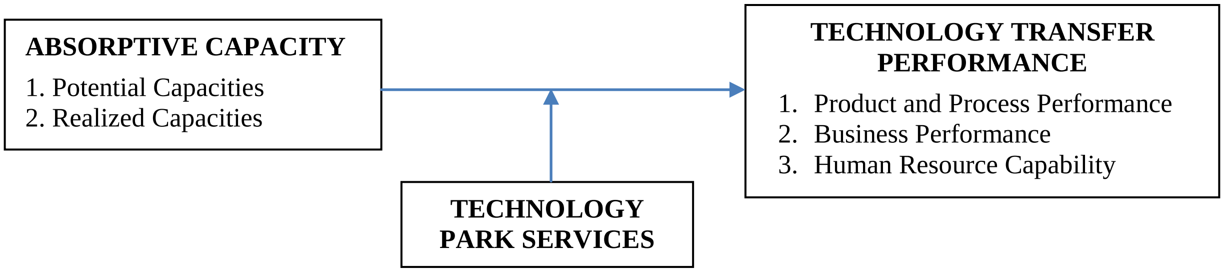

Figure 3.6
The Moderating Effect of Technology Park Services on the Relationship between Absorptive Capacity and Technology Transfer Performance

Besides, moderation also can be tested using multi group structural equation modeling. The multi group model is convenient for testing moderation if a continuous moderating variable can be collapsed into groups. According to Hair et. al. (2010), structural equation modeling (SEM), a multivariate technique based on variants in both the measurement and structural models is the most appropriate when the study involves multiple construct. However, when using continues variable moderator formed as a construct interaction larger sample sizes are needed (i.e., N > 500). Due to smaller sample size, this study used hierarchical regression analysis following the steps suggested by Sharma, Durand and Gur-Arie (1981). The connections of the research questions, objectives, hypotheses and analyses are shown in Table 3.11.

Table 3.11

The Connection of the Research Questions, Objectives, Hypotheses and Analyses

Research questions	Research objectives	Hypotheses		Analyses
What is the effect of social capital on technology transfer performance in the technology park incubating companies?	To determine the effects of social capital and technology transfer performance	*The relationship between social capital and technology transfer performance*		Pearson correlation and regression analysis
		H_{1A1}	Structural dimension significantly related to product and process performance.	
		H_{1A2}	Cognitive dimension significantly related to product and process performance.	
		H_{1A3}	Relational dimension significantly related to product and process performance.	
		H_{1B1}	Structural dimension significantly related to business performance.	
		H_{1B2}	Cognitive dimension significantly related to business performance.	
		H_{1B3}	Relational dimension significantly related to business performance.	
		H_{1C1}	Structural dimension significantly related to human resource performance.	
		H_{1C2}	Cognitive dimension significantly related to human resource performance.	
		H_{1C3}	Relational dimension significantly related to human resource performance.	
What is the relationship between dimensions of social capital and dimensions of absorptive capacity?	To determine the relationships between social capital and absorptive capacity	*The relationship between social capital and absorptive capacity*		Pearson correlation and regression analysis
		H_{2A1}	Structural dimension significantly related to potential capacity.	
		H_{2A2}	Cognitive dimension significantly related to potential capacity.	
		H_{2A3}	Relational dimension significantly related to potential capacity.	
		H_{2B1}	Cognitive dimension significantly related to potential realized capacity.	
		H_{2B2}	Structural dimension significantly related to realized capacity.	
		H_{2B3}	Relational dimension significantly related to realized capacity.	

Table 3.11 *Continue*

What is the effect of absorptive capacity on technology transfer performance in the technology park incubating companies?	To determine the effects of absorptive capacity and technology transfer performance	*The relationship between absorptive capacity and technology transfer performance*		Pearson correlation and regression analysis
		H_{3A1}	Potential capacity significantly related to product and process performance.	
		H_{3A2}	Potential capacity significantly related to business performance.	
		H_{3A3}	Potential capacity significantly related to human resource performance.	
		H_{3B1}	Realized capacity significantly related to product and process performance.	
		H_{3B2}	Realized capacity significantly related to business performance.	
		H_{3B3}	Realized capacity significantly related to human resource performance.	

Table 3.11 *Continue*

Does the absorptive capacity mediate the relationship between social capital and technology transfer performance?	To examine the mediating effect of absorptive capacity on the relationship between social capital and technology transfer performance.	***H_{4A}***	***The mediating effect of potential capacity on the relationship between social capital and technology transfer performance***	Pearson correlation and regression analysis
		H_{4A1}	Potential capacity mediates the relationship between structural network and product and process performance	
		H_{4A2}	Potential capacity mediates the relationship between structural network and business performance	
		H_{4A3}	Potential capacity mediates the relationship between structural network and human resource performance	
		H_{4A4}	Potential capacity mediates the relationship between cognitive and product and process performance	
		H_{4A5}	Potential capacity mediates the relationship between cognitive and business performance	
		H_{4A6}	Potential capacity mediates the relationship between cognitive and human resource performance	
		H_{4A7}	Potential capacity mediates the relationship between relational and product and process performance	
		H_{4A8}	Potential capacity mediates the relationship between relational and business performance	
		H_{4A9}	Potential capacity mediates the relationship between relational and human resource performance	

Table 3.11 *Continue*

	H_{4B}	***The mediating effect of realized capacity on the relationship between social capital and technology transfer performance***	Pearson correlation and regressions analysis
	H_{4B1}	Realized capacity mediates the relationship between structural network and product and process performance	
	H_{4B2}	Realized capacity mediate the relationship between structural network and business performance	
	H_{4B3}	Realized capacity mediate the relationship between structural network and human resource performance	
	H_{4B4}	Realized capacity mediate the relationship between cognitive and product and process performance	
	H_{4B5}	Realized capacity mediate the relationship between cognitive and business performance	
	H_{4B6}	Realized capacity mediate the relationship between cognitive and human resource performance	
	H_{4B7}	Realized capacity mediate the relationship between relational and product and process performance	
	H_{4B8}	Realized capacity mediate the relationship between relational and business performance	
	H_{4B9}	Realized capacity mediate the relationship between relational and human resource performance	

Table 3.11 *Continue*

Do the technology parks services moderate the relationship between social capital and technology transfer performance within technology park incubating companies?	To examine the moderating effects of the technology park services on the relationship of social capital and technology transfer performance.	***H_5***	***The moderating effect of technology parks services on the relationship between social capital and technology transfer performance***	Hierarchical regression analysis
		H_{5A}	Technology park services moderate the relationship between structural networks and product and process performance.	
		H_{5B}	Technology park services moderate the relationship between structural networks and business performance.	
		H_{5C}	Technology park services moderate the relationship between structural networks and human resource performance.	
		H_{5D}	Technology park services moderate the relationship between cognitive and product and process performance.	
		H_{5E}	Technology park services moderate the relationship between cognitive and business performance.	
		H_{5F}	Technology park services moderate the relationship between cognitive and human resource performance.	
		H_{5G}	Technology park services moderate the relationship between relational and product and process performance.	
		H_{5H}	Technology park services moderate the relationship between relational and business performance.	
		H_{5I}	Technology park services moderate the relationship between relational and human resource performance.	

Table 3.11 *Continue*

Do the technology parks services moderate the relationship between absorptive capacity and technology transfer performance within technology park incubating companies?	To examine the moderating effects of the technology park services on the relationship of absorptive capacity and technology transfer performance.	*The moderating effect of technology parks services on the relationship between absorptive capacity and technology transfer performance*		Hierarchical regression analysis
		H_{6A}	Technology park services moderate the relationship between potential capacity and product and process performance.	
		H_{6B}	Technology park services moderate the relationship between potential capacity and business performance.	
		H_{6C}	Technology park services moderate the relationship between potential capacity and human resource performance.	
		H_{6D}	Technology park services moderate the relationship between realized capacity and product and process performance.	
		H_{6E}	Technology park services moderate the relationship between realized capacity and business performance.	
		H_{6F}	Technology park services moderate the relationship between realized capacity and human resource performance.	

3.9 Summary of the Chapter

The chapter explained the process of undertaking research. It provides an overview of the research methodology used with the intention of addressing the research objectives of the study. Particularly the deployment of quantitative research, survey method was used in the data collection. The chapter incorporates some sections such as research design, sampling method, data collection method, operationalised of variables, item measure development and methods of data analysis. The next chapter presents the findings and interpretations of the finding.

CHAPTER FOUR

ANALYSIS AND RESULTS

4.1 Introduction

This chapter presents the results of the data analysis for this study. As suggested by Sekaran (2003) and Kervin (1992), systematic data analysis flow was used. This involved the following: preparing for data analysis, statistical analysis and hypothesis testing. The discussion of data analysis addresses four main sections such as the demographic data on respondent profile, examining the data of the variables, validation of instrument, and hypotheses testing. The analyses were based solely on the data furnished by the respondents through returned questionnaires.

4.2 Response Rate

The data collection was made through survey method. The sample for this study consist a total of 358 companies operate in the four selected technology parks in Malaysia. The survey was conducted on the 29th November 2012 on 358 respondents. Two ways of managing the survey were used. First was by mailing a set of questionnaires together with a cover letter, a self-addressed stamped envelope and a bookmark as a souvenir to encourage higher response. Besides permitting for a high contact rate, mail questionnaires allowed the respondents to have ample time to give the information and reflect before responding. Understanding there is tendency for low response and bias in mail questionnaires, the questionnaires had undergone a detailed look into the organization of variables, the wording of the questions and the appearance of the questionnaire.

The second way of administrating the survey was by using online survey. The available software program helped in creating the questionnaire via Internet and e-mail which make the distribution process faster. However the reliability of survey statistic depends on the respondent integrity. Therefore in order to prevent survey cheater and maintain high respondent integrity, several security actions were taken. The respondent must receive an e-mail invitation to participate in the survey. This gave a chance to verify the address and assure that the same name and contact information was not already assigned to email address in the system. The survey started with straight forward, demographic questions and only one survey can be submitted by one IP address that was set. To ensure that only one questionnaire was received or responded by each of the companies, the companies were contacted through phone calls to ask about their preference in answering the questionnaire, whether to respond through online survey or by postal delivery.

Additionally, personal visit to the high technology companies in KHTP also been initiated to increase the respond rate. It was found that the respondents are more likely to respond to online survey by means of almost 50 percent of the responses were received from online survey. Although many efforts have been done, out of 358 companies, only 97 replied the questionnaire and seven was excluded due to the incomplete answers. The 90 responses yielded 25.13 percent response rate (Table 4.1a). This response rate would be considered acceptable. This is based on information gathered from previous studies which shows that response rate of studies in Malaysia ranged from as low as 9% to as high as 95% (Table 4.1b).

Table 4.1a
Response Rate of the Questionnaire

Response	Cyberjaya	Technology Park Malaysia	UPM-MTDC	Kulim Hi-Tech Park	Total
No. of questionnaires distributed	148	123	40	47	358
No. of questionnaires received	31	28	6	32	97
No. of usable questionnaires	31	27	6	26	90
No. of questionnaires excluded	0	1	0	6	7
Response rate	21.62%	22.76%	15%	68.09%	27.09%
Response rate (usable questionnaire)	20.95%	21.95%	15%	55.32%	25.13%

Table 4.1b
Response Rate of Several Studies in Malaysia

Authors	Topic	Targeted respondent	Response Rate
Mohamad (2012)	E-business capabilities across business process (e-business alignment)	Owner or Manager of the firms	Received 143 from 1453. Only 123 usable (9% from the total distributed)
Noor (2012)	Knowledge work performance and knowledge integration	Knowledge workers	Received 496 from 600 (82.67% from the total distributed)
Min (2010)	Social responsibility adoption	Managers	Received 102 from 300 (34% from the total distributed)
Noor (2010)	Performance of technology transfer in electronics and electrical firms in Malaysia	Organization, the key manager as respondent	Received 79 from 457 (17% from the total distributed)
Mustaffa et. al. (2007)	Multinational subsidiaries in Malaysia	CEO of foreign companies	Received 112 from 1203 (9% of total distributed)
Chew et. al. (2006)	Technology transfer in High Tech industry	Chose ten respondents of each industry	Received 114 from 120 (95% of total distributed and interviewed)

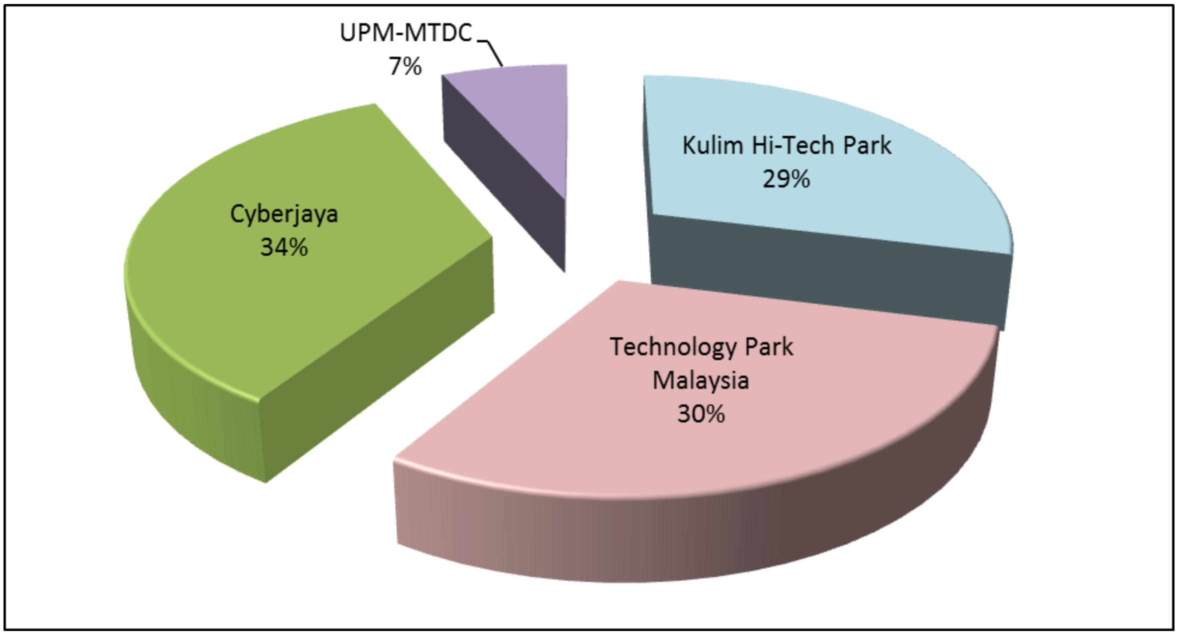

Figure 4.1
Distributions of Respondents

4.3 Profile of the Respondents

The respondents came from a variety of designations. However, all of these respondents are eligible since their responsibilities are directly related to the operation works. With regard to their position in the companies, most of the respondents were managers (41.1 percent), executive (21.1 percent), directors (17.8 percent), and CEO and engineer (10.0 percent). Forty-two respondents have less than five years in their designations, while thirty-two respondents have between five to ten years, and sixteen respondents have more than ten years in their designation. Table 4.2 shows the breakdown of this demographic.

Table 4.2

Respondents' Characteristics by Designation and Year of Designation

Variable	Item	Frequency	Percentage
Designation	Director	16	17.8
	CEO	9	10.0
	Manager	37	41.1
	Engineer	9	10.0
	Executive	19	21.1
	Total	90	100.0
Year of Designation	Less than 5 years	42	46.7
	Between 5 to 10 years	32	35.6
	More than 10 years	16	17.8
	Total	90	100.0

Table 4.3

Size of the Companies in Terms of Number of Employees

	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 50	49	54.4	54.4	54.4
50-100	12	13.3	13.3	67.8
101-300	12	13.3	13.3	81.1
301-500	9	10.0	10.0	91.1
More than 500	8	8.9	8.9	100.0
Total	90	100.0	100.0	

Table 4.4

Time the Companies Operating in Technology Park

	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 5 years	33	36.7	36.7	36.7
5-10 years	31	34.4	34.4	71.1
11-20 years	23	25.6	25.6	96.7
More than 20 years	3	3.3	3.3	100.0
Total	90	100.0	100.0	

To help in content validity, this research involved experienced or expert people together with the literature review while, factor analysis is used to provide criterion validity. Several methods in analyzing the data were utilized. At the beginning, any abnormalities of the data were cleared through screening and cleaning. Then, the data was analyzed using descriptive statistics such as the percentage of firms according to their location, time the companies operate in the technology park and the number of employees. The purpose of the steps is to summarize the data and to carefully analyze and understand data. Validity, reliability and appropriate measurement were employed in this research to reduce measurement error.

4.4 Data Preparation and Screening

Data preparation and screening is the procedure of transformation of raw data from questionnaire to usable data file. This process involves checking for errors, finding the error in the data file and correcting the error in the data file (Pallant, 2011). The purpose is to make sure that the data have been entered accurately and the variables are normally distributed. After data collection process, the data obtained from the survey was carefully keyed-in and screened for any errors in coding. The data screening procedure performed by the following steps:

i. Examine the accuracy of entered data.
ii. Checking for missing values.
iii. Examine the outliers
iv. Testing the assumptions underlying most multivariate techniques.

4.4.1 The Accuracy of Entered Data and Missing Value

One of the most pervasive problems in data analysis is missing data problem (Tabachnick & Fidell, 2007). In the identification of missing data for this study, the received questionnaires were firstly browsed through by the researcher and in the condition of there are missing values the respondents were requested to fill it up. After the data has been keyed-in, frequency test were run to identify any extreme minimum or maximum value exceeding the range and whether the mean values were within the specified range. Then, a missing Value Analysis (MVA) was conducted to check for the missing values. The results from missing value analysis reveal that there were a few missing values encountered in some cases. However, these missing values were not in the variables used in the proposed model and the missing values were only 5% (Figure 4.2). Hence, the questionnaires which have missing values were removed to ensure the reliability and stability of the constructs.

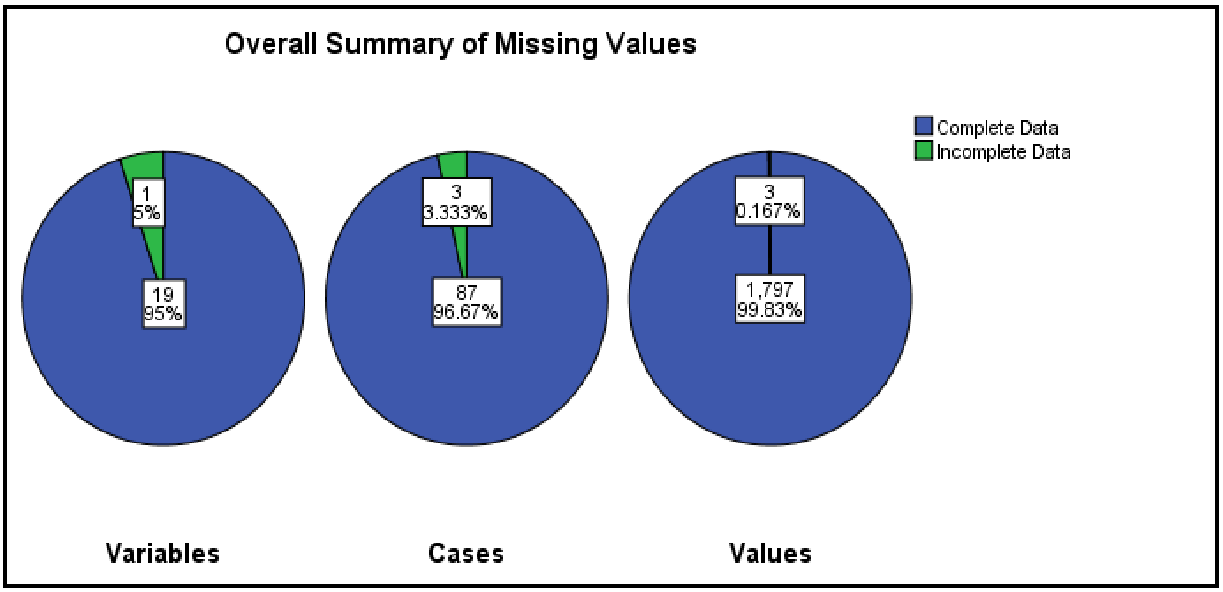

Figure 4.2
Summary of Missing Value

4.4.2 The Outliers

Outliers are data points that appear to be significantly different than the majority of data points which have much higher impact on the outcome of any statistical analysis (Tabachnick and Fidell, 2007).Outliers can skew data from a normal distribution, affect accuracy of data analysis and affect how well a sample represents the population.

Therefore the outliers are not wanted as part of the sample in the analyzing process and need to be removed from the sample. To examine the existence of outlier, histogram and boxplot were performed (Appendix B-1). Figure 4.3 shows the histogram of dependent variable 1 that is Technology Advantages as an example. Histogram inspection was performed by looking at the tails of distribution (Pallant 2011). Data points that sitting on their own and out on the extremes are the potential outliers.

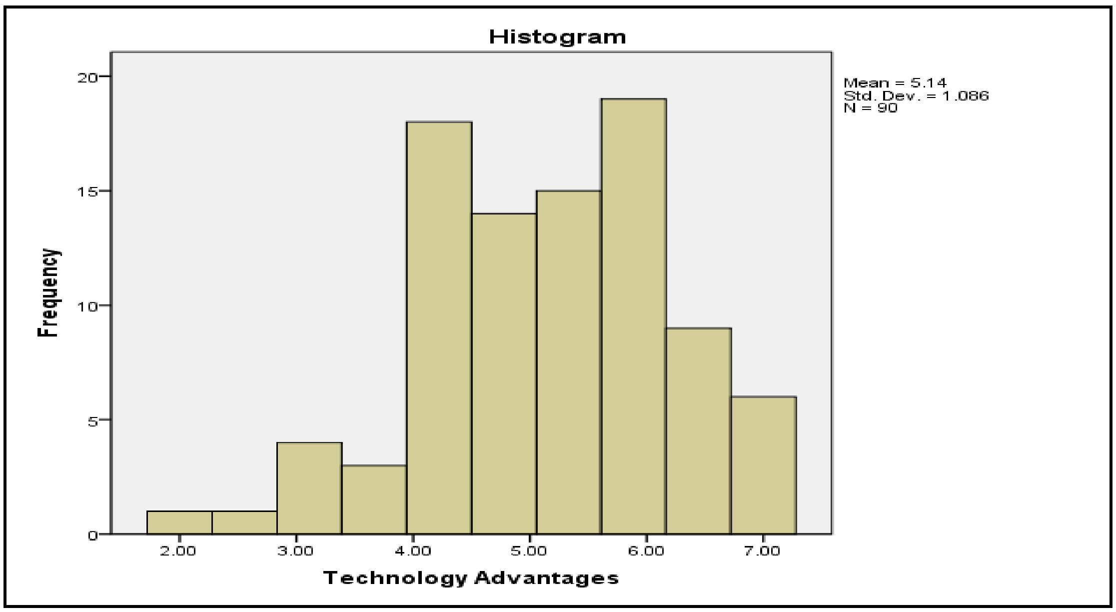

Figure 4.3
Histogram forDV1 - Technology advantages

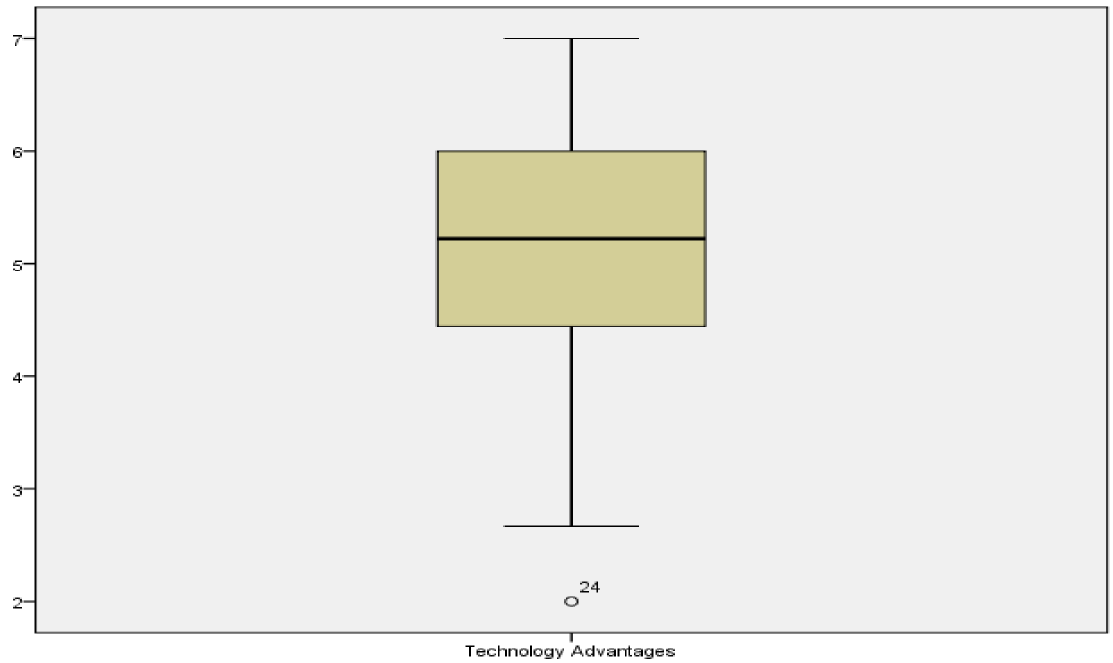

Figure 4.4
Boxplot for DV1– Technology Advantages

From the boxplot inspection a data point was identified to be different than the majority of data points, however based on outlier labeling rule Tukey (1977), the comparison between the extreme value of this variable with the upper and lower boundary indicated that the data point is not an outlier as it does not reached upper and lower boundaries. The boundaries of each variable were calculated by using an equation formulated by using 2.2 as multiplier (Table 4.5) (Hoaglin, Iglewicz and Tukey,1986).

Upper boundary = Q3 + [2.2 X (Q3 –Q1)]

Lower boundary = Q1 - [2.2 X (Q3 – Q1)]

Where Q1 = first quartile
Q3 = third quartile
2.2 = multiplier

The following is an example of upper and lower boundary calculation (DV1-Technology Advantages).

Upper boundary = 6.0000 + [2.2 X (6.0000 –4.4444)] = 9.4222

Lower boundary = 4.4444 - [2.2 X (6.0000 –4.4444)] = 1.0222

Table 4.5
Percentile of Data for DV1 (Technology Advantages)

		Percentiles						
		5	10	25	50	75	90	95
Weighted Average(Definition 1)	ttp1	3.0000	3.8000	4.4444	5.2222	6.0000	6.4444	6.7778
Tukey's Hinges	ttp1			4.4444	5.2222	6.0000		

Table 4.6
Extreme Values of Dependent Variable 1 (Technology Advantages)

			Case Number	Value
ttp1	Highest	1	19	7.00
		2	79	7.00
		3	42	6.89
		4	11	6.78
		5	12	6.78[a]
	Lowest	1	24	2.00
		2	26	2.67
		3	78	3.00
		4	52	3.00
		5	28	3.00

a. Only a partial list of cases with the value 6.78 is shown in the table of upper extremes.

Table 4.6 shows that the extreme values for ttp1 are 7 (case 19) and 2(case 24) which do not reach the upper and lower boundary of this variable provided in Table 4.5. After doing the comparison between extreme values and upper and lower boundary, certainly no outliers were found hence the data analysis continued to the next step. The percentiles and extreme values for all variables in this study are provided in Appendix B-1c. The upper and lower boundary for each variable is provided in Table 4.7.

Table 4.7
Upper and Lower Boundaries of Outliers for Each Variable

Variable	Upper	Lower
DV1-Technology Advantages	9.422	1.022
DV2-Product and Process Advantages	9.850	0.400
DV3-Business Advantages	9.333	0.333
IV1- Structural dimension	9.575	0.800
IV2- Relational dimension	8.750	2.000
IV3- Cognitive dimension	9.000	0.000
Mediator 1- Potential Capacity	9.500	0.500
Mediator 2- Realized Capacity	9.500	0.500
Moderator- Technology park services	8.400	0.975

4.4.3 Multivariate Assumptions

An adequate examination on the data gathered from the survey was conducted to ascertain whether underlying assumptions are met in order to use factor analysis, correlation and regression techniques. The assumptions are normality, multicolinearity, homoskedasticity and linearity. They were examined by using methods as suggested by Hair et al. (2006) and Coakes (2005). These assumptions can be tested using some statistical tests.

The first assumption to be met is normality, which refers to the shape of the data distribution for each variable and its correspondence to the normal distribution. To indicate normal distribution, the histogram, p-p plot and scatter plot were applied. The presence of multicolinearity, linearity and homoscedasticity can be identified by several criteria. The value of Durbin-Watson should be within the acceptable range of 1.5-2.5, whereas the condition index should not be more than or equal to 30. Furthermore, to indicate that the independent variables are not highly correlated with each other the tolerance value should not be 0.01 or less and VIF (Variance inflation factor) must be less than 10. After the above assumptions were checked, proper action was taken. The outliers of the sample data were deleted to reduce multicolinearity.

4.4.3.1 Normality

Normality is the most fundamental assumption in multivariate analysis. Multivariate normality is the combination of two or more variables. According to Hair et al (2010), if a variable is multivariate normal, it is also univariate normal, however two or more univariate normal variable are not necessarily multivariate normal. The diagnostic tests of multivariate normality of the study were done by referring to the shape of the distribution from the histogram (Figure 4.5) and normal probability plot which compares the cumulative distribution of a normal distribution (Figure 4.6).

The data needs to follow a normal distribution in order for most analyses to work properly. Even in situations where normality is not required if normality exists it will make for a stronger assessment. There are two aspects to normality of a distribution, skewness and kurtosis, and both must be tested before normality can be established. A simple test is a rule of thumb based on the skewness and kurtosis value. The statistical value (z) for the skewness value is calculated as

$$z_{skewness} = \frac{\text{Skewness}}{\sqrt{6/N}} \qquad (4.1)$$

Where N is the sample size, a z value can also be calculated for the kurtosis value using the following formula:

$$z_{kurtosis} = \frac{\text{Kurtosis}}{\sqrt{24/N}} \qquad (4.2)$$

If the calculated z value exceeds a critical value, ± 2.58 if the research considers .01 significance level and ± 1.96 which correspond to .05 significant level (Hair et al., 2006), then the distribution is not normal in terms of those characteristics. The critical value is from a z distribution, based on the desired significance level. The results of these tests are given in Table 4.7. All the calculated values for skewness and kurtosis were not exceeded ± 2.58. Thus, all variables exhibit a statistically significant departure from normality at the 0.01 probability level (Hair et al., 2006).

Table 4.8
Test of Normality (Skewness and Kurtosis Values)

Variable	Skewness		Kurtosis	
	Statistic	z value	Statistic	z value
DV1-Technology Advantages	-0.455	-1.760	-0.196	-0.380
DV2-Product and Process Advantages	-0.504	-1.951	-0.018	-0.035
DV3-Business Advantages	-0.235	-0.910	-0.252	-0.488
IV 1- Structural dimension	-0.275	-1.065	-0.483	-0.936
IV 2- Relational dimension	-0.557	-2.159	-0.331	-0.640
IV 3- Cognitive dimension	-0.002	-0.009	-0.858	-1.661
Mediator 1 - Potential Capacity	-0.059	-0.228	-0.600	-1.162
Mediator 2 - Realized Capacity	0.089	0.345	-0.394	-0.763
Moderator - Technology park services	-0.611	-2.366	0.278	0.538

The z values are derived by dividing the statistics by the appropriate standard errors of 0.254 (skewness) and 0.503(kurtosis)

In addition, this study also used graphical analysis to assess normality, i.e. histograms and normal probability plot. The histograms of standardized residuals for all of the variables are shown in Appendix B-2.

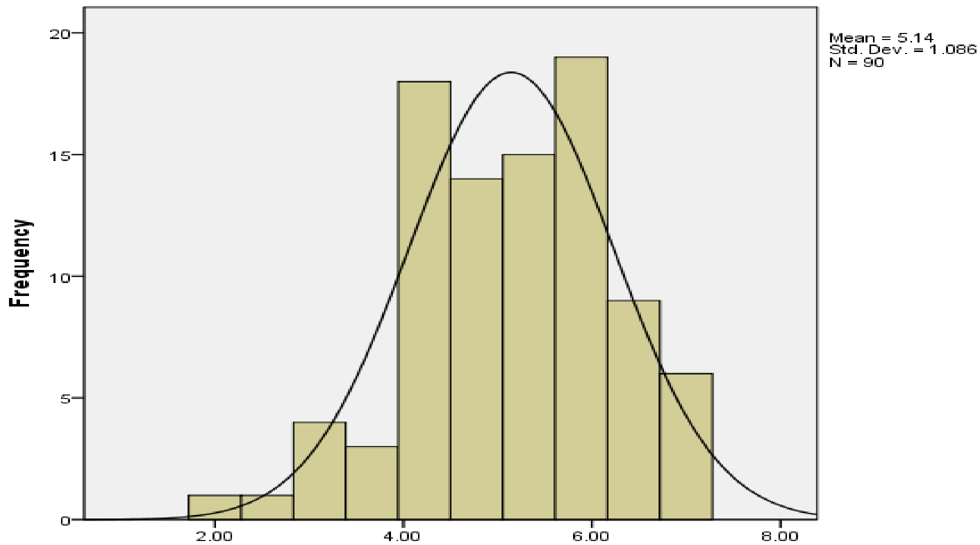

Figure 4.5
Histogram of Normal Probability for Technology Advantages

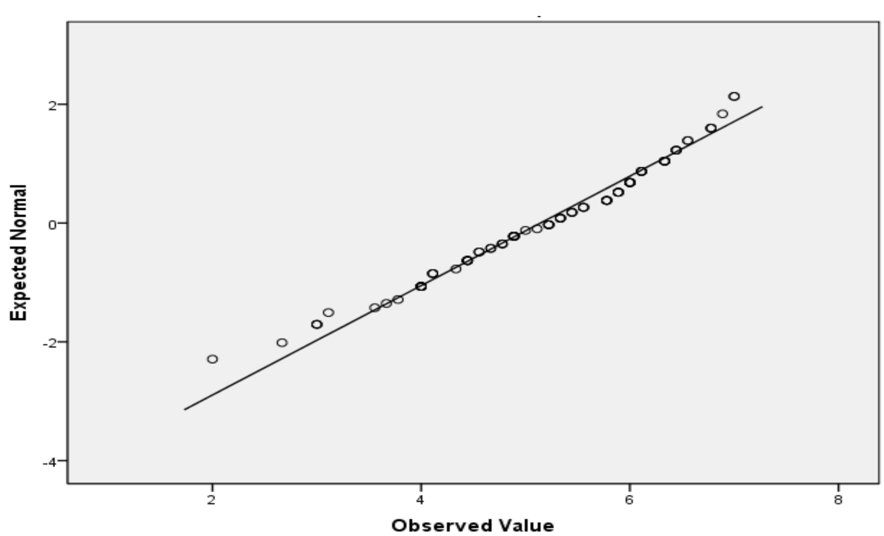

Figure 4.6
Normal Probability Plot for Technology advantages

Normality of distribution is examined by referring to the shape of the distribution from the histogram as shown in Figure 4.5. In this study, all figures for checking normality shows that the scores to be reasonably normally distributed as the greatest frequency of scores at the middle and the smaller frequencies towards the extremes. This is then supported by an inspection of the normal probability plots (labeled Normal P-P Plot) shown in the following Figure 4.6. From this plot, the observed value for each score is plotted against the expected value from the normal distribution. A reasonable straight line suggests a normal distribution. Appendix B-2 provides the normality histogram and Normal P-P plot for other variables.

4.2.3.2 Multicollinearity

According to Hair et al. (2006), the assessment of multi-collinearity in any regression analysis should be undertaken in two steps: (1) identification of the extent of collinearity and (2) assessment of the degree to which the estimated coefficients are affected. The simplest and most obvious means of identifying collinearity is an examination of the correlation matrix for the independent variables. The presence of high correlations (generally 0.90 and above) is the first indication of substantial collinearity. However, based on the data shown in Table 4.9, there is no collinearity problem in this study.

Table 4.9
Pearson correlation between the construct

	ttp1	ttp2	ttp3	sc1	sc2	sc3	Potent	Realize	Technopark services
ttp1	1								
ttp2	.748**	1							
ttp3	.703**	.729**	1						
sc1	.773**	.657**	.519**	1					
sc2	.507**	.406**	.288**	.754**	1				
sc3	.380**	.220*	.323**	.398**	.258**	1			
Potent	.511**	.303**	.242*	.604**	.530**	.462**	1		
Realize	.507**	.301**	.371**	.539**	.451**	.557**	.779**	1	
Technopark services	.200*	.136	.222*	.249**	.245*	.323**	.234*	.279**	1

**. Correlation is significant at the 0.01 level.
*. Correlation is significant at the 0.05 level.

Two common measures for assessing both pairwise and multiple variables collinearity are (1) tolerance value and (2) the variance inflation factor (VIF). The results of this test are shown in Table 4.10. A common cut off threshold is a tolerance value of .10, which corresponds to VIF value of above 10 (Hair et al., 2006). As presented in Table 4.10, the VIF and tolerance values indicate inconsequential collinearity. No VIF value exceeds 10.0 and the tolerance values show that collinearity does not explain more that 10% of any independent variable's Variance. Thus, this indicates that there is no support for the existence of multicolinearity problem in this study.

Table 4.10
VIF and Tolerance Values

Dependent Variable	Variables	Collinearity	
		Tolerance	VIF
DV1-Technology Advantages	Sc1-Structural Dimension	0.357	2.799
	Sc2-Relational Dimension	0.412	2.426
	Sc3-Cognitive Dimension	0.638	1.567
	Ac1-Potential Capacity	0.340	2.940
	Ac2-Realize Capacity	0.340	2.944
	Tps- Technology Park Services	0.863	1.159
DV2- Production Advantages	Sc1-Structural Dimension	0.357	2.799
	Sc2-Relational Dimension	0.412	2.426
	Sc3-Cognitive Dimension	0.638	1.567
	Ac1-Potential Capacity	0.340	2.940
	Ac2-Realize Capacity	0.340	2.944
	Tps- Technology Park Services	0.863	1.159
DV3- Business Advantages	Sc1-Structural Dimension	0.357	2.799
	Sc2-Relational Dimension	0.412	2.426
	Sc3-Cognitive Dimension	0.638	1.567
	Ac1-Potential Capacity	0.340	2.940
	Ac2-Realize Capacity	0.340	2.944
	Tps- Technology Park Services	0.863	1.159

4.2.3.3 Linearity and Homoscedasticity

The next assumptions to be met are linearity and homoskedasticity. The linearity of the relationship between dependent and independent variables represents the degree to which the change in the dependent variable is associated with the independent variable. The concept of correlation is based on a linear relationship, thus making it a critical issue in regression analysis. Conversely, homoskedasticity is an assumption related primarily to dependence relationship between independent variables in the study. It refers to the assumption that dependent variable(s) exhibit equal levels of variance across the range dependent or predictor variables. It is concerned with how the scores cluster uniformly about the regression line.

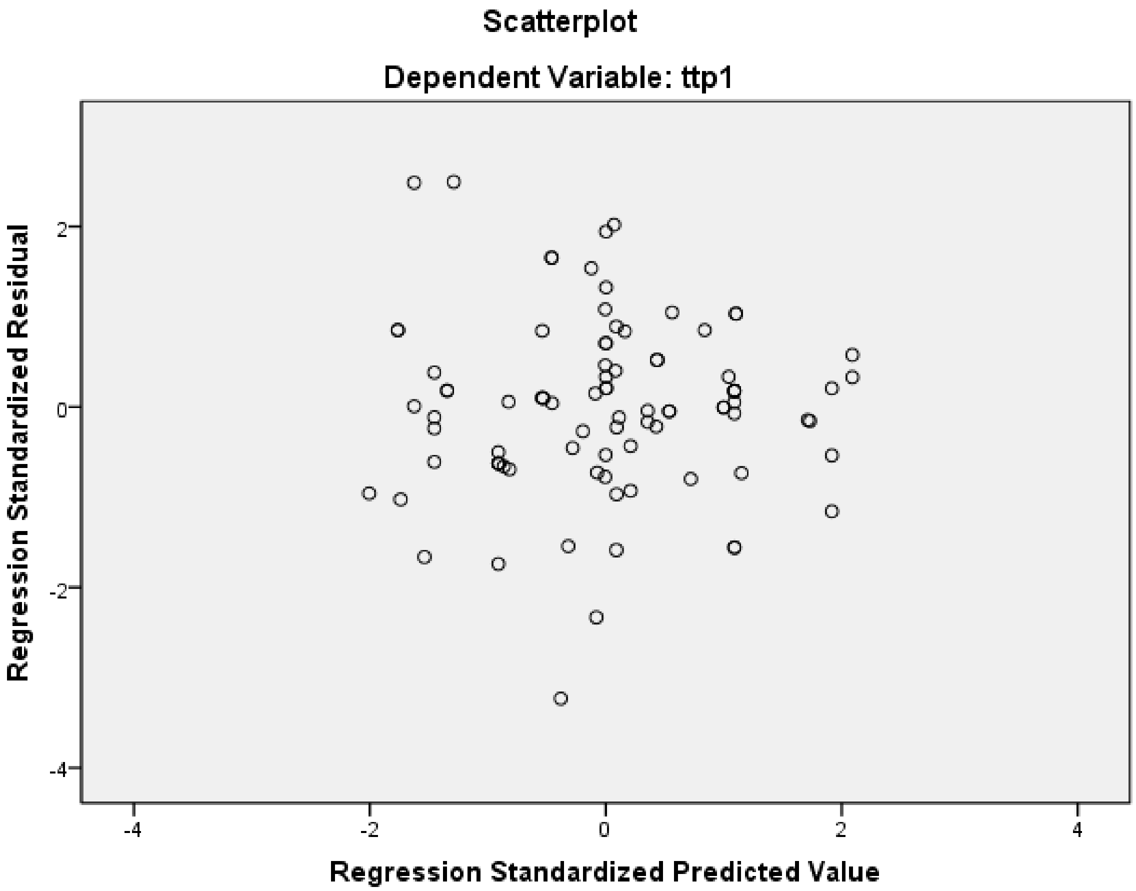

Figure 4.7
Scatterplot of Technology Advantages (DV1)

Appendix B-3 shows all scatter plots for other variables in this study. Examination of the residual scatterplots relating to all other factors shows that relevant residuals are randomly distributed in a band clustered around horizontal through 0 (Appendix B-2). Therefore, the linearity and homoskedasticity assumptions relating to the data of the studied factors and dependent variables are supported.

4.5 Goodness of Measure

Establishment of the goodness of measures is important for it indicates whether the instrument used is accurately and consistently measuring the concept (reliability) and whether it indeed measuring what it supposed to measure (validity). Therefore, before further tests were performed, the construct of questionnaires was thoroughly checked for validity and reliability tests. Validity of the instrument used can be established through face validity, content validity, criterion-related validity and construct validity or convergent and discriminant validity. Reliability analysis for this study was formed by evaluating the internal consistency of the measure through Cronbach's alpha.

4.5.1 Factor Analysis

Factor analysis was carried out to test the construct of the questionnaires. Since the questionnaire was developed from the combination of adapting the instrument from previous study and interviewing the industrial practitioners, exploratory factor analysis (EFA) is used to examine internal reliability and to discover the factor structure of a measure. Exploratory factor analysis is mainly used to identify the number of dimensions and describe a simple structure of interrelated measures. In addition, it is used to verify items cross-loading (items loading on two or more factors) or unreliable indicator (low communality or a very low unique factor specific loading, <0.3). According to Meyers, et al (2006), the purpose of this procedure is to identify small number of themes, dimensions, components or factors underlying a relatively large set of variables. One item may represent a part of a construct. Therefore, a group of items is required to explain that construct. Factor analysis allows the researcher to develop quality items to determine the construct validity as it deals with items that are correlated and related to each other. Factor analysis helps to explain which item in which dimension. According to Hair, Anderson, Tatham and Black (1998) and Coakes (2005) to conduct factor analysis, a minimum of five observations for each variable are needed. MacCallum, Widaman, Preacher and Hong (2001) found that population factors were not affected by sample size and violation of assumptions. Hence, conducting factor analysis was tolerated as the respondents for this study were 90. Moreover, sample size is not important especially with high communalities (MacCallum, Browne, & Sugawara, 1996; MacCallum, et al., 2001).

The significant loading of factor analysis varies; at ±0.30, there is only 10% explanation that makes it the minimum level of significance, ±0.4 loading is more important, at ±0.50 the loading is more significant as 25% of the variance is accounted for by the factors and above ±0.70 explains 50% of the variances. According to Comrey and Lee (1992) (in Tabachnick & Fidell, 2007), 0.71 was considered excellent, 0.63 was very good, 0.45 was fair and 0.32 was poor. They suggested that loading in excess of 0.71 indicates 50% overlapping variance, 0.63 has 40% overlapping variance and 30% overlapping variance for 0.55 loading. As Comrey and Lee (1992) gives a detailed explanation on the loading variance, this research follows Hair (1992) whereby for sample size of 90, if the loading for each item is less than 0.6, the item is deleted from the construct.

To determine the factorability of the dimensions, the Bartlett's test of sphericity had to be significant (0.05 or smaller) and the Kaiser-Meyer-Olkin (KMO) Measure of sampling adequacy had to be more than 0.50 in order to be acceptable (Hair, et al., 1998). Some authors suggested 0.6 and above as mediocre, 0.5 and above as miserable and below 0.5 as not acceptable. Field (2000) recommends that 0.5 – 0.7 as mediocre, 0.7-0.8 as good and 0.8-0.9 as superb. This study accepted those with 0.60 and above (Pallant, 2011).

4.5.1.1 Factor Analysis of Technology Transfer Performance

In performing factor analysis for this study, a threshold value of 0.6 for loading significant and rearrange the variables according to loading was set. To ensure that maximize factor loading on one factor the VARIMAX rotation was utilized. The result of factor analysis of technology transfer performance is provided in Table 4.11a and Table 4.11b. Table 4.11a shows the communalities of 16 items for technology transfer performance. Communality refers to the percent of variance in an observed variable that is accounted for by the retained components (or factors). Each item's communality was examined to make sure that the accounted items for by the factor solution are having sufficient explanation.

Table 4.11a
Communalities of Items of Technology Transfer Performance

	Initial	Extraction
TTa1expproduct	1.000	.835
TTa2techcabilities	1.000	.642
TTa3qualevel	1.000	.759
TTa4targetproduction	1.000	.815
TTa5newproduct	1.000	.722
TTb1targetcost	1.000	.686
TTb2marketontime	1.000	.764
TTb3cycletime	1.000	.783
TTb4growthterget	1.000	.754
TTb5plannedgoal	1.000	.839
TTb6mrketshare	1.000	.687
TTb7profitability	1.000	.709
TTc1managetec	1.000	.674
TTc2managetectrans	1.000	.744
TTc3knowhow	1.000	.757
TTc4skills	1.000	.722

Extraction Method: Principal Component Analysis.

The communality for technology transfer performance ranged from 0.642 until 0.839. The result shows that that all the communalities are greater than 0.6, so all items are retained for further analysis. Table 4.11b indicated a three-factor solution was appropriate. The value KMO is 0.893 which is above 0.60 and the Bartlett's test is highly significant (p=0.000). This shown that the factor analysis is appropriate for this data.

Table 4.11b
PFA Result: Technology Transfer Performance

	Component		
	1	2	3
TTc4skills	.831		
TTb5plannedgoal	.815		
TTb6mrketshare	.767		
TTb4growthterget	.765		
TTb7profitability	.756		
TTa2techcabilities	.709		
TTc2managetectrans	.706		
TTc3knowhow	.675		
TTc1managetec	.654		
TTa1expproduct		.849	
TTb1targetcost		.748	
TTa3qualevel		.689	
TTa4targetproduction		.638	
TTb2marketontime			.822
TTb3cycletime			.773
TTa5newproduct			.707
Eigenvalue	9.347	1.414	1.132
Variance Explained	58.420	8.836	7.074
KMO			0.893
Bartlett's Test of Sphericity			1253.265
Df			120
Sig.			.000
Cronbach's Alpha	0.942	0895	0.820

Note: Loading less than 0.6 are not shown and variable are sorted by highest loading

4.5.1.2 Factor Analysis of Social Capital

Table 4.12a and Table 4.12b show the results obtained from the factor analysis of the social capital. Factor analysis result from Table 4.12a shows the communality of the items in social capital. The communality for social capital ranged from 0.564 until 0.838. Out of 16 items of the social capital, communalities of 15 items are greater than 0.6 and one item is smaller than 0.6 (SCc5share), so this item is not retained for further analysis.

Table 4.12a
Communalities of Items of Social Capital

	Initial	Extraction
SCa1knowledge	1.000	.761
SCa2knowwhatknow	1.000	.757
SCa3knowwhich	1.000	.746
SCa4knowwho	1.000	.838
SCa5knowoutside	1.000	.713
SCa6knowhave	1.000	.741
SCa7contact	1.000	.657
SCb1technicallanguage	1.000	.669
SCb2notunderstand	1.000	.745
SCb3halfaword	1.000	.804
SCb4difficulty	1.000	.789
SCc1connected	1.000	.694
SCc2belong	1.000	.874
SCc3support	1.000	.836
SCc4trust	1.000	.721
SCc5share	1.000	.564

Extraction Method: Principal Component Analysis.

Results from Table 4.12b show the value KMO is 0.859 which is above 0.60 with a three-factor solution. The Bartlett's test is highly significant (p=0.000) so the factor analysis is also appropriate for this data.

Table 4.12b
PFA Result: Social Capital

	Component		
	1	2	3
SCa4knowwho	.845		
SCa3knowwhich	.833		
SCa1knowledge	.800		
SCa5knowoutside	.729		
SCa6knowhave	.725		
SCa2knowwhatknow	.703		
SCb1technicallanguage	.629		
SCc1connected	.622		
SCc5share			
SCc2belong		.868	
SCc3support		.825	
SCc4trust		.805	
SCa7contact		.695	
SCb2notunderstand			.861
SCb4difficulty			.860
SCb3halfaword			.809
Eigenvalue	8.854	2.020	1.034
Variance Explained	55.340	12.626	6.460
KMO			.859
Bartlett's Test of Sphericity			1322.022
Df			120
Sig.			.000
Cronbach's Alpha	0.942	0.897	0.831

Note: Loading less than 0.6 are not shown and variable are sorted by highest loading

4.5.1.3 Factor Analysis of Absorptive Capacity

Table 4.13a shows that all the communalities of the 18 items of absorptive capacity are sufficient ranged from 0.647 until 0.898. Table 4.13b shows that the result of factor analysis produced a four-factor solution with two or more acceptable loading. The value KMO is 0.857 which is above 0.60 and the Bartlett's test is highly significant (p=0.000). However, it was identified that two items (*ACb1commnlanguage* and *ACb2complementary*) had less than 0.6 loading and item *ACa1close* had substantial cross loading on factor 1 and 2. Thus, the action taken was to delete this item from the analysis and the loadings recalculated. The rotated factor matrix for the new factor analysis is shown in Table 4.13c and Table 4.13d.

Table 4.13a
Communalities of Items of Absorptive capacity

	Initial	Extraction
ACa1close	1.000	.867
ACa2trust	1.000	.891
ACa3respects	1.000	.883
ACa41friendship	1.000	.860
ACa5reciprocity	1.000	.786
ACb1commnlanguage	1.000	.688
ACb2complementary	1.000	.683
ACb3overlapcapability	1.000	.777
ACb4culture	1.000	.647
ACb5mngstyle	1.000	.786
ACc1informal	1.000	.746
ACc2intrdpartmt	1.000	.807
ACc3publishdoc	1.000	.741
ACc4datatransmit	1.000	.867
ACc5informtime	1.000	.895
ACd1knowldgflow	1.000	.874
ACd2responsibilt	1.000	.894
ACd3ableexploit	1.000	.898

Extraction Method: Principal Component Analysis.

Table 4.13b

PFA Result: Absorptive Capacity

	Component			
	1	2	3	4
ACc2intrdpartmt	.846			
ACc4datatransmit	.810			
ACb5mngstyle	.721			
ACc3publishdoc	.685			
ACc5informtime	.663			
ACb4culture	.612			
ACa3respects		.821		
ACa5reciprocity		.803		
ACa41friendship		.741		
ACa2trust		.736		
ACa1close	.631	.655		
ACb1commnlanguage				
ACb2complementary				
ACd2responsibilt			.886	
ACd3ableexploit			.875	
ACd1knowldgflow			.744	
ACb3overlapcapability				.876
ACc1informal				.695
Eigenvalue	9.585	2.300	1.545	1.161
Variance Explained	53.254	12.776	8.583	6.449
KMO				.857
Bartlett's Test of Sphericity				1764.734
Df				153
Sig.				.000
Cronbach's Alpha	0.918	0.914	0.732	0.727

Note: Loading less than 0.6 are not shown and variable are sorted by highest loading

Table 4.14c shows that all communalities above 50 percent and most much higher. As shown in Table 4.14d, the factor structure for the remaining 17 items representing four distinct groups of variables. The value KMO is 0.843 which is above 0.60 with a three-factor solution. The Bartlett's test is highly significant (p=0.000) so the factor analysis is also appropriate for this data.

Table 4.13c

Communalities of Items of Absorptive capacity

	Initial	Extraction
ACa2trust	1.000	.858
ACa3respects	1.000	.889
ACa41friendship	1.000	.863
ACa5reciprocity	1.000	.784
ACb1commnlanguage	1.000	.673
ACb2complementary	1.000	.704
ACb3overlapcapability	1.000	.798
ACb4culture	1.000	.660
ACb5mngstyle	1.000	.791
ACc1informal	1.000	.752
ACc2intrdpartmt	1.000	.789
ACc3publishdoc	1.000	.745
ACc4datatransmit	1.000	.870
ACc5informtime	1.000	.902
ACd1knowldgflow	1.000	.881
ACd2responsibilt	1.000	.908
ACd3ableexploit	1.000	.907

Extraction Method: Principal Component Analysis.

Table 4.13d

PFA Result: Absorptive Capacity with ACa1close deleted

	Component			
	1	2	3	4
ACc2intrdpartmt	.839			
ACc4datatransmit	.806			
ACb5mngstyle	.754			
ACc3publishdoc	.694			
ACc5informtime	.659			
ACb4culture	.656			
ACa5reciprocity		.831		
ACa3respects		.809		
ACa41friendship		.783		
ACa2trust		.709		
ACb1commnlanguage		.654		
ACb2complementary		.621		
ACd2responsibilt			.895	
ACd3ableexploit			.875	
ACd1knowldgflow			.740	
ACb3overlapcapability				.883
ACc1informal				.675

Table 4.13d *Continue*

Eigenvalue	8.940	2.286	1.541	1.007
Variance Explained	52.586	13.448	9.067	5.924
KMO				.843
Bartlett's Test of Sphericity				1596.355
Df				136
Sig.				.000
Cronbach's Alpha	0.908	0.917	0.941	0.727

Note: Loading less than 0.6 are not shown and variable are sorted by highest loading

4.5.1.4 Factor Analysis of Technology Park Services

Table 4.14a and Table 4.14b show the results obtained from the factor analysis of the technology park services. Factor analysis result from table 4.14a shows the communality of the items in social capital. All the communalities above 50 percent, ranged from 0.656 until 0.931. Table 4.14b shows that the result of factor analysis produced a three-factor solution. The value KMO is 0.922 which is above 0.60 with a three-factor solution. The Bartlett's test is highly significant (p=0.000) so the factor analysis is also appropriate for this data. However, there are three items that have loading smaller than 0.6 (*bss2Nknowledgedissemination, bss7PRmarketingevents and bss1Nknowledgesharing*), so these items were not retained for further analysis.

Table 4.14a
Communalities of Items of Technology Park Services

	Initial	Extraction
tss1PRstafftraining	1.000	.746
tss2SRlaboratory	1.000	.806
tss3SRoperation	1.000	.846
tss4SRtestingequipment	1.000	.931
tss5SRadministrativesupport	1.000	.879
bss1Nknowledgesharing	1.000	.831
bss2Nknowledgedissemination	1.000	.809
bss3CLskillLabour	1.000	.788
bss4GPaccessresearchcentre	1.000	.726
bss5GPaccessuniversities	1.000	.789
bss6CLsupportingnetwork	1.000	.849
bss7PRmarketingevents	1.000	.714
cs1legalprovision	1.000	.875
cs2accounting	1.000	.814
cs3business	1.000	.656
cs4technicaladvice	1.000	.879
f1Crentalsubsidies	1.000	.857
f2Cnetworksubsidies	1.000	.858
f3Ccostreduction	1.000	.908
f4Fbankingfacilities	1.000	.779

Extraction Method: Principal Component Analysis.

Table 4.14b
PFA Result: Technology Park Services

	Component		
	1	2	3
tss4SRtestingequipment	.872		
tss5SRadministrativesupport	.832		
tss3SRoperation	.825		
cs1legalprovision	.759		
tss2SRlaboratory	.758		
tss1PRstafftraining	.721		
cs2accounting	.661		
cs3business	.601		
f2Cnetworksubsidies		.838	
cs4technicaladvice		.793	
f4Fbankingfacilities		.777	
f3Ccostreduction		.766	
f1Crentalsubsidies		.718	
bss2Nknowledgedissemination			
bss7PRmarketingevents			
bss1Nknowledgesharing			
bss6CLsupportingnetwork			.864
bss3CLskillLabour			.789
bss5GPaccessuniversities			.775
bss4GPaccessresearchcentre			.726

Table 4.14b *Continue*

Eigenvalue	13.904	1.353	1.084
Variance Explained	69.518	6.765	5.418
KMO			.922
Bartlett's Test of Sphericity			2395.967
Df			190
Sig.			.000
Cronbach's Alpha	0.965	0.955	0.909

Note: Loading less than 0.6 are not shown and variable are sorted by highest loading

4.5.2 Common Method Variance (CMV) Test

Common method variance is variance that is attributed to the measurement method rather than the construct interest. It may cause systematic measurement error and further bias the estimates of the true relationship among theoretical constructs. To prevent the occurrence of common method variance the study adopts Harman's single factor analysis to conduct posterior examination of common method variance (Podsakoff & Organ, 1986). All the items in this study were loaded into an exploratory factor analysis, using un-rotated principal components factor analysis, to determine the number of factors that are necessary to account for the variance in the variables. The basic assumption of this techniques is that if a substantial amount of common method variance is present, either (a) a single factor will emerge from the factor analysis, or (b) one general factor will account for the majority of the covariance among the variables. For this study, un-rotated factor analysis with seventy items results in twelve factors those together accounts for 82.3% of the total variance. The first largest factor did not account for a majority of variance (33.875%). Since a single factor does not emerge in this analysis and no-single factor account for majority of covariance between variables it can be established that the results of this analysis do not preclude the possibility of common method variance, they do suggest that common method variance is not of great concern and thus is unlikely to confound the interpretations of results.

4.5.3 Reliability Analysis

An internal consistency analysis was performed separately for the items of each dimension emerged after factor analysis was conducted by using the SPSS reliability procedure. The reliability analysis enables the researchers to study the measurement scales and the items that make them up. The reliability of the summated scales is best measured by Cronbach's alpha (Hair et al, 2010), the approximate average correlation between all pairs of items. Cronbach's alpha of 0.6 and above can be considered as an effective reliability for judging scale (Flyn, Schroeder, and Sakakibara, 1994). From Table 4.15, the alpha values of reliability analysis for this study ranges from 0.727 to 0.965.

Table 4.15
Reliability Analysis

Variables/scales	Number of Items	Cronbach's Alpha	Cronbach's Alpha (Combined reliability)
Technology Transfer Performance (DV)			
DV1- Technology Advantages	9	0.942	
DV2 - Production Advantages	4	0.895	0.950
DV3- Business Advantages	3	0.820	
Social Capital (IV)			
IV1- Structural	8	0.942	
IV2- Relational	4	0.897	0.932
IV3- Cognitive	3	0.831	
Potential Absorptive Capacity (Mediator 1)			
ac1- Assimilation	6	0.908	0.918
ac2- Acquisition	4	0.917	
Realize Absorptive Capacity (Mediator 2)	3	0.941	
ac3- Exploitation			0.734
ac4- Transformation	2	0.727	

Table 4.15 *Continue*

Technology Park Services (Moderator)			
tps1-Technological Support	8	0.965	
tps2-Cost and Subsidies	5	0.955	0.971
tps3-Business Support	4	0.909	

From the results obtained, all the alpha values are greater than 0.6.Thus it can be concluded that this instrument has high internal consistency and is therefore reliable. Table 4.16 shows the dimensions derived after factor analysis.

Table 4.16
The Variables after Factor Analysis

Variables	**Dimensions**
Dependent Variable Technology Transfer Performance	1. Technology Advantages 2. Production Advantages 3. Business Advantages
Independent Variable Social Capital	1. Structural Dimension 2. Relational Dimension 3.Cognitive Dimension
Mediating Variable Absorptive Capacity	1. Assimilation (Potential Capacities) 2. Acquisition(Potential Capacities) 3. Exploitation (Realized Capacities) 4. Transformation(Realized Capacities)
Moderating Variables Technology Park Services	1. Technical support 2. Cost and subsidies 3. Business support

For the purpose of this study, the analysis focused on the three dimensions of social capital and technology transfer performance. It concentrated on the mediating effect of absorptive capacity from two distinction concept those are potential and realize absorptive capacity (Zahra & George, 2002). Potential absorptive capacity captures efforts expended in identifying and acquiring new external knowledge and in assimilating knowledge obtained from external, while realize absorptive capacity encompasses deriving new insights and consequences from the combination of existing and newly acquired knowledge, and incorporating transformed knowledge into operations (Zahra & George, 2002). Based on the objective of the study, the analyses for moderating effect of technology park services were done by taking the combination of the three dimensions of technology park services.

4.6 Restatement of Hypotheses

Since the result of factor analysis required some dimensions to be renamed, the previous hypotheses needed to be amended. The hypotheses are restated as follows.

4.6.1 Hypotheses for Direct Effect

H_1 Social capital has significant positive influence on technology transfer performance.

H_{1A1} Structural dimension has significant positive influence on technology advantages.

H_{1A2} Relational dimension has significant positive influence on technology advantages.

H_{1A3} Cognitive dimension has significant positive influence on technology advantages.

H_{1B1} Structural dimension has significant positive influence on production advantages.

H_{1B2} Relational dimension has significant positive influence on production advantages.

H_{1B3} Cognitive dimension has significant positive influence on production advantages.

H_{1C1} Structural dimension has significant positive influence on business advantages.

H_{1C2} Relational dimension has significant positive influence on business advantages.

H_{1C3} Cognitive dimension has significant positive influence on business advantages.

H_2 Social capital has positively relationship with absorptive capacity.

H_{2A1} Structural dimension has significant positive relationship with potential capacity.

H_{2A2} Relational dimension has significant positive relationship with potential capacity.

H_{2A3} Cognitive dimension has significant positive relationship with potential capacity.

H_{2B1} Structural dimension has significant positive relationship with realize capacity.

H_{2B2} Relational dimension has significant positive relationship with realize capacity.

H_{2B3} Cognitive dimension has significant positive relationship with realize capacity.

H_3 Absorptive capacity has significantly positive influence on technology transfer performance.

H_{3A1} Potential capacity has significant positive influence on technology advantages.

H_{3A2} Potential capacity has significant positive influence on production advantages.

H_{3A3} Potential capacity has significant positive influence on business advantages.

H_{3B1} Realize capacity has significant positive influence on technology advantages.

H_{3B2} Realize capacity has significant positive influence on production advantages.

H_{3B3} Realize capacity has significant positive influence on business advantages.

4.6.2 Hypotheses for Mediating Effect

Mediating hypotheses assist in understanding on how the relationship occurs by treating potential capital and realized capital as the mediating variable. Based on the definition of mediation proposed by Baron and Kenny (1986), the variables may be said to function as mediator to the extent that they accounts for the relation between social capital and technology transfer performance. The hypotheses for mediating effect are as follows.

H4 Absorptive Capacity mediates the relationship between social capital and technology transfer performance.

The mediating effect of potential capacity on the relationship between social capital and technology transfer performance.

H_{4A} Potential Capacity mediates the relationship between social capital and technology transfer performance.

H_{4A1} Potential Capacity mediates the relationship between structural network and technology advantages.

H_{4A2} Potential Capacity mediates the relationship between relational and technology advantages.

H_{4A3} Potential Capacity mediates the relationship between cognitive and technology advantages.

H_{4A4} Potential Capacity mediates the relationship between structural network and production advantages.

H_{4A5} Potential Capacity mediates the relationship between relational and production advantages.

H_{4A6} Potential Capacity mediates the relationship between cognitive and production advantages.

H_{4A7} Potential Capacity mediates the relationship between structural network and business advantages.

H_{4A8} Potential Capacity mediates the relationship between relational and business advantages.

H_{4A9} Potential Capacity mediates the relationship between cognitive and business advantages.

The mediating effect of realize capacity on the relationship between social capital and technology transfer performance.

H_{4B} ***Realize capacity mediates the relationship between social capital and technology transfer performance.***

H_{4B1} Realize capacity mediates the relationship between structural network and technology advantages

H_{4B2} Realize capacity mediates the relationship between relational and technology advantages.

H_{4B3} Realize capacity mediates the relationship between cognitive and technology advantages.

H_{4B4} Realize capacity mediates the relationship between structural network and production advantages.

H_{4B5} Realize capacity mediates the relationship between relational and production advantages.

H_{4B6} Realize capacity mediates the relationship between cognitive and production advantages.

H_{4B7} Realize capacity mediates the relationship between structural network and business advantages.

H_{4B8} Realize capacity mediates the relationship between relational and business advantages.

H_{4B9} Realize capacity mediates the relationship between cognitive and business advantages.

4.6.2 Hypotheses for Moderating Effect

Moderating hypotheses assist in understanding on how the relationship occurs by treating technology park services as the mediating variable. Based on the definition of mediation proposed by Baron and Kenny (1986), a variable may be said to function as moderator if it effects the direction and strength of the relation between the independent variable and dependent variable. The hypotheses for moderating effect are as follows.

H5 Technology park services moderate the relationship between social capital and technology transfer performance.

H_{5A} Technology park services moderate the relationship between structural networks and technology advantages.

H_{5B} Technology park services moderate the relationship between relational and technology advantages.

H_{5C} Technology park services moderate the relationship between cognitive and technology advantages.

H_{5D} Technology park services moderate the relationship between structural networks and production advantages.

H_{5E} Technology park services moderate the relationship between relational and production advantages.

H_{5F} Technology park services moderate the relationship between cognitive and production advantages.

H_{5G} Technology park services moderate the relationship between structural networks and business performance.

H_{5H} Technology park services moderate the relationship between relational and business advantages.

H_{5I} Technology park services moderate the relationship between cognitive and business advantages.

H6 Technology park services moderate the relationship between absorptive capacity and technology transfer performance.

H_{6A} Technology park services moderate the relationship between potential capacity and technology advantages.

H_{6B} Technology park services moderate the relationship between potential capacity and production advantages.

H_{6C} Technology park services moderate the relationship between potential capacity and business advantages.

H_{6D} Technology park services moderate the relationship between realize capacity and technology advantages.

H_{6E} Technology park services moderate the relationship between realize capacity and production advantages.

H_{6F} Technology park services moderate the relationship between realize capacity and business advantages.

The reinstatement of the research framework is shown in Figure 4.8.

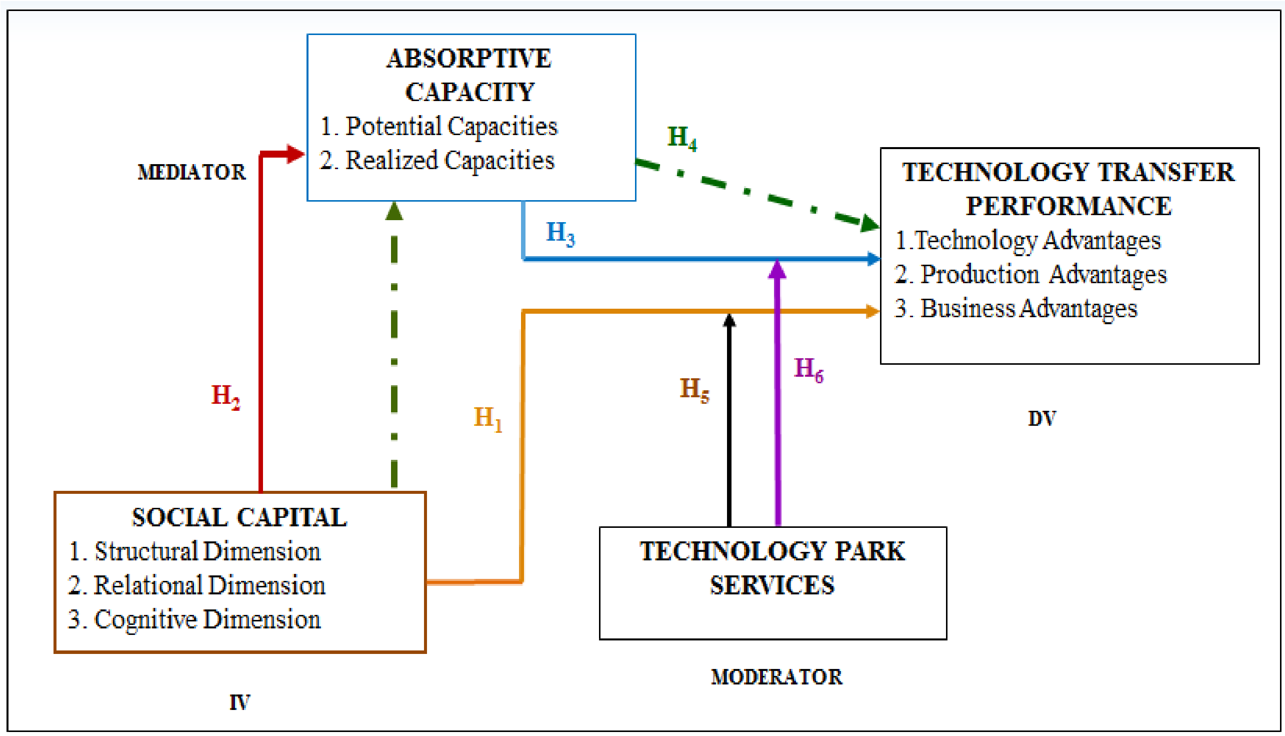

Figure 4.8
Reinstatement of Research Framework

4.6.3 Descriptive Statistics

The scores for descriptive statistics of variables are related to mean, standard deviation, minimum and maximum of the theoretical range. Table 4.5 shows the score of descriptive statistics of variables. From the descriptive statistics, the mean values for technology transfer dimensions ranged from 4.84 to 5.19 with a minimum scale of 2 and a maximum scale of 7. This confirmed that the firms are involved in technology transfer activities. Besides, the mean values for independent variables ranged from 4.55 to 5.25 with minimum scale of 2.33 to 2.88 and maximum scale of 7.00. Structural dimension shows the highest mean with the smallest standard deviation (0.93). Whereas, Technology Park services show the lowest mean with the highest standard deviation. While the mean values for potential and realize absorptive capacity are 4.87 and 4.86 with minimum scale of 2.00 and maximum scale of 7. Overall the mean values are higher than four which are more than the mid-point.

Table 4.17
Descriptive Analysis

	Mean	Minimum	Maximum	Std. Deviation
DV1-Technology Advantages	5.14	2.00	7.00	1.09
DV2-Production Advantages	5.19	2.00	7.00	1.17
DV3-Business Advantages	4.84	2.00	7.00	1.11
IV1- Structural	5.25	2.88	7.00	0.93
IV2- Relational	5.23	2.50	7.00	1.11
IV3- Cognitive	4.55	2.33	7.00	1.14
Mediator 1- Potential Capacity	4.87	2.17	7.00	1.08
Mediator 2- Realize Capacity	4.86	2.00	7.00	1.02
Moderator -Technology Park Services	4.34	1.00	7.00	1.37

4.7 Hypotheses Testing

The correlation analysis is performed to examine the type and the strength of relationship exists between the variables in the hypothesis. Then, a series of regression analyses were used to support the hypothesis testing in this study. Multiple regression was used to predict the changes in the dependent variables in response to change in the independent variables.

First, regression analysis performed to test on the hypothesis that the dimensions of social capital have some kind of relationships with the knowledge work performance and absorptive capacity. Second, to test on the hypothesis regarding dimension of absorptive capacity has some sort of relationships with technology transfer performance. Next, to test the potential linear relationship between social capitals, absorptive capacity and technology transfer performance.

4.7.1 Pearson Correlation Analysis

Pearson correlation test was conducted in this study to identify any association between independent variable, mediating variable and dependent variable of the study. Since the statements of hypotheses stipulate the directions of the relationships are positive relation, one-tailed test was used. The range of the correlation coefficient is used to quantitatively determine the strength of the associations.

The results of Pearson correlation test for the relationship between independent variables and dependent variables are presented in Table 4.18. The results indicated that all the three independent variables have significant relationship with dependent variable. Among the social capital dimensions, structural dimension has the highest associations with the three dimensions of dependent variable. Therefore, Hypothesis 1A1 to Hypothesis 1C3 are supported (Table 4.19).

Table 4.18
Pearson Result on the Correlation of Social Capital (IV) with the Technology Transfer Performance (DV)

Variables	Technology advantages (DV1)	Production advantages (DV2)	Business advantages (DV3)
Structural dimension (IV1)	0.773**	0.657**	0.519**
Relational dimension (IV2)	0.507**	0.406**	0.288**
Cognitive dimension (IV3)	0.380**	0.220*	0.323**

**.Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

Table 4.19
Finding of the Hypotheses H_1, The Influence of Social Capital (IV) on Technology Transfer Performance (DV)

Hypothesis	Hypothesis Statement	Remarks
H_{1A1}	Structural dimension has significant positive influence on technology advantages.	Supported
H_{1A2}	Relational dimension has significant positive influence on technology advantages.	Supported
H_{1A3}	Cognitive dimension has significant positive influence on technology advantages.	Supported
H_{1B1}	Structural dimension has significant positive influence on production advantages.	Supported
H_{1B2}	Relational dimension has significant positive influence on production advantages.	Supported
H_{1B3}	Cognitive dimension has significant positive influence on production advantages.	Supported
H_{1C1}	Structural dimension has significant positive influence on business advantages.	Supported
H_{1C2}	Relational dimension has significant positive influence on business advantages.	Supported
H_{1C3}	Cognitive dimension has significant positive influence on business advantages.	Supported

Table 4.20 shows the results of Pearson correlation test between independent variable and mediating variables. The results confirm that there are significant positive correlation between all the dimensions of social capital and the two mediating variables with 0.01 significant levels. The positive correlation implies that higher absorptive capacity to go with higher social capital and lower absorptive capacity to go with lower social capital. Hence, Hypothesis 2A1 to Hypothesis 2B3 are supported (Table 4.21).

Table 4.20

Pearson Result on the Correlation between the Social Capital (IV) and the Absorptive Capacity (Mediator)

Variables	Potential (Med. V1)	Realize (Med. V2)
Structural dimension (IV1)	0.604**	0.539**
Relational dimension (IV2)	0.530**	0.451**
Cognitive dimension (IV3)	0.462**	0.557**

**.Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

Table 4.21

Finding of the HypothesesH$_2$, Relationship between Social Capital (IV) and Absorptive Capacity (Mediator)

Hypothesis	Hypothesis Statement	Remarks
H_{2A1}	Structural dimension has significant positive influence on potential capacity.	Supported
H_{2A2}	Relational dimension has significant positive influence on potential capacity.	Supported
H_{2A3}	Cognitive dimension has significant positive influence on potential capacity.	Supported
H_{2B1}	Structural dimension has significant positive influence on realize capacity.	Supported
H_{2B2}	Relational dimension has significant positive influence on realize capacity.	Supported
H_{2B3}	Cognitive dimension has significant positive influence on realize capacity.	Supported

The results of Pearson correlation test between mediating variables and dependent variables are provided in Table 4.22. It is found that both of the mediating variables, potential absorptive capacity and realize absorptive capacity also have significant positive relationships with the dependent variables. Therefore, the third hypotheses, Hypothesis 3A1 to Hypothesis 3B3 are more likely to the explanation of the finding (Table 4.23).

Table 4.22

Pearson Result on the Correlation between the Absorptive Capacity (Mediator) and Technology Transfer Performance (DV)

Variables	Technology advantages (DV1)	Production advantages (DV2)	Business advantages (DV3)
Potential (Mediator 1)	0.511**	0.303*	0.242*
Realize (Mediator2)	0.507**	0.301**	0.371**

Table 4.23

Finding of the Hypotheses H3, Relationship between Absorptive Capacity (Mediator) and Technology Transfer Performance (DV)

Absorptive Capacity and Technology Transfer Performance		
H_{3A1}	Potential capacity has significant positive influence on technology advantages.	Supported
H_{3A2}	Potential capacity has significant positive influence on production advantage	Supported
H_{3A3}	Potential capacity has significant positive influence on business advantages.	Supported
H_{3B1}	Realize capacity has significant positive influence on technology advantages.	Supported
H_{3B2}	Realize capacity has significant positive influence on production advantages.	Supported
H_{3B3}	Realize capacity has significant positive influence on business advantages.	Supported

Base on the Pearson correlation coefficient in Table 4.18 and Table 4.20, it can be concluded that all the dimensions of social capital have influence on dependent variables and mediating variables. As well, Table 4.23 shows that potential absorptive capacity and realize absorptive capacity also have influence on technology transfer performance. These results were indication to the existence of mediating effect of absorptive capacity. In order to understand whether the relationship between social capital and technology transfer performance is direct or whether it occurs indirectly through the third variable (absorptive capacity) analysis on mediating effect was conducted. The details of the results were discussed in the next section.

4.7.2 Regression Analysis on The Mediating Effect of Absorptive Capacity

This study followed the test standard of mediating effect discussed by Baron and Kenny (1986), Judd and Kenny, and James and Brett (1984) which established that when there is mediating factor between the dependent variables and the independent variables, it must meet four conditions:

I. The independent variables must affect the dependent variables; this condition establishes that there is an effect that may be mediated.

II. The independent variables must affect the mediating variables; this condition essentially involves treating the mediating variables as if it were a dependent variable.

III. The mediating variables must affect the dependent variables. In establishing the effect of the mediating variables on dependent variables, the independent variable must be controlled because it is not sufficient just to correlate the mediating variables with dependent variables as the mediating variables and the dependent variables may be correlated because they were both caused by the independent variables.

IV. With the above conditions are the simultaneous tenable, considering the simultaneous effect of the independent variables and the mediating variables on the dependent variables, the effect of the independent variables is less than the individual effect of the independent variables on the dependent variables. The effects in both condition III and IV are estimated in the same equation.

The regression analyses to test the occurrence of every condition that need to be consider for mediating effect are available in Appendix C-2. The summaries of these regression analyses are provided in Table 4.24 until Table 4.27.

Relationship of Social Capital (IV), Absorptive Capacity (Mediator) and Technology Transfer Performance (DV)

Table 4.24 provides the summary of regression analyses which are conducted to identify whether the independent variable (social capital dimensions) directly influence the dependent variables (technology transfer performance). Although there are varieties of significant levels, the results show that all the independent variables have significant positive influence on all the dependent variables. The outcomes established that there are effects that may be mediated. On the other hand, Table 4.25 shows the summary of regression analyses to identify the effects of the independent variable (social capital dimensions) on the mediating variables (absorptive capacity). The results approve that all the independent variables have significant positive influence on the mediating variables with $p<0.001$ level of significant. Therefore, condition I and condition II are fulfilled.

Table 4.24

Regression Analysis between Social Capital (IV) and Technology Transfer Performance (DV) ***(Condition I)***

No.	IV	DV	Coefficient (β)	F	R^2
1	Structural	Technology advantages	0.773***	130.340***	0.597
2	Structural	Production advantages	0.657***	66.969***	0.432
3	Structural	Business advantages	0.519***	32.403***	0.269
4	Relational	Technology advantages	0.507***	30.457***	0.257
5	Relational	Production advantages	0.406***	17.385***	0.165
6	Relational	Business advantages	0.288**	7.945**	0.083
7	Cognitive	Technology advantages	0.380***	14.828***	0.144
8	Cognitive	Production advantages	0.220*	4.481*	0.048
9	Cognitive	Business advantages	0.323*	10.239**	0.104

*** p<0.001, **p<0.01, *p<0.05

Table 4.25

Regression Analysis between Social Capital (IV) and Absorptive Capacity (Mediating variable) ***(Condition II)***

IV	DV	Coefficient (β)	F	R^2
Structural	Potential Capacity	0.604***	50.510***	0.365
	Realize Capacity	0.539***	36.123***	0.291
Relational	Potential Capacity	0.530***	34.439***	0.281
	Realize Capacity	0.451***	22.478***	0.203
Cognitive	Potential Capacity	0.462***	23.819***	0.213
	Realize Capacity	0.557***	39.492***	0.310

*** p<0.001, **p<0.01, *p<0.05

Table 4.26 and Table 4.27 summarize the results of multiple regressions on the independent variables, mediating variables and dependent variables. They provide information to examine the occurrence of Condition III and Condition IV.

Table 4.26

Regression Analysis About Social Capital (IV) and Potential Capacity (Mediating variable 1) to Technology Transfer Performance (DV) ***(Condition III and IV)***

No.	Hypothesis	IV	DV	Coefficient (β)	F	R^2
1	H_{4A1}	Structural	Technology Advantages	0.731***	65.253***	0.600
		Potential Capacity		0.069		
2	H_{4A4}	Structural	Production Advantages	0.746***	35.011***	0.446
		Potential Capacity		-0.147		
3	H_{4A7}	Structural	Business advantages	0.587***	16.683***	0.277
		Potential Capacity		-0.113		
4	H_{4A2}	Relational	Technology Advantages	0.329**	22.247***	0.338
		Potential Capacity		0.336**		
5	H_{4A5}	Relational	Production Advantages	0.341**	9.274***	0.176
		Potential Capacity		0.122		
6	H_{4A8}	Relational	Business Advantages	0.222	4.504*	0.094
		Potential Capacity		-0.124		
7	H_{4A3}	Cognitive	Technology Advantages	0.183	17.517***	0.287
		Potential Capacity		0.426***		
8	H_{4A6}	Cognitive	Production Advantages	0.102	4.843*	0.079
		Potential Capacity		0.256*		
9	H_{4A9}	Cognitive	Business Advantages	0.269*	5.659**	0.115
		Potential Capacity		0.118		

*** p<0.001, **p<0.01, *p<0.05

Table 4.27

Regression Analysis about Social Capital (IV) and Realize Capacity (Mediating variable 2) to Technology Transfer Performance (DV) ***(Condition III and IV)***

No.	Hypothesis	IV	DV	Coefficient (β)	F	R^2
1	H_{4B1}	Structural	Technology Advantages	0.704***	67.563***	0.608
		Realize Capacity		0.127		
2	H_{4B4}	Structural	Production Advantages	0.698***	33.649***	0.423
		Realize Capacity		-0.075		
3	H_{4B7}	Structural	Business Advantages	0.450***	16.983***	0.281
		Realize Capacity		0.128		
4	H_{4B2}	Relational	Technology Advantages	0.350***	23.843***	0.354
		Realize Capacity		0.349**		
5	H_{4B5}	Relational	Production Advantages	0.339**	9.709***	0.182
		Realize Capacity		0.148		
6	H_{4B8}	Relational	Business Advantages	0.151	8.025**	0.156
		Realize Capacity		0.303**		
7	H_{4B3}	Cognitive	Technology Advantages	0.142	16.129***	0.270
		Realize Capacity		0.428***		
8	H_{4B6}	Cognitive	Production Advantages	0.076	4.553*	0.095
		Realize Capacity		0.259*		
9	H_{4B9}	Cognitive	Business Advantages	0.169	8.111**	0.157
		Realize Capacity		0.277*		

*** p<0.001, **p<0.01, *p<0.05

Table 4.26 provides the results of regression analyses conducted to examine the mediating effect of potential capacity on the relationship between social capital dimensions and technology transfer performance dimensions. While Table 4.27 provides the results of regression analyses conducted to examine the mediating effect of realize capacity on the relationship between social capital dimensions and technology transfer performance dimensions.

The existence of mediating effect can be determined by comparing the results of regression analyses between IVs and DVs when the regression analyses were conducted without mediator (Table 4.24) and the results of regression analyses between IV and DV when the regression analyses were conducted with Mediator (Table 4.26 and Table 4.27). If the influence of Mediator on DV is statistically significant in Table 4.26 and Table 4.27, then the interpretation is that the Mediator mediates the relationship between IV and DV. If the relationships between IV and DV become not significant with the introduction of the mediator, then the interpretation is that mediator fully mediates the relationship. If the relationship between IV and DV is statically significant, then the interpretation is that mediator partially mediates the relationship (Shaver, 2005, Ramayah & Ignatius, 2010).

From Table 4.26, it is found that potential capital has moderating effect on several relationships between social capital dimensions and technology transfer performance dimensions. In row number 4 of Table 4.26, it is found that the influence of mediating variable (Potential Capital) and independent variable (Relational) on dependent variables (Technology Advantages) are statistically significant ($\beta=0.336$, $p<0.01$ & $\beta=0.329$, $p<0.01$), This result confirms that potential capacity has partially mediates the relationship between relational dimension and technology advantages. Hence, the result supports $H_{4A1.}$

In row number 7 of Table 4.26, the mediating variable (potential capacity) has significant effect on dependent variable (technology advantages) ($\beta=0.426$, $p<0.001$). However, the influence of independent variable (cognitive dimension) on the dependent variable is not significant (β=0.183, $p>0.05$). This confirms that potential capacity has fully mediates the relationship between cognitive dimension and technology advantage and this support $H_{4A3.}$

Row number 8 of Table 4.26 shows that the mediating variable (potential capacity) has significant effect on dependent variable (production advantages) (β=0.256, $p<0.05$) while the independent variables (cognitive dimension) has no significant effect on the dependent variable (β=0.102, $p>0.05$). This confirms that potential capacity is a full mediator between cognitive dimension and technology advantage and this support $H_{4A3.}$ In summary, it is found that potential capacity has moderating effect on the relationship between relational dimension and technology advantages; relationship between cognitive dimension and technology advantages and cognitive dimension and production performance. These findings support hypotheses H_{4A2}, H_{4A3} and H_{4A6}. However, the influence of potential capacity on dependent variables in rows 1, 2, 3, 5, 6 and 9 are not significant, hence hypotheses H_{4A1}, H_{4A4}, H_{4A5}, H_{4A7}, H_{4A8}, and H_{4A9} are not supported.

Table 4.27 summarized the results of regression analyses those were conducted to examine the mediating effect of realize capacity on the relationship between social capital dimensions and technology transfer performance dimensions. From Table 4.27, it shows that realize capital has moderating effect on several relationships between social capital dimensions and technology transfer performance dimensions. In row number 4 of Table 4.27, it shows that the independent variable (relational dimension) and the mediating variable (realize capacity) have significant effect on dependent variable (technology advantage) (β=0.350, $p<0.001$ & β=0.349, $p<0.01$). This result confirms that realize capacity partially mediates the relationship between relational dimension and technology advantages. Hence, the result supports hypothesis H_{4B1}.

In row number 6, the influence of mediating variable (realize capacity) on dependent variable (business advantages) is statistically significant (β=0.303, $p<0.01$), while the influence of independent variables (relational dimension) on the dependent variable is not significant (β=0.151, $p>0.05$). This indicated that realize capacity fully mediates the effect of relational dimension on business advantages, therefore hypothesis H_{4B8} is supported.

The same situation occur in row number 7, 8 and 9, the results indicated that realize capacity fully mediates the effects of cognitive dimension on technology advantages (β=0.428, $p<0.001$); the effects of cognitive dimension on production advantages (β=0.259, $p<0.05$); and the effects of cognitive dimension on business advantages (β=0.277, $p<0.05$). In summary, it is found that realize capacity has moderating effect on the relationship between relational dimension and technology advantages; relationship between relational dimension and business advantages; relationship between cognitive dimension and technology advantages; relationship between cognitive dimension and production performance; and relationship between cognitive dimension and business performance These findings support hypotheses H_{4B2}, H_{4B3}, H_{4B6}, H_{4B8} and H_{4B9}. Table 4.28 summarizes the results of hypotheses H_{4A} and H_{4B}.

Table 4.28

Finding of the hypotheses H_{4A} and H_{4B}

Hypothesis	Hypothesis Statement	Remarks
	Mediating effect of potential capacity	
H_{4A1}	Potential Capacity mediates the relationship between structural network and technology advantages.	Not supported
H_{4A2}	Potential Capacity mediates the relationship between relational and technology advantages.	Supported
H_{4A3}	Potential Capacity mediates the relationship between cognitive and technology advantages.	Supported
H_{4A4}	Potential Capacity mediates the relationship between structural network and production advantages.	Not supported
H_{4A5}	Potential Capacity mediates the relationship between relational and production advantages.	Not supported
H_{4A6}	Potential Capacity mediates the relationship between cognitive and production advantages.	Supported
H_{4A7}	Potential Capacity mediates the relationship between structural network and business advantages.	Not supported
H_{4A8}	Potential Capacity mediates the relationship between relational and business advantages.	Not supported
H_{4A9}	Potential Capacity mediates the relationship between cognitive and business advantages.	Not supported
	Mediating effect of realize capacity	
H_{4B1}	Realize capacity mediates the relationship between structural network and technology advantages	Not supported
H_{4B2}	Realize capacity mediates the relationship between relational and technology advantages.	Supported
H_{4B3}	Realize capacity mediates the relationship between cognitive and technology advantages.	Supported
H_{4B4}	Realize capacity mediates the relationship between structural network and production advantages.	Not supported
H_{4B5}	Realize capacity mediates the relationship between relational and production advantages.	Not supported
H_{4B6}	Realize capacity mediates the relationship between cognitive and production advantages.	Supported
H_{4B7}	Realize capacity mediates the relationship between structural network and business advantages.	Not supported
H_{4B8}	Realize capacity mediates the relationship between relational and business advantages.	Supported
H_{4B9}	Realize capacity mediates the relationship between cognitive and business advantages.	Supported

4.7.3 Hierarchical Regression Analysis

To examine the effect of moderating variable on the relationships between the two variables (social capital and absorptive capacity) and technology transfer performance, a moderated regressions analysis (MRA) was utilized. When the effects of the moderator were identified, the results could add insights into the usefulness of them to the relationship between social capital dimensions, absorptive capacity dimensions, technology park services and technology transfer dimensions. The steps used in identifying the existence of moderating effect in this study were in accordance to the suggestion by Sharma, Durand and Gur-Arie (1981) and Frazier, Barron and Tix (2004). To do so, initially, the predictor and moderator variables were standardized to provide a meaningful interpretation. The steps started with control variable followed with an estimation of the unmoderate equation, after that followed by the moderated relationship. Only the change in R square would indicate that there is a significant moderator (Hair et al. 1998).

The hierarchical analysis was conducted by evaluating the direct effects of the independent variables on dependent variables in the first step. In the second step the moderator variable was entered to determine whether the moderator (Technology Park Services) has a significant direct impact on the dependent variable (Technology Transfer Performance) and in the third step the interaction terms (product of the independent variable and moderator variable) were entered to see any additional variance explained. In order for moderation effect to occur, step 3 must show a significant R square increase with a significant F-change value. Once step 3 shows a significant R square increase, it can be established that there is a moderating effect. Figure 4.9 shows the step followed in identifying the moderator variables.

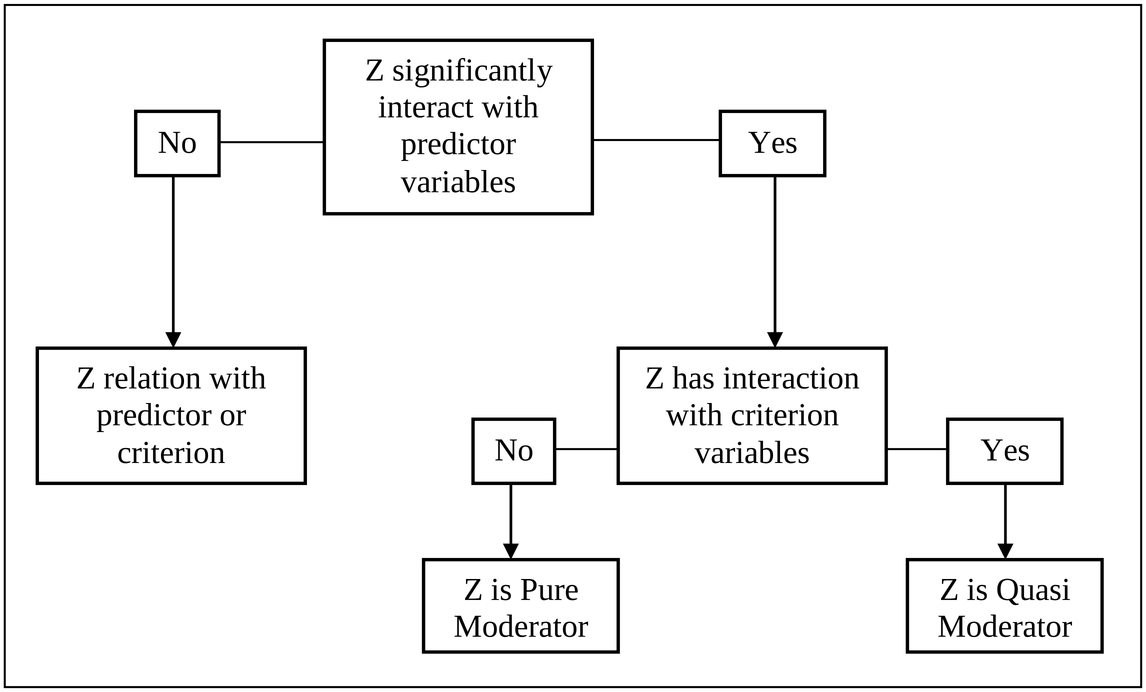

Figure 4.9
Framework for Identifying Moderator Variable (Adapted from Sharma, Durand & Gur-Arie, 1981)

A typology of moderator variables can be developed by using two dimensions or characteristics. First, classification can be based on the relationship with criterion variable; that is, whether the specification variables that are or are not related to a criterion variable. The second dimension is whether the specification variable interacts with the predictor variable. Such a topology of specification variables is depicted in Figure 4.10

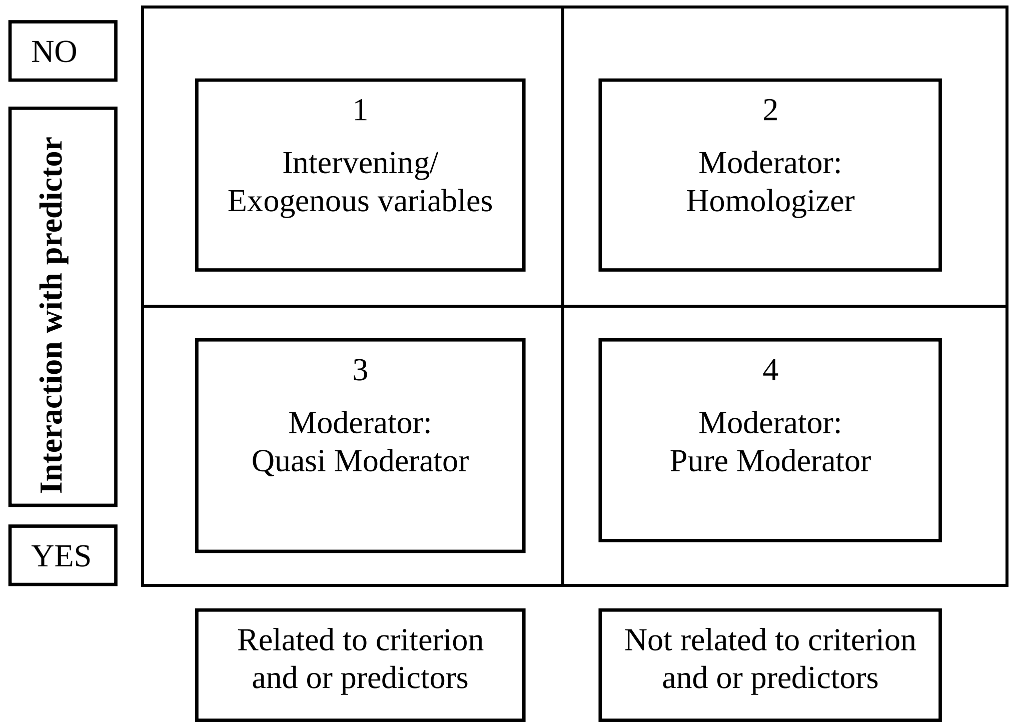

Figure 4.10
The moderators identified for the study based on typology of specification variables by Sharma et al. (1981)

This section establishes the results of the interaction effects between technology park services on the relationship between social capital dimensions and technology transfer performance; and the moderating effect of technology park services on the relationship between absorptive capacity and technology transfer performance. The outcome gave the answers to the fifth and sixth research objectives and hypotheses to the study.

4.7.3.1 Moderating Effect of Technology Park Services on Relationship between Social Capital and Technology Transfer Performance

Table 4.29-4.31 show the multiple regressions results for the three dimensions of technology transfer performance as the criterions with the three dimensions of social capital and technology park services as predictors. Several steps were involved. In Table

4.29, Step 1 includes the control variable of structural dimension. Step 2 shows the change in F is not significant with technology park services. The beta value is 0.771, 0.665 and 0.494 for structural dimension and 0.08, -0.030 and 0.099 for technology park services.

Table 4.29

Hierarchical Regression Result for Moderating Effect of Technology Park Services (Moderator) on the relationship between Structural Dimension (IV1) and Technology Transfer Performance (DV)

Variable	Technology Advantages (DV1)			Production Performance (TDV2)			Business Performance (DV3)		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Structural	0.773	0.771	0.794	0.657	0.665	0.643	0.519	0.494	0.486
Technology Park Services		0.008	0.009		-0.030	-0.030		0.099	0.099
Structural x Technology Park Services			-0.055			0.051			0.019
R Square	0.597	0.597	0.599	0.432	0.433	0.435	0.269	0.278	0.279
Adjusted R square	0.592	0.588	0.586	0.426	0.420	0.415	0.261	0.262	0.253
F Change	130.340	0.014	0.572	66.969	0.126	0.321	32.403	1.113	0.035
Sig. F. Change	0.000	0.907	0.470	0.000	0.724	0.572	0.000	0.294	0.852

*** p<0.001, **p<0.05, *p<0.1

The adjusted R square in Step 2 are 0.588, 0.420 and 0.262. Hence, the predictive powers to explain the criterions by the predictors are 58.8%, 42.0% and 26.2% for technology advantages, production advantages and business advantages respectively. The moderator variable was introduced under Step 3. However, there are no significant F change that indicates there are no major effect from the moderator variable in the relationships between the predictors and criterion variables.

In Table 4.30, Step 1 includes the control variable of relational dimension. Step 2 shows the change in F is not significant with technology park services. The beta value is 0.487, 0.397 and 0.248 for relational dimension and 0.081, 0.039 and 0.162 for technology park services. The adjusted R square is 0.246, 0.147 and 0.087. Hence, the predictive power to explain the criterions by the predictors is 24.6%, 14.7% and 8.7% for technology advantages, production advantages and business advantages respectively. The introductions of moderator variable under Step 3 show that there are significant F changes in the three criterion variables.

Table 4.30
Hierarchical Regression Result for Moderating Effect of Technology Park Services (Moderator) on the relationship between Relational Dimension (IV2) and Technology Transfer Performance (DV)

Variable	Technology Advantages (DV1)			Production Performance (DV2)			Business Performance (DV3)		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Relational	0.507	0.487	0.858	0.406	0.397	0.639	0.288	0.248	0.524
Technology Park Services		0.081	0.074		0.039	0.418		0.162	0.156
Relational x Technology Park Services			-0.580***			-0.437***			-0.430**
R Square	0.257	0.263	0.463	0.165	0.166	0.280	0.083	0.107	0.218
Adjusted R square	0.249	0.246	0.444	0.155	0.147	0.255	0.072	0.087	0.190
F Change	30.457	0.730	31.965	17.385	0.150	13.590	7.945	2.394	12.106
Sig. F. Change	0.000	0.395	0.000	0.000	0.699	0.000	0.006	0.125	0.001

*** $p<0.001$, ** $p<0.05$, * $p<0.1$

The adjusted R square is 0.444, 0.255 and 0.190. Hence, the predictive power to explain the criterions by the predictors is 44.4%, 25.5% and 19.0% for technology advantages, production advantages and business advantages respectively. These indicate that there are effect from the moderator variable in the relationships between the predictors and criterion variables.

According to Selya et. al, (2012), an appropriate way to calculate the effect size within a multiple regression is by using Cohen's f^2(Cohen, 1988). Adopting the variation of Cohen's f^2, to measure the effect size can be presented as the following form.

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2}$$

Where the m is the variable of interest, i is the other variables, R_{im}^2 is the proportion of variance accounted for by i and m together, and R_i^2 is the proportion of variance accounted for by i. Based on Cohen (1988) guideline, $f^2 \geq 0.02$, $f^2 \geq 0.15$ and $f^2 \geq 0.35$ represent small, medium and large effect sizes respectively.

The effect size of technology park services on the relationship between relational dimension and technology advantages is calculated as follows:

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2} = \frac{0.463 - 0.257}{1 - 0.463} = 0.38$$

The result shows a large moderating impact ($f^2 = 0.38$; Cohen 1988) with significant beta changes ($\beta = -0.580$, $t = -5.654$). Consequently, it is confirmed that technology park services does moderate the relationship between relational dimension and technology advantages, hence H_{5B} is supported. The relationship between relational dimension and technology advantages with technology park services as moderator was plotted in graph as shown in Figure 4.11. The graph demonstrated that Technology Advantages increase with the increase of Relational Social Capital. However there are differences in the rate of change between when there are high Technology Park Services and low Technology Park Services therefore, Technology Park Services is considered as a pure moderator.

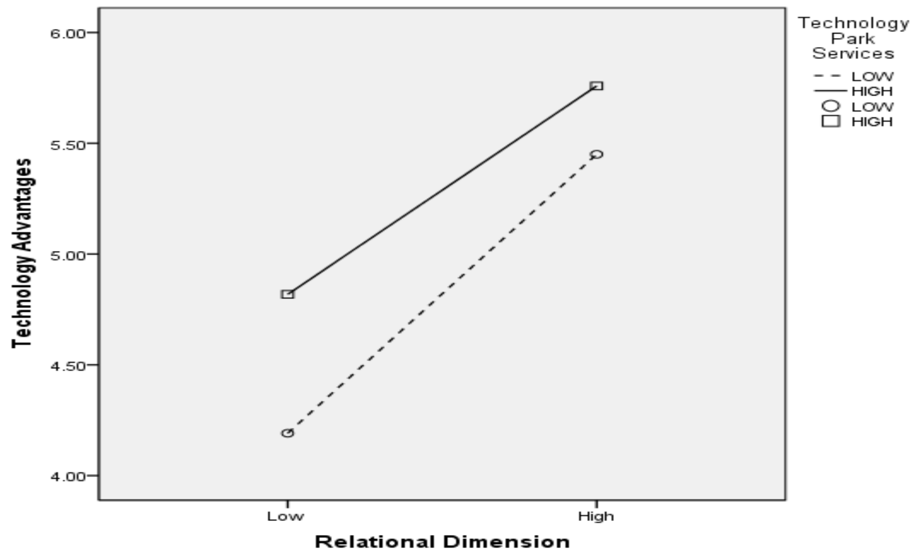

Figure 4.11
The Relationship between Relational Dimension and Technology Advantages with Technology Park Services as Moderator

The following is the effect size of technology park services on the relationship between relational dimension and production advantages:

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2} = \frac{0.280 - 0.165}{1 - 0.280} = 0.16$$

The result shows a medium moderating impact ($f^2 = 0.16$; Cohen 1988) with significant beta changes ($\beta = -0.437$, $t = -3.686$). Consequently, it is confirmed that technology park services does moderate the relationship between relational dimension and production advantages, hence H_{5E} is supported. The relationship between relational dimension and production advantages with technology park services as moderator was plotted in graph as shown in Figure 4.12. The graph demonstrated that Production Advantages increase with the increase of Relational Social Capital. However there are differences in the rate of change between when there are high Technology Park Services and low Technology Park

Services therefore, Technology Park Services also is considered as a pure moderator in this relationship.

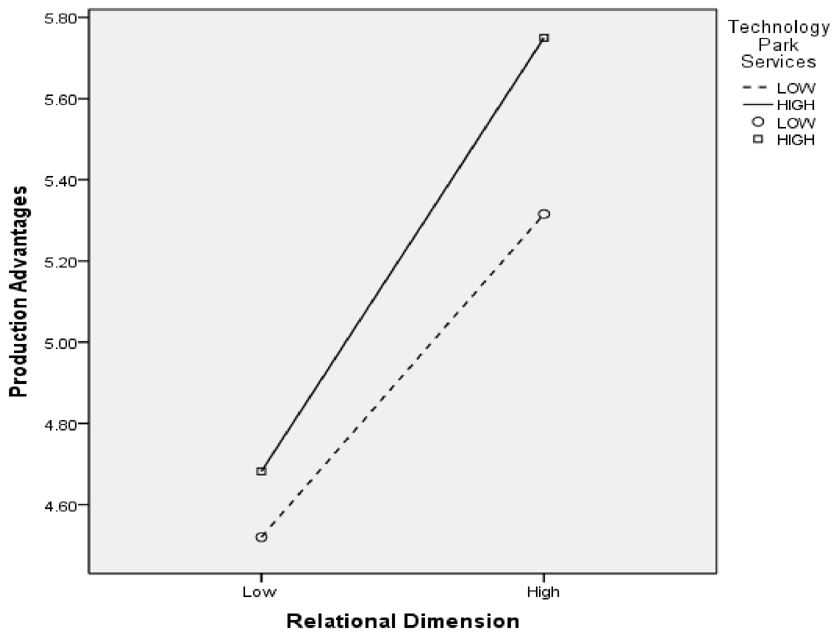

Figure 4.12
The Relationship between Relational Dimension and Production Advantages with Technology Park Services as Moderator

The following is the effect size of technology park services on the relationship between relational dimension and business advantages:

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2} = \frac{0.218 - 0.083}{1 - 0.218} = 0.17$$

The result shows a medium moderating impact ($f^2 = 0.17$; Cohen 1988) with significant beta changes ($\beta = -0.430$, $t = -3.479$). Consequently, it is confirmed that technology park services does moderate the relationship between relational dimension and production advantages, hence H_{5H} is supported. The relationship between relational dimension and business advantages with technology park services as moderator was plotted in graph as shown in Figure 4.13. The graph demonstrated that Business Advantages increase with the increase of Relational Social Capital. It is found that there are no differences in the rate of change between the situations when there are high Technology Park Services and when there are low Technology Park Services. Therefore, Technology Park Services is considered as a quasi-moderator.

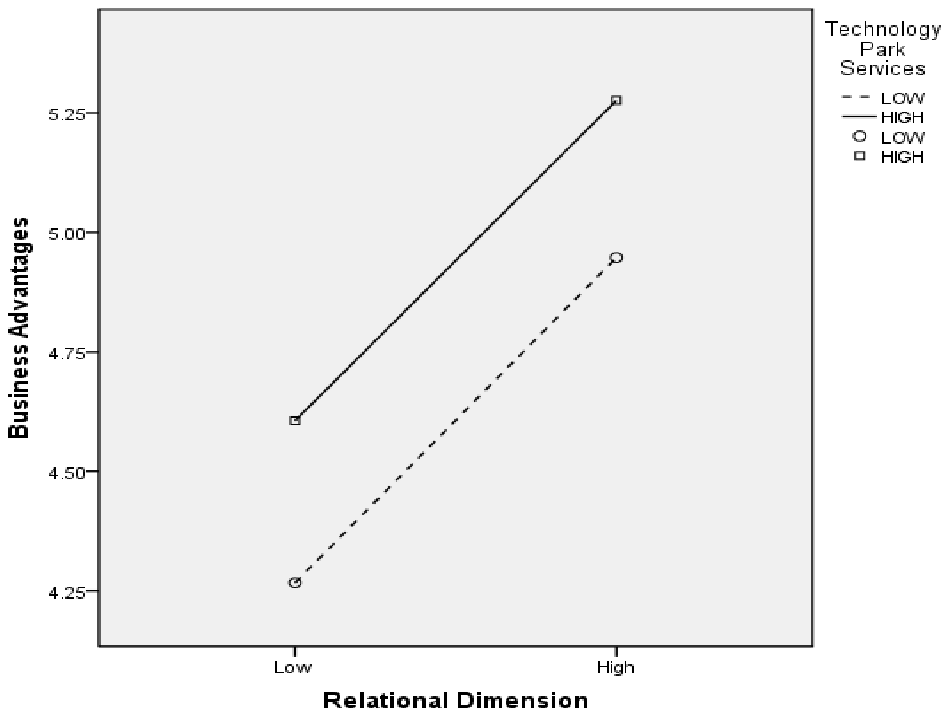

Figure 4.13
The Relationship between Relational Dimension and Business Advantages with Technology Park Services as Moderator

In Table 4.31, Step 1 includes the control variable of cognitive dimension. Step 2 shows the change in F is not significant with technology park services. The beta value is 0.352, 0.197 and 0.280 for relational dimension and 0.087, -0.148 and 0.132 for technology park services. The adjusted R square is 0.131, 0.031 and 0.100. Hence, the predictive power to explain the criterions by the predictors is 13.1%, 3.1% and 10.0% for technology advantages, production advantages and business advantages respectively. The introductions of moderator variable under Step 3 show that there are significant F changes in the three criterion variables. The adjusted R square is 0.350, 0.184 and 0.190. Hence, the predictive power to explain the criterions by the predictors is 35.0%, 18.4% and 19.0% for technology advantages, production advantages and business advantages respectively. These indicate that there are effect from the moderator variable in the relationships between the predictors and criterion variables.

Table 4.31
Hierarchical Regression Result for Moderating Effect of Technology Park Services (Moderator) on the relationship between Cognitive Dimension (IV3) and Technology Transfer Performance (DV)

Variable	Technology Advantages (DV1)			Production Performance (DV2)			Business Performance (DV3)		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Cognitive	0.380	0.352	0.816	0.220	0.197	0.590	0.323	0.280	0.588
Technology Park Services		0.087	-0.173		0.073	-0.148		0.132	-0.041
Cognitive x Technology Park Services			-0.652***			-0.553***			-0.433**
R Square	0.144	0.151	0.372	0.048	0.053	0.212	0.104	0.120	0.217
Adjusted R square	0.134	0.131	0.350	0.038	0.031	0.184	0.094	0.100	0.190
F Change	14.828	0.687	30.191	4.481	0.433	17.309	10.239	1.536	10.659
Sig. F. Change	0.000	0.409	0.000	0.037	0.517	0.000	0.002	0.219	0.002

*** p<0.001, **p<0.05, *p<0.1

The effect size of technology park services on the relationship between cognitive dimension and technology advantages is calculated as follows:

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2} = \frac{0.372 - 0.144}{1 - 0.372} = 0.36$$

The result shows a large moderating impact ($f^2 = 0.36$; Cohen 1988) with significant beta changes ($\beta = -0.652$, $t = -5.495$). Consequently, it is confirmed that technology park services does moderate the relationship between cognitive dimension and technology advantages, hence H_{5C} is supported. The relationship between cognitive dimension and technology advantages with technology park services as moderator was plotted in graph as shown in Figure 4.14.

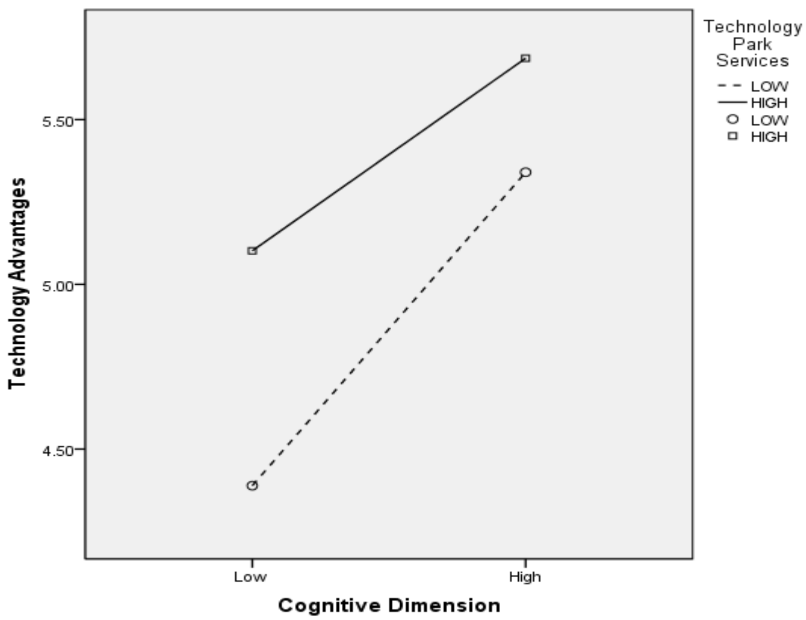

Figure 4.14
The Relationship between Cognitive Dimension and Technology Advantages with Technology Park Services as Moderator

The graph demonstrated that Technology Advantages increase with the increase of Cognitive Social Capital. However there are differences in the rate of change between when there are high Technology Park Services and when there are low Technology Park Services. Thus it can be concluded that Technology Park Services is a pure moderator.

The effect size of technology park services on the relationship between cognitive dimension and production advantages is calculated as follows:

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2} = \frac{0.212 - 0.048}{1 - 0.212} = 0.21$$

The result shows a medium moderating impact ($f^2 = 0.21$; Cohen 1988) with significant beta changes ($\beta = -0.553$, $t = -4.160$). Consequently, it is confirmed that technology park services does moderate the relationship between cognitive dimension and production advantages, hence H_{5F} is supported. The relationship between cognitive dimension and production advantages with technology park services as moderator was plotted in graph as shown in Figure 4.15.

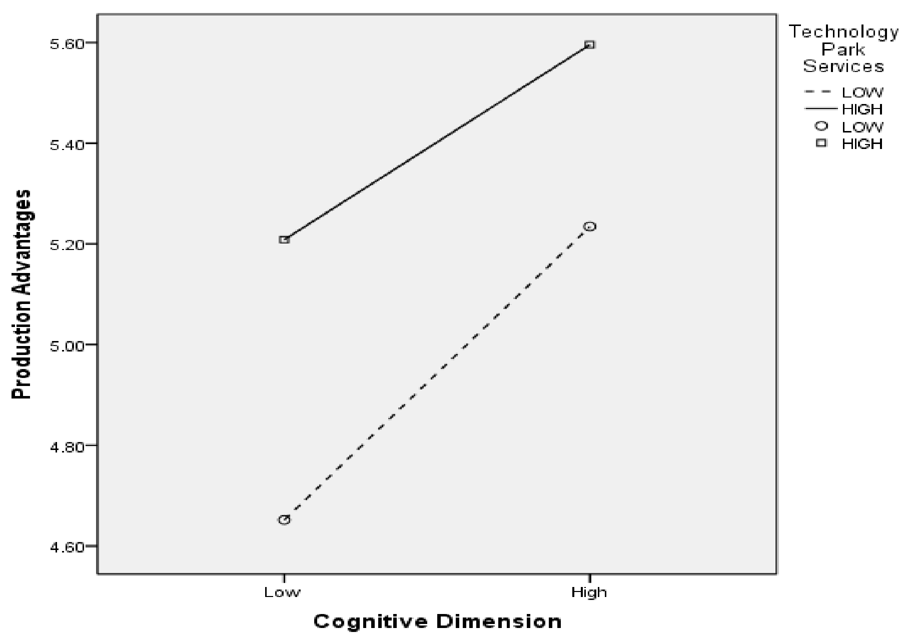

Figure 4.15
The Relationship between Cognitive Dimension and Production Advantages with Technology Park Services as Moderator

The graph demonstrated that Production Advantages increase with the increase of Cognitive Social Capital. However there are differences in the rate of change between when there are high Technology Park Services and when there are low Technology Park Services hence, Technology Park Services is considered as a pure moderator.

The effect size of technology park services on the relationship between cognitive dimension and business advantages is calculated as follows:

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2} = \frac{0.217 - 0.104}{1 - 0.217} = 0.14$$

The result shows a medium moderating impact ($f^2 = 0.14$; Cohen 1988) with significant beta changes ($\beta = -0.433$, $t = -3.265$). Consequently, it is confirmed that technology park services does moderate the relationship between cognitive dimension and business advantages, hence H_{5F} is supported. The relationship between cognitive dimension and business advantages with technology park services as moderator was plotted in graph as shown in Figure 4.16. The graph demonstrated that Business Advantages increase with the increase of Cognitive Social Capital. However there are differences in the rate of change between when there are high Technology Park Services and low Technology Park Services therefore, Technology Park Services also is considered as a pure moderator.

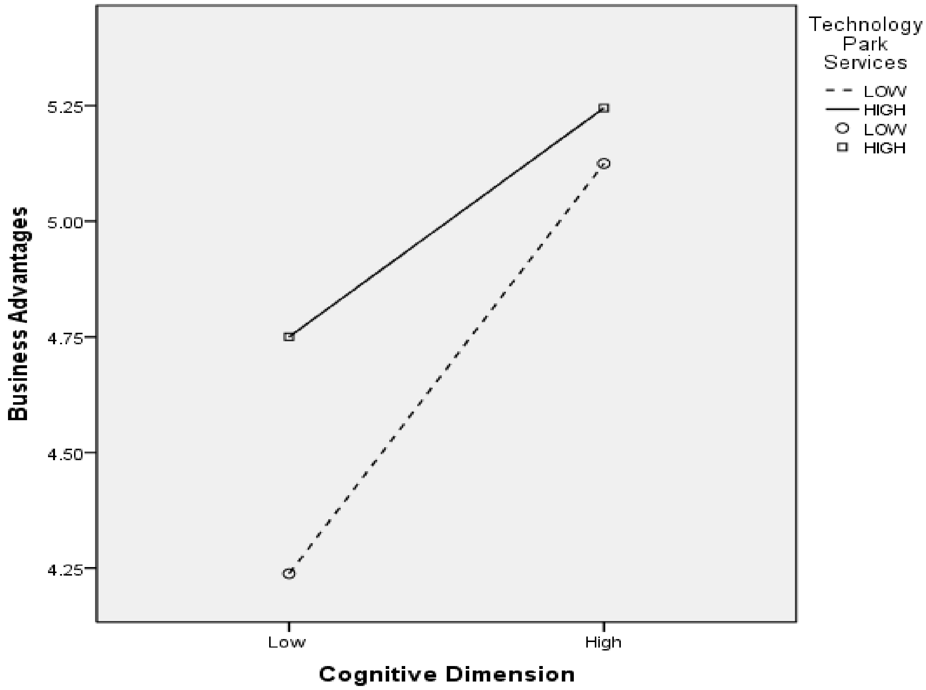

Figure 4.16
The Relationship between Cognitive Dimension and Business Advantages with Technology Park Services as Moderator

It is found that Technology Park Services has moderating effect on the relationship between Relational dimension and Technology Advantages; and relationship between Cognitive Dimension and Technology Advantages; relationship between Relational Dimension and Production Advantages; relationship between Cognitive Dimension and Production Advantages; relationship between Relational Dimension and Business Advantages; and relationship between Cognitive Dimension and Business Advantages. These findings support hypotheses $H_{5B,}$ $H_{5C,}$ $H_{5E,}$ $H_{5F,}$ $H_{5H,}$ and H_{51} while the others are not supported. The summaries of finding for Hypotheses 5 are provided in Table 4.32.

Table 4.32
Finding of the hypotheses H_5

Hypothesis	Hypothesis Statement	Remarks
	Moderating effect of Technology Park services on the relationship between Social Capital and Technology Transfer Performance	
H_{5A}	Technology park services moderate the relationship between structural networks and technology advantages.	Not Supported
H_{5B}	Technology park services moderate the relationship between relational and technology advantages.	Supported
H_{5C}	Technology park services moderate the relationship between cognitive and technology advantages.	Supported
H_{5D}	Technology park services moderate the relationship between structural networks and production advantages.	Not Supported
H_{5E}	Technology park services moderate the relationship between relational and production advantages.	Supported
H_{5F}	Technology park services moderate the relationship between cognitive and production advantages.	Supported
H_{5G}	Technology park services moderate the relationship between structural networks and business performance.	Not Supported
H_{5H}	Technology park services moderate the relationship between relational and business advantages.	Supported
H_{5I}	Technology park services moderate the relationship between cognitive and business advantages.	Supported

4.7.3.2 Moderating Effect of Technology Park Services on Relationship between Absorptive Capacity and Technology Transfer Performance

Table 4.33 and Table 4.34 show the multiple regressions results for the three dimensions of technology transfer performance as the criterions with the two dimensions of absorptive capacity and technology park services as predictors. In Table 4.33, Step 1 includes the control variable of potential capacity. Step 2 shows the change in F is not significant with technology park services. The beta value is 0.491, 0.287 and 0.201 for potential capacity and 0.086, 0.069 and 0.175 for technology park services. The adjusted R square is 0.251, 0.076 and 0.066. Hence, the predictive power to explain the criterions by the predictors is

25.1%, 7.6% and 6.6% for technology advantages, production advantages and business advantages respectively. Under Step 3, the introduction moderator variable results in significant F change for Business Advantage criterion. The adjusted R square is 0.109. Hence, the predictive power to explain the criterions by the predictors is 10.9%. However, there are no major effect from the moderator variable in the relationships between the predictors and the other two criterion variables (technology advantages and production advantages).

Table 4.33

Hierarchical Regression Result for Moderating Effect of Technology Park Services (Moderator) on the relationship between Potential Capacity (IV1) and Technology Transfer Performance (DV)

Variable	Technology Advantages (DV1)			Production Advantages (DV2)			Business Advantages (DV3)		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Potential Capacity	0.511	0.491	0.548	0.303	0.287	0.318	0.242	0.201	0.282
Technology Park Services		0.086	0.087		0.069	0.070		0.175	0.177
Potential Capacity x Technology Park Services			-0.168			-0.091			-0.241**
R Square	0.261	0.268	0.293	0.092	0.097	0.104	0.058	0.087	0.139
Adjusted R square	0.252	0.251	0.268	0.082	0.076	0.073	0.048	0.066	0.109
F Change	31.033	0.822	3.033	8.919	0.433	0.704	5.455	2.774	5.123
Sig. F. Change	0.000	0.367	0.085	0.004	0.512	0.404	0.022	0.099	0.026

*** p<0.001, **p<0.05, *p<0.1

The effect sizes of technology park services on the relationship between potential capacity and business advantages is calculated as follows:

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2} = \frac{0.139 - 0.058}{1 - 0.139} = 0.09$$

The result shows a small moderating impact ($f^2 = 0.09$; Cohen 1988) with significant beta changes ($\beta = -0.241$, $t = -2.263$). Consequently, it is confirmed that technology park services does moderate the relationship between potential capacity and business advantages, hence H_{6C} is supported. The relationship between potential capacity and business advantages with technology park services as moderator was plotted in graph as shown in Figure 4.17. The graph demonstrated that Business Advantages increase with the increase of Potential Absorptive Capacity. However there are differences in the rate of change between when there are high Technology Park Services and low Technology Park Services therefore, Technology Park Services is considered as a pure moderator.

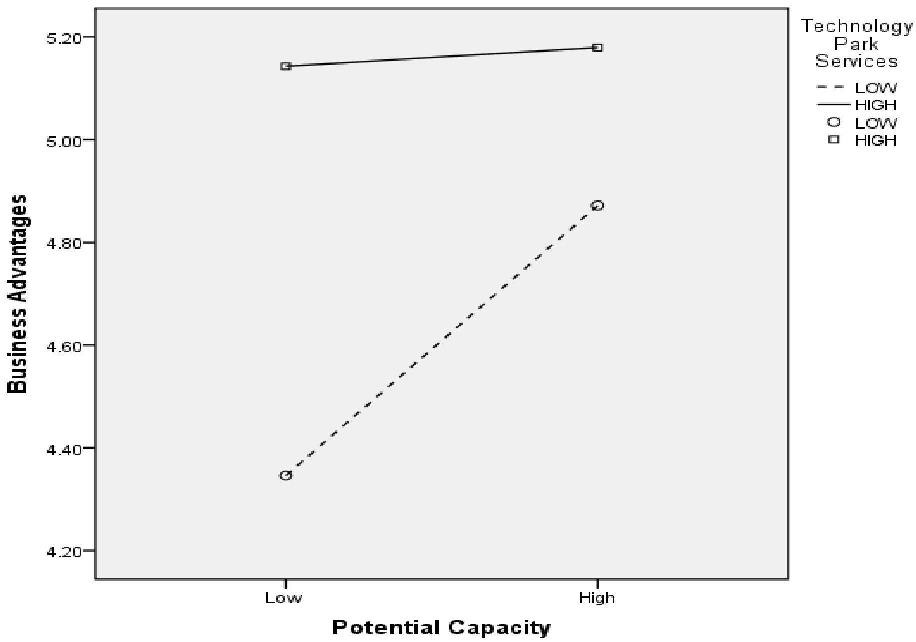

Figure 4.17
The Relationship between Potential Capacity and Technology Advantages with Technology Park Services as Moderator

In Table 4.34, Step 1 includes the control variable of realize capacity. Step 2 shows the change in F is not significant with technology park services. The beta value is 0.489, 0.286 and 0.335 for realize capacity and 0.064, 0.056 and 0.129 for technology park services. The adjusted R square is 0.243, 0.073 and 0.133. Hence, the predictive power to explain the criterions by the predictors is 24.3%, 7.3% and 13.3% for technology advantages, production advantages and business advantages respectively. Under Step 3, the introduction moderator variable results in significant F change for Technology Advantage criterion. The adjusted R square is 0.263. Hence, the predictive power to explain the criterions by the predictors is 26.3%. However, there are no major effect from the moderator variable in the relationships between the predictors and the other two criterion variables (production advantages and business advantages).

Table 4.34
Hierarchical Regression Result for Moderating Effect of Technology Park Services (Moderator) on the relationship between Realize Capacity (IV1) and Technology Transfer Performance (DV)

Variable	Technology Advantages (DV1)			Production Advantages (DV2)			Business Advantages (DV3)		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Realize	0.507	0.489	0.547	0.301	0.286	0.943	0.371	0.335	0.868
Technology Park Services		0.064	0.032		0.056	1.006		0.129	0.899
Realize x Technology Park Services			-0.177*			-0.110			-1.063
R Square	0.257	0.260	0.288	0.091	0.094	0.105	0.138	0.153	0.155
Adjusted R square	0.248	0.243	0.263	0.080	0.073	0.073	0.128	0.133	0.126
F Change	30.381	0.441	3.362	8.785	0.281	1.044	14.031	1.571	0.249
Sig. F. Change	0.000	0.509	0.074	0.04	0.597	0.310	0.000	0.213	0.619

*** p<0.001, **p<0.05, *p<0.1

The effect sizes of technology park services on the relationship between realize capacity and technology advantage is calculated as follows:

$$f^2 = \frac{R_{im}^2 - R_i^2}{1 - R_{im}^2} = \frac{0.288 - 0.257}{1 - 0.288} = 0.04$$

The result shows a small moderating impact ($f^2 = 0.04$; Cohen 1988) with significant beta changes (β = -0.177, t = -1.833). Consequently, it is confirmed that technology park services does moderate the relationship between potential capacity and technology advantages, hence H_{6D} is supported. The relationship between potential capacity and technology advantages with technology park services as moderator was plotted in graph as shown in Figure 4.18. The graph demonstrated that Technology Advantages increase with the increase of Realize Absorptive Capacity. However there are differences in the rate of change between when there are high Technology Park Services and low Technology Park Services. Therefore, Technology Park Services is considered as a pure moderator.

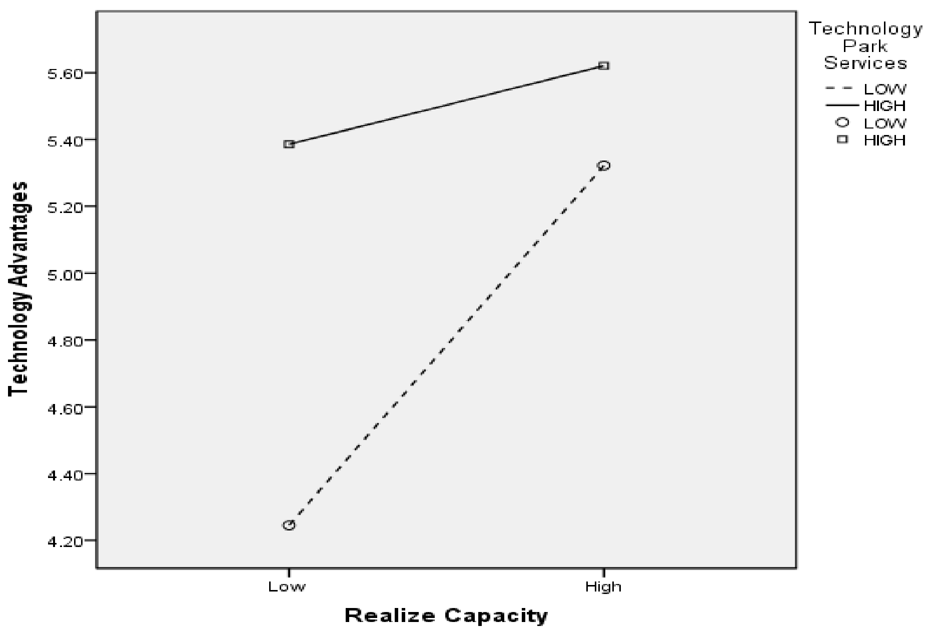

Figure 4.18
The Relationship between Realize Capacity and Technology Advantages with Technology Park Services as Moderator

It is found that technology park services has moderating effect on the relationship between potential capacity and business advantages, and relationship between realize capacity and technology advantages. These findings support hypotheses H_{6C} and H_{6D} while the others are not supported. The summaries of finding for Hypotheses 6 are provided in Table 4.35.

Table 4.35
Finding of the hypotheses H_6: Moderating effect of Technology Park services on the relationship between Absorptive Capacity and Technology Transfer Performance

Hypothesis	Hypothesis Statement	Remarks
H_{6A}	Technology park services moderate the relationship between potential capacity and technology advantages.	Not Supported
H_{6B}	Technology park services moderate the relationship between potential capacity and production advantages.	Not Supported
H_{6C}	Technology park services moderate the relationship between potential capacity and business advantages.	Supported
H_{6D}	Technology park services moderate the relationship between realize capacity and technology advantages.	Supported
H_{6E}	Technology park services moderate the relationship between realize capacity and production advantages.	Not Supported
H_{6F}	Technology park services moderate the relationship between realize capacity and business advantages.	Not Supported

4.8 Summary of the Chapter

The chapter has untaken the analysis and findings of this study. The geographic distribution among them is fairly distributed with main concentration on the four selected technology park in Malaysia. The validation of instrument was conducted through factor analysis to confirm the dimensions. After testing the reliability and the assumption for multivariate analysis were done, descriptive test was prepared. Finally, correlation test and regression tests were done to answer the hypothesized questions. Most of the findings under Pearson correlations were as expected and in concurrent with previous findings. The multiple regression results showed that several integrated dimensions of social capital and absorptive capacity contributed to the technology transfer performance. The mediator mediates several relationships between dimensions of social capital and dimensions of technology transfer performance. The moderator has moderating effects on some of the relationships between dimensions of social capital and dimensions of technology transfer performance; and the relationships between dimensions of absorptive capacity and dimensions of technology transfer performance. More discussion and conclusion in the next chapter will elaborate further on the result and their implication to the theory.

CHAPTER FIVE

DISCUSSIONS AND CONCLUSION

5.1 Introduction

This chapter is divided into nine different sections. It started with gaps of the study where the objectives of this study are reconsidered in section 5.2. Then, the third section provides discussion of the findings. It is covered under Section 5.3. These followed by section 5.4. This section consists of the implications of the study which are separated into theoretical, managerial and policy implications. This section followed by Section 5.5 which covers the limitation of the study. The next section is Section 5.6 which provides the suggestion for future research. The conclusion of the study is then covered in Section 5.7. It is follows by recommendation in Section 5.8. As a final point, section 5.9 summarizes the chapter.

5.2 Recapitulation of the Study

The main purpose of this study is to examine the influence of social capital, absorptive capacity and technology park services on technology transfer performances which can be divided into three broad objectives. First is to determine the direct effect of social capital and absorptive capacity on the technology transfer performance; second is to identify the mediating effect of absorptive capacity; and third is to confirm the moderating role of technology park services. The research framework of this study was supported by the Knowledge Based View (KBV) theory which specified that knowledge-based resources are usually hard to imitate and socially complex. It is embedded and carried through multiple entities including organizational culture and identity, policies, routines, documents, systems, and employees. In this study, technology is defined as the theoretical and practical knowledge, skills and artifacts that are used to develop a product as well as the production and delivery systems which can be embodied in people, materials, and physical process.

Data was collected through survey method. The sample used for this study is high technology companies those operate in four selected technology parks in Malaysia. The unit of analysis was organization with the managerial level such as managers, directors, executives, engineers and CEOs as the respondent to the mailed questionnaires. A total of 358 questionnaires were distributed. The response rate was 25% of the sample size.

Generally, factor analysis on the data gathered from high technology companies operate in the technology parks shows that social capital has three main dimensions those are structural, relational and cognitive. As well, absorptive capacity has four dimensions those are assimilation, acquisition, exploitation and transformation. These dimensions were categorized into potential absorptive capacity and realize absorptive capacity. The dependent variable, technology transfer performance emerged into three dimensions. The dimensions were renamed as technology advantages; product and process advantages; and business advantages. The moderating variable, technology park services also emerge into three dimensions.

In order to answer the research questions and to achieve the objectives of the study, Pearson correlation and regression analyses were utilized in the hypotheses testing. The results of the analyses established the importance of social capital and absorptive capacity to ensure high performance of technology transfer. There are mediating effects of absorptive capacity on the relationships between the dimensions of social capital and technology transfer performance. The results also proved that technology park services have effects on the strength of the relationships between the dimensions of social capital and technology transfer performance; as well as between absorptive capacity and technology transfer performance. Table 5.1 summarize of the hypotheses testing results of this study.

Table 5.1
Results of the Hypotheses Testing of the Study

Research question	Research objectives	Test of hypotheses			
What is the effect of social capital on technology transfer performance in the technology park incubating companies?	To determine the effect of social capital on technology transfer performance	H_{1A1}	SSC → TA	R = 0.773**	Supported
		H_{1A2}	RSC → TA	R = 0.657**	Supported
		H_{1A3}	CSC → TA	R = 0.519**	Supported
		H_{1B1}	SSC → PA	R = 0.507**	Supported
		H_{1B2}	RSC → PA	R = 0.406**	Supported
		H_{1B3}	CSC → PA	R = 0.288**	Supported
		H_{1C1}	SSC → BA	R = 0.380**	Supported
		H_{1C2}	RSC → BA	R = 0.220*	Supported
		H_{1C3}	CSC → BA	R = 0.323**	Supported
What is the relationship between dimensions of social capital and dimensions of absorptive capacity?	To determine the relationships between social capital and absorptive capacity	H_{2A1}	SSC→ PAC	R = 0.604**	Supported
		H_{2A2}	RSC → PAC	R = 0.530**	Supported
		H_{2A3}	CSC → PAC	R = 0.462**	Supported
		H_{2B1}	SSC → RAC	R = 0.539**	Supported
		H_{2B2}	RSC → RAC	R = 0.451**	Supported
		H_{2B3}	CSC → RAC	R = 0.557**	Supported
What is the effect of absorptive capacity on technology transfer performance in the technology park incubating companies?	To determine the effect of absorptive capacity on technology transfer performance	H_{3A1}	PAC → TA	R = 0.511**	Supported
		H_{3A2}	PAC → PA	R = 0.303**	Supported
		H_{3A3}	PAC → BA	R = 0.242*	Supported
		H_{3B1}	RAC → TA	R = 0.507**	Supported
		H_{3B2}	RAC → PA	R = 0.301**	Supported
		H_{3B3}	RAC → BA	R = 0.371**	Supported

Table 5.1 *Continue*

Does the absorptive capacity mediate the relationship between social capital and technology transfer performance?	To examine the mediating effect of absorptive capacity on the relationship between social capital and technology transfer performance (Potential Capacity)	H_{4A1}	SSC→PAC→TA	B = 0.069	Not supported
		H_{4A2}	RSC→PAC→ TA	B = 0.336**	Supported
		H_{4A3}	CSC →PAC → TA	B = 0.426***	Supported
		H_{4A4}	SSC→PAC→PA	B = -0.147	Not supported
		H_{4A5}	RSC→PAC→PA	B = 0.122	Not supported
		H_{4A6}	CSC→PAC→PA	B = 0.256*	Supported
		H_{4A7}	SSC→PAC→BA	B = -0.113	Not supported
		H_{4A8}	RSC→ PAC→BA	B = -0.124	Not supported
		H_{4A9}	CSC→PAC→BA	B = 0.118	Not supported
	(realize capacity)	H_{4B1}	SSC→RAC→TA	B = 0.127	Not supported
		H_{4B2}	RSC→RAC→TA	B = 0.349**	Supported
		H_{4B3}	CSC→RAC→TA	B = 0.428***	Supported
		H_{4B4}	SSC→RAC→PA	B = -0.075	Not supported
		H_{4B5}	RSC→RAC→PA	B = 0.148	Not supported
		H_{4B6}	CSC→RAC→PA	B = 0.259*	Supported
		H_{4B7}	SSC→RAC→BA	B = 0.128	Not supported
		H_{4B8}	RSC→ RAC→BA	B = 0.303**	Supported
		H_{4B9}	CSC→ RAC→BA	B = 0.277*	Supported

Table 5.1 *Continue*

Do the technology parks services moderate the relationship between social capital and technology transfer performance within technology park incubating companies?	To examine the moderating effects of the technology park services on the relationship of social capital and technology transfer performance.	H_{5A}	SSC → TA TPS ↑	B = -0.055	Not Supported
		H_{5B}	RSC → TA TPS ↑	B = -0.580***	Supported
		H_{5C}	CSC → TA TPS ↑	B = -0.652***	Supported
		H_{5D}	SSC → PA TPS ↑	B = 0.051	Not Supported
		H_{5E}	RSC → PA TPS ↑	B = -0.437***	Supported
		H_{5F}	CSC → PA TPS ↑	B = -0.553***	Supported
		H_{5G}	SSC → BA TPS ↑	B = 0.019	Not Supported
		H_{5H}	RSC → BA TPS ↑	B = -0.430**	Supported
		H_{5I}	CSC → BA TPS ↑	B = -0.433**	Supported
Do the technology parks services moderate the relationship between absorptive capacity and technology transfer performance within technology park incubating companies?	To examine the moderating effects of the technology park services on the relationship of absorptive capacity and technology transfer performance	H_{6A}	PAC → TA TPS ↑	B = -0.168	Not Supported
		H_{6B}	PAC → PA TPS ↑	B = -0.091	Not Supported
		H_{6C}	PAC → BA TPS ↑	B = -0.241**	Supported
		H_{6D}	RAC → TA TPS ↑	B = -0.177*	Supported
		H_{6E}	RAC → PA TPS ↑	B = -0.110	Not Supported
		H_{6F}	RAC → BA TPS ↑	B = -1.063	Not Supported

*** p<0.001, **p<0.01, *p<0.05

TA Technology Advantages
PA Production Advantages
BA Business Advantages
SSC Structural Social Capital
RSC Relational Social Capital
CSC Cognitive Social Capital
PAC Potential Absorptive Capacity
RAC Realize Absorptive Capacity
TPS Technology Park Services

5.3 Discussions on Hypotheses Testing Results

One of the fundamental arguments of this study is that firms operating in the technology parks are supposed to gain better performance of technology transfer, provided that they initiate themselves to construct proper social capital and having high absorptive capacity with the existence of technology park services. Empirically, this research focused on investigating whether social capital and absorptive capacity of a firm are beneficial to technology transfer performance and whether technology park services contribute in the success of technology transfer. The measurement of dependent variables (Technology Transfer Performance), independent variable (Social Capital), mediating variable (Absorptive Capacity) and moderating variable (Technology Park Services) is based on seven point scales, in which data are characterized as continuous.

5.3.1 The Effect of Social Capital on Technology Transfer Performance

The first objective was achieved through correlation test. The aim is to examine the relationship between social capital dimensions and technology transfer performance. The identification of the social capital in an organization is by looking at whether the company is connected internally; whether the critical people or teams or projects in the company connected internally; whether information flowing between these units of people exist; whether there are exchanging of knowledge; and whether knowledge of the environment flows into the right parties inside the company.

Overall the results proven and confirmed that the social capital is useful, meaningful and significantly contribute to Technology Transfer Performance. The positive influence of social capital reveal from this study is in correlation with some previous studies on social capital and performance relationship, for example Khan, Quaddas and Rowe (2013); Anderson, Forsgren, and Holm (2002) and Park and Luo (2001). Since all the dimensions of Social Capital have significantly positive impacts on the Technology Transfer Performance, this implies that companies those have high level of structural, relational and cognitive dimensions of social capital will improve the performance of their technology transfer.

Figure 5.1 demonstrates the relationships between the dimensions of social capital and technology advantages. The significance levels are at $p<0.01$. This result shows that social capital dimensions create ample contributions to explain the technology transfer performance on the aspect of technology advantages. Technology advantages was measured in terms of the increasing of the capability of the workers and the organization such as the ability to manage the acquired technology, the ability to manage new technology transfer programs, the ability to achieve planned goal and increasing in management skills.

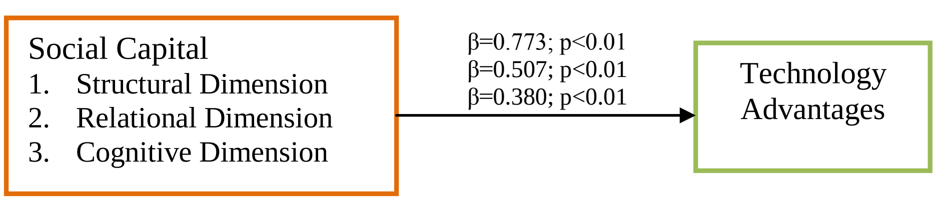

Figure 5.1
Relationships between Social Capital Dimensions and Technology Advantages

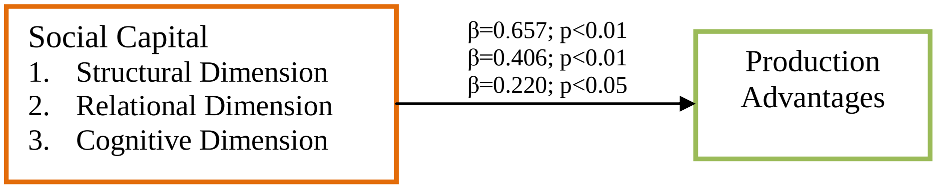

Figure 5.2
Relationships between Social Capital Dimensions and Production Advantages

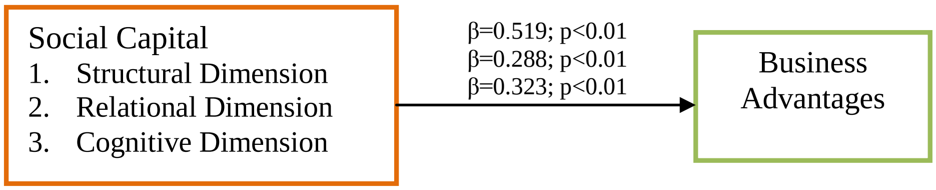

Figure 5.3
Relationships between Social Capital Dimensions and Business Advantages

Figure 5.2, shows the relationships between the dimensions of Social Capital and Production Advantages are positively significance with $p < 0.001$ for Structural Dimension and Relational Dimension while the relationship between Cognitive Dimensions with Production Advantages is significant with $p<0.05$. Figure 5.3 represents the relationships between the dimensions of Social Capital and Business Advantages. The significance levels are at $p < 0.001$. This result shows that Social Capital dimensions also create a great contribution to explain the Technology Transfer Performance on the aspect of Business Advantages. These results indicated that, the three dimensions of social capital have significant contribution in these activities, especially in terms of the networks connectivity or organizational relationships. These results supported Rahmani and Mousavi (2011) who proposed that the involvement of social capital in technology transfer will reduce transaction costs among firms and among firms and other actors, particularly search and information costs, bargaining and decision costs, policing and enforcement costs which contribute to the success of technology transfer.

It is found that structural dimension has the highest influence on the three measured aspects of technology transfer performance. These indicated that social interaction such as network connectivity, network patterns, and organization relationships are important to ensure the success of technology transfer. This finding is coordinated with Li and Zhu (2009) and Gulati, Nohria and Zaher (2000), who emphasized that the structural pattern of a firm's relationships is beneficial to knowledge transfer. The finding confirmed that social capital makes a very good contribution to explain the Technology Transfer Performance. These findings also support the findings of prior research (Rad et. al, 2011; Hsu et al, 2007; Watson and Hewett, 2006; Chiu et al., 2006) that observes a positive significant relationships between social capital dimensions and sharing of knowledge which is the vital aspect of technology transfer.

5.3.2 The Effect of Social Capital on Absorptive Capacity

The second objective of present study is about the relationship between Social Capital and Absorptive Capacity. Social capital is about the firms' quality and quantity of social interaction such as relationship, networks and norms (Gamarnikow, 2011) while absorptive capacity is about an edifice of routines or the firms' ability through which they acquires, assimilates, transform and exploit the technological knowledge (Selmi, 2013). The results show strong and linear relationship between the dimensions of Social Capital and Absorptive Capacity. Figure

5.4 implied the relationships between the dimensions of Social Capital and Potential Capacity. The significance levels are at p < 0.001. This result shows that Social Capital dimensions also create high influence on Potential Capacity.

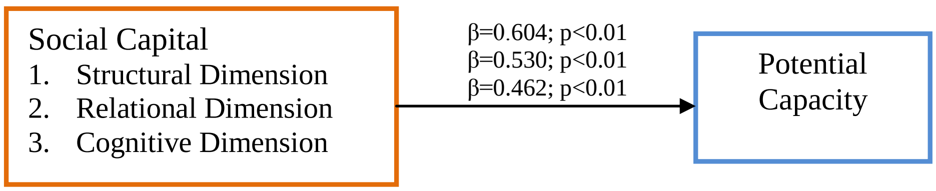

Figure 5.4
Relationships between Social Capital Dimensions and Potential Capacities

Figure 5.5 represents the relationships between the dimensions of Social Capital and Business Advantages. The significance levels are at p < 0.001. This result shows that social capital dimensions also create a great influence on Realize Capacity.

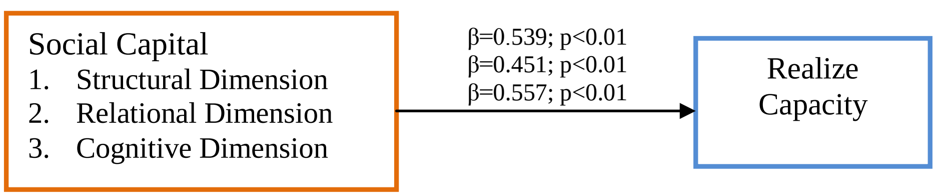

Figure 5.5
Relationships between Social Capital Dimensions and Realize Capacity

The findings validate that the three dimensions of social capital have significantly positive relationships with both potential absorptive capacity and realize absorptive capacity. The results aligned Rahmani and Mousavi (2011) who proposed that social capital has impact on absorptive capacity.

5.3.3 The Effect of Absorptive Capacity on Technology Transfer Performance

The third objective of present study is about the relationship between Absorptive Capacity and Technology Transfer Performance. Overall the finding indicated absorptive capacity is positively related to the performance of technology transfer. This result support previous studies (Junni & Sarala, 2013; Daghfous, 2004) which emphasizes that firms' absorptive capacity helps them to participate in technology transfer activities as knowledge and learning support technology transfer.

Figure 5.6 represents the relationships between the dimensions of Absorptive Capacity and Technology Advantages. The significance levels are at $p < 0.001$. This result shows that two dimensions of Absorptive Capacities also create a medium contribution to explain the Technology Transfer Performance on the aspect of Technology Advantages.

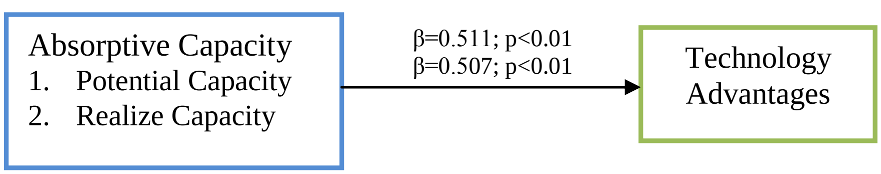

Figure 5.6
Relationships between Absorptive Capacity Dimensions and Technology Advantages

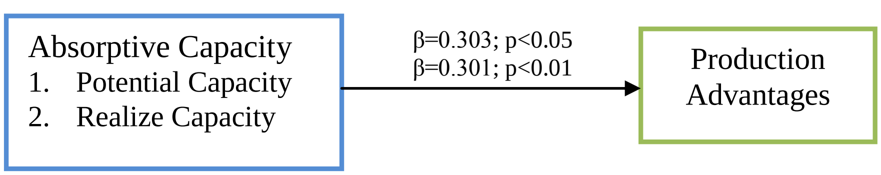

Figure 5.7
Relationships between Absorptive Capacity Dimensions and Production Advantages

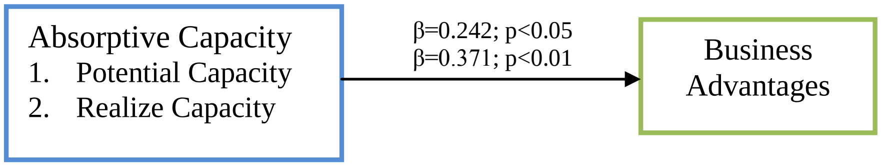

Figure 5.8
Relationships between Absorptive Capacity Dimensions and Business Advantages

Appointing to Figure 5.7 and Figure 5.8, it is found that Potential Capacity has significant relationships with Production Advantages and Business Advantages with $p < 0.05$ while the Realize Capacity has significant relationship with Production Advantages and Business Advantages with $p<0.001$. The strength of their relationship is small to moderate, with *r* between 0.242 – 0.371. These results sustenance prior study by Kumar, et al. (1999), it confirms that absorptive capacity assists the process of technology transfer. These findings also align with previous scholars who highlighted absorptive capacity as factor in innovation process such as technology diffusion and knowledge transfer performance of a firm (Lin, Tan & Chang, 2002; Cohen & Levinthal, 1989).

5.3.4 The Effect of Absorptive Capacity on the Relationship between Social Capital Dimensions and Technology Transfer Performance

This section discussed the results of the interaction effects of absorptive capacity on the relationship between the dimensions of social capital and technology transfer performance. Four steps to establish mediation proposed by Baron and Kenny (1986) were performed. From Step 1 it is found that all dimensions of social capital (Independent Variables) have significant positive impacts on the entire dimension of technology transfer performance

(Dependent Variables). The relationships between dimensions of social capital and technology transfer performance are the compulsory relationship to be proven by the data set in determining mediator variables. In Step 2, the relationship between the dimensions of social capital (Independent Variables) and potential capacity (Mediating Variable 1) and realize capacity (Mediating Variable 2) were examined. These relationships also are vital to be proven by the data set in order to test mediating effect. The result reveals that social capital dimensions have strong positive relationship with potential capacity and realize capacity potential. Step 3 is to show that Potential Capacity and Realize Capacity (Mediating Variables) effect the dimensions of Technology Transfer Performance (Dependent Variables) with the dimensions of Social Capital (Independent Variable) being controlled to establish the mediating effect of mediators which is Step 4. Hence, the estimation of the effects of Step 3 and Step 4 are delivered in the same equation.

The focus on absorptive capacity as a mediating variable is warranted due to it being the fundamental element in technology transfer as it involved the firms' ability to acquire and assimilate technological knowledge (Noor, 2010; Zahra & George, 2002). Overall the results on the examination of mediating effect of absorptive capacity represented that both potential and realize absorptive capacity have effect on the realization and cognitive dimensions of social capital. These indicated that quality of social interaction among members in the networks and the common norms or general belief may contribute to the performance of technology transfer with the presence of absorptive capacity. Figure 5.9 to Figure 5.11 demonstrates the results of each step in establishing the mediating effect of potential capacity on the relationships between Social Capital dimensions and Technology Transfer Performance dimensions.

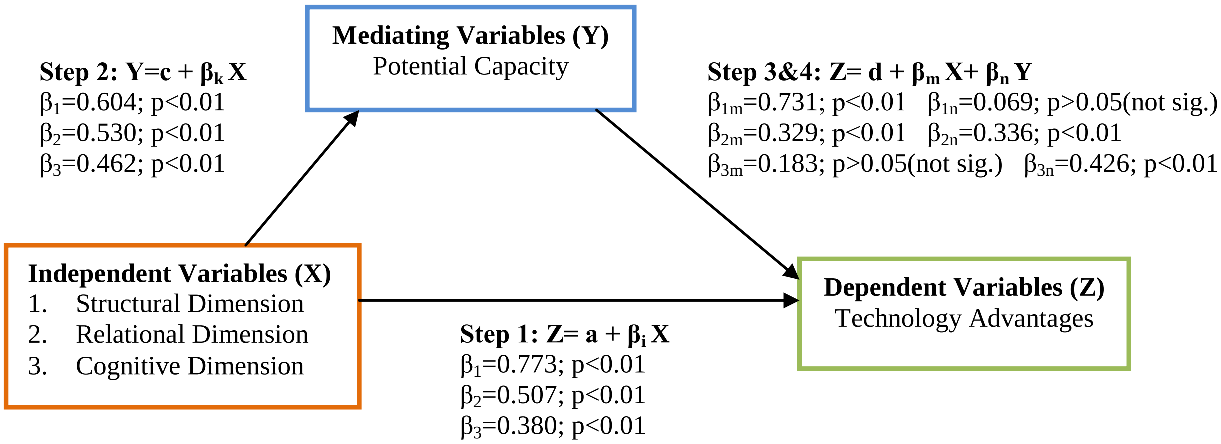

Figure 5.9
Mediation of Potential Capacity on Social Capital Dimensions and Technology Advantages

Figure 5.9 reveals that all the relationships are significant in Step 1 and Step 2 which tolerate the analysis to proceed to Step 3 and Step 4. In step 3 and 4, when Relational Dimension and Potential Capacity are regressed together on Technology Advantages, Potential Capacity is significant (β_{2n}=0.336; $p<0.01$) fulfilling Step 3. Besides, Relational Dimension also significant (β_{2m} = 0.329; $p<0.01$). The results proved that there are partial mediating effects of Potential Capacity on the relationship between Relational Dimension and Technology Advantages. As well, when Cognitive Dimension and Potential Capacity are regressed together on Technology Advantages, Potential Capacity is significant (β_{3n}=0.426; $p<0.01$) fulfilling Step 3, while Cognitive Dimension is not significant (β_{3m}=0.183; $p>0.05$(not sig.). Consequently, Potential Capacity was proven to be a full mediator between Cognitive Dimension and Technology Advantages. On the other hand, Potential Capacity does not have any significant influence on Technology Advantages when regressed together with Structural Dimension.

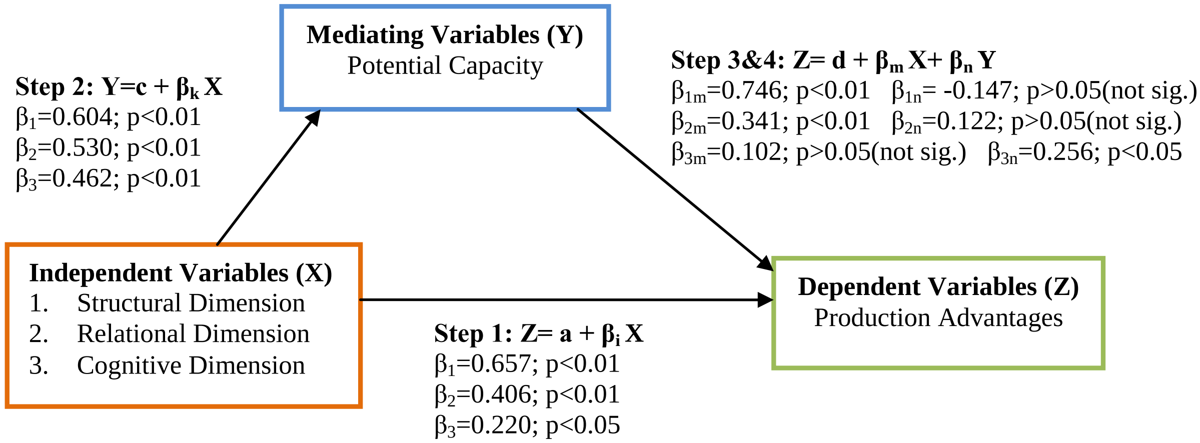

Figure 5.10
Mediation of Potential Capacity on Social Capital Dimensions and Production Advantages

From Figure 5.10, since all the relationships are significant in Step 1 and Step 2 the analysis was proceed to Step 3 and Step 4. Potential Capacity was proven to be a full mediator between Cognitive Dimension and Production Advantages. This conclusion was derived based on the result of regression which indicated that Potential Capacity has significant influence on Production Advantages (β_{3n}=0.256; $p<0.05$) while Cognitive Dimension does not have significant influence on Production Advantages (β_{3m}=0.102; $p>0.05$) which supporting H_{4A6}. Potential Capacity does not have any significant effect on production advantages when regressed together with Structural Dimension and Relational Dimension (β_{1n}= -0.147; $p>0.05$; β_{2n}=0.249; $p>0.05$).

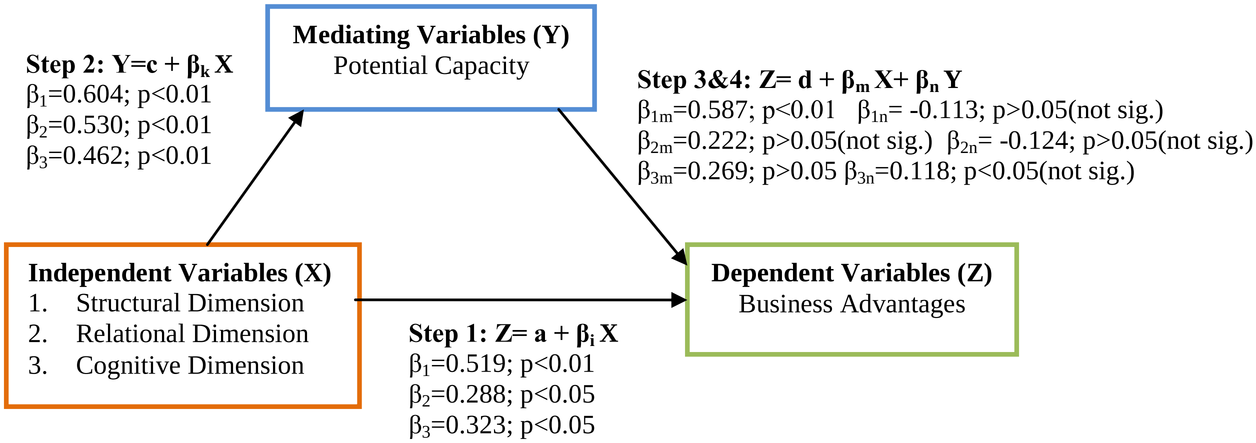

Figure 5.11
Mediation of Potential Capacity on Social Capital Dimensions and Business Advantages

Figure 5.11 shows that in step three and four when the three dimensions of social capital were regressed together with potential capacity on each dimensions of technology transfer performance, potential capacity does not have significant influence on the three dimensions of technology transfer performance. Therefore, it can be concluded that Potential Capacity does not mediate the relationships between social capital dimension and technology transfer performance.

Figure 5.12 to Figure 5.14 demonstrates the results of each step in establishing the mediating effect of Realize Capacity on the relationships between Social Capital dimensions and Technology Transfer Performance dimensions.

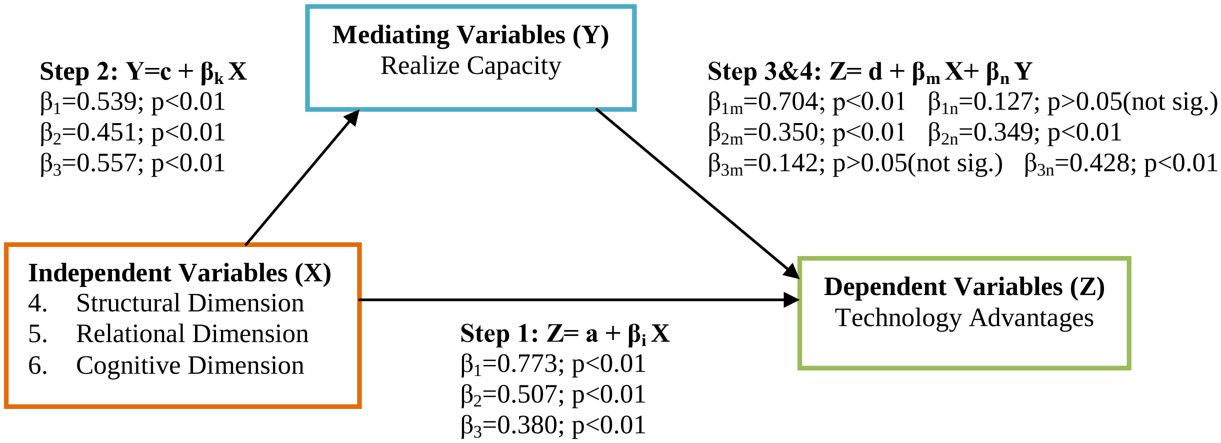

Figure 5.12
Mediation of Realize Capacity on Social Capital Dimensions and Technology Advantages

Figure 5.12 discloses that all the relationships are significant in Step 1 and Step 2 which tolerate the analysis to proceed to Step 3 and Step 4. In step 3 and 4, when Relational Dimension and Realize Capacity are regressed together on Technology Advantages, it reveals that Realize Capacity and Relational Dimension have significantly fulfilled step 3 with (β_{2n}=0.349; p<0.01) and (β_{2m} = 0.350; p<0.01) respectively. The result proven that there is partial mediating effects of Realize Capacity on the relationship between Relational Dimension and Technology Advantages. Furthermore, when Cognitive Dimension and Realize Capacity are regressed together on Technology Advantages, Realize Capacity is significant (β_{3n}=0.426; p<0.01) in fulfilling Step 3 while Cognitive Dimension is not significant (β_{3m}=0.183; p>0.05(not sig.). Consequently, potential capacity was proven to be a full mediator between cognitive dimension and technology advantages. On the other hand, Realize Capacity does not have any significant influence on Technology Advantages when regressed together with Structural Dimension.

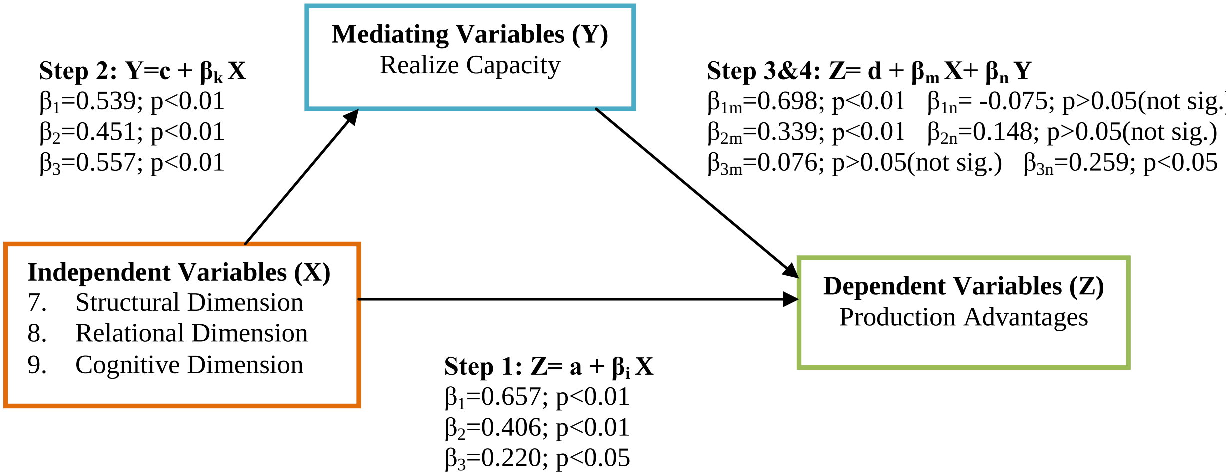

Figure 5.13
Mediation of Realize Capacity on Social Capital Dimensions and Production Advantages

From Figure 5.13, since all the relationships are significant in Step 1 and Step 2 the analysis was proceed to Step 3 and Step 4. Realize Capacity was proven to be a full mediator between Cognitive Dimension and Production Advantages. This conclusion was derived based on the result of regression which indicated that Realize Capacity has significant influence on Production Advantages (β_{3n}=0.259; $p<0.05$) while Cognitive Dimension does not have significant influence on Production Advantages (β_{3m}=0.076; $p>0.05$). Realize Capacity does not have any significant effect on production advantages when regressed together with Structural Dimension and Relational Dimension (β_{1n}= -0.075; $p>0.05$; β_{2n}=0.148; $p>0.05$).

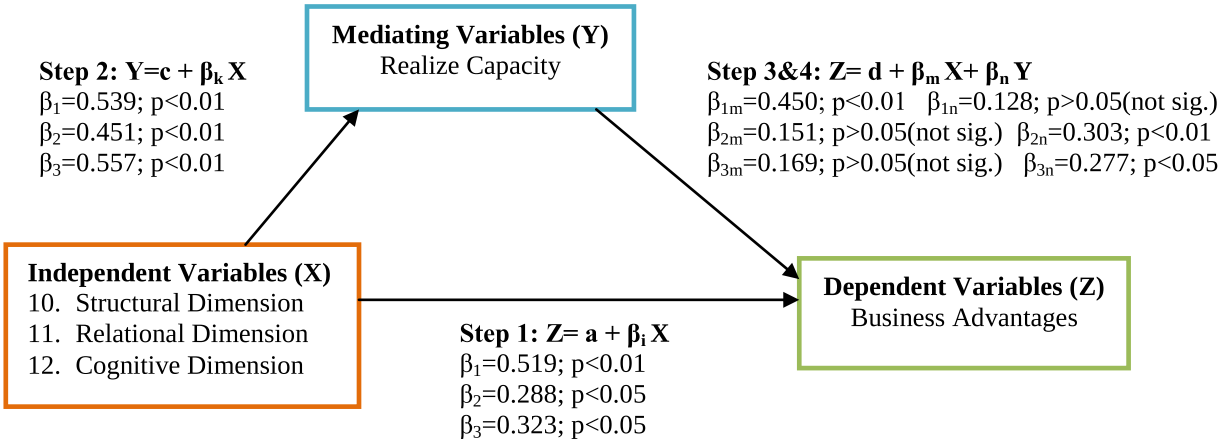

Figure 5.14
Mediation of Realize Capacity on Social Capital Dimensions and Business Advantages

Figure 5.14 reveals that all the relationships are significant in Step 1 and Step 2 which tolerate the analysis to proceed to Step 3 and Step 4. In step 3 and 4, when Relational Dimension and Realize Capacity are regressed together on Business Advantages, Realize Capacity is significant (β_{2n}=0.303; p<0.01) in fulfilling Step 3 besides, while relational dimension is not significant (β_{2m} = 0.151; p>0.05). The result has proven that there are full mediating effects of Realize Capacity on the relationship between Relational Dimension and Business Advantages. As well, when Cognitive Dimension and Realize Capacity are regressed together on Business Advantages, Realize Capacity is significant (β_{3n}=0.277; p<0.05) fulfilling Step 3 while Cognitive Dimension is not significant (β_{3m}=0.169; p>0.05(not sig.). Therefore, Realize Capacity was proven to be a full mediator between Cognitive Dimension and Technology Advantages. Instead, Realize Capacity does not have any significant influence on Business Advantages when regressed together with Structural Dimension. The results aligned Rahmani and Mousavi (2011) who proposed that social capital and absorptive capacity have influence on the competitive advantage of the firms.

5.3.5 The Moderating Effect of Technology Park Services

Other prime objectives of this study are regarding the test on the moderating effect of technology park services on the relationship between the social capital dimensions and technology transfer performance dimensions; and the test on the moderating effect of technology park services on the relationship between the absorptive capacity dimensions and technology transfer performance dimensions. Viewing as the partial framework, Figure 5.15 and Figure 5.16 represent the situations.

As a whole, it was found that Technology Park Services significantly moderate the relationships between two of the dimensions of Social Capital (relational and cognitive) and dimensions of Technology Transfer Performance. Technology Park Services also found to moderate relationship between Potential Capacity and Business Advantages; and Realize Capacity and Technology Advantages.

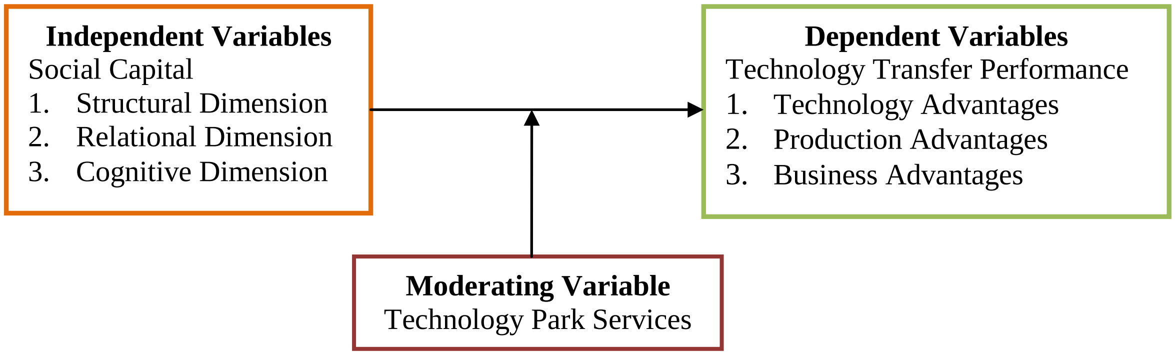

Figure 5.15
Moderating Effect of Technology Park Services on Social Capital Dimensions and Technology Transfer Performance Dimensions

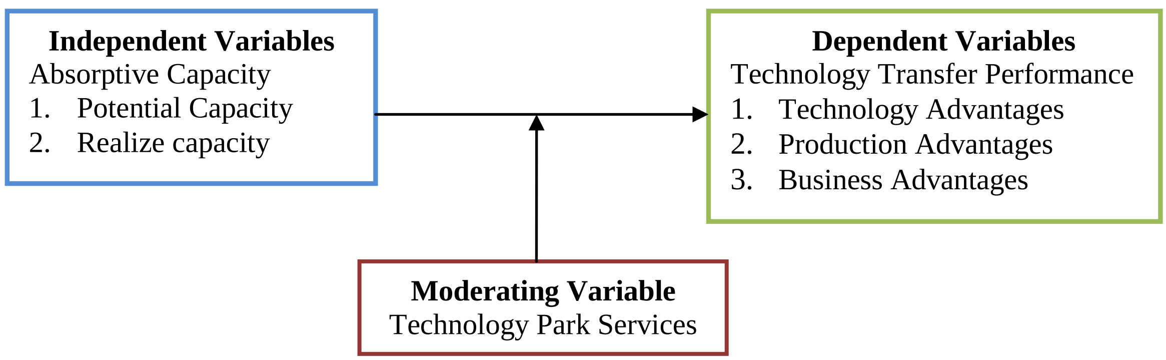

Figure 5.16
Moderating Effect of Technology Park Services on Absorptive Capacity Dimensions and Technology Transfer Performance Dimensions

By inclusion of Technology Park Services into the Social Capital dimensions and Absorptive Capacity dimensions will enhance the process as it adds value to the existing networks. Thus, these combinations provide an answer to the argument advances by previous authors (Suhaimi and Sharif, 2008; Lofsten and Lindelof, 2005; Lofsten and Lindelof, 2003) which argued whether the technology park has effect in increasing technology transfer performance.

5.4 Implication of the Study

The framework of this study has laid the groundwork not only to address the impact of social capital and absorptive capacity on technology transfer performance but also illustrated the influence of technology park services of these relationships. This research creates some contributions to the body of knowledge relating to technology transfer as well as to practitioners who are working on the tasks that relating to knowledge management and human resources especially in those involve in the development and operating in technology parks.

5.4.1 Theoretical Implication

This study supports knowledge-based view (KBV) theories. The knowledge-based theory's proponent argues that knowledge-based resources are usually difficult to imitate and socially complex, therefore, diverse knowledge foundations and capabilities among firms are the main determinants of sustained competitive advantage and higher corporate performance. Since the most important thing for the success of technology transfer is the transfer of soft aspect of the technology such as knowledge and skill, the argument acknowledged in this study was social capital and absorptive capacity indeed significantly influence technology transfer performance and their relationships were moderated by technology park services. In other word, this study believes that the firms' ability to reach high level of transferred technology would be influenced by the firms' resources which are social capital and absorptive capacity. While the effects of these factors on technology transfer performance are influenced by the technology park services.

This study advances our knowledge about how social capitals' creation in an organization may assist in the performance of the technology transferred. Social capital reflects the character of social relationships within an organization. Results of this study confirmed that social capital is an essential factor towards high performance of technology transfer. The result verified that structural capital which refers to social interactions such as networks types and strength of ties among the knowledge workers is very important. Besides that, the transfer of technological knowledge will become easier and more successful if the knowledge workers are sharing same unique language, and narratives that are commonly known and understood. These elements described the cognitive capital of social capital. Additionally, the results confirmed that the element such as trust, norms, obligations and identity of the knowledge worker also contributed in assisting the success of technology transfer.

Absorptive capacity refers to the ability of firms to identify external resources towards the implementation of the strategic posture and using inner strength for the purpose of achieving their competitive advantage. Strength lies in its ability to absorb these resources based on their stock of knowledge. With a high absorptive capacity, it is expected that firms can fully absorb the technology transferred. Besides, with the resources and capabilities, firms are able to identify and transform technology into their winning strategy.

With a high social capital and absorptive capacity together with technology to suit their operations, firms are able to develop their own competencies and capabilities.

The findings verified the connection of social capital, absorptive capacity and technology park service's impact on the transferred technology. The findings in this study demonstrated that it is important for a firm to have sufficient social capital and absorptive capacity for the success of technology transfer performance. Therefore, this study supports the resource-based theories and knowledge-based theory. Furthermore, the study discloses that the dimensions of social capacity and absorptive capacity explain the success of technology transfer. Hence, taking into account only the social capital or absorptive capacity alone is not enough to understand the advancement of technology transfer. The integrated variables of social capital and absorptive capacity are crucial to the firms. Additionally, other factors such as technology park services also have contribution in enhancing the success of technology transfer.

5.4.2 Practical Implication

The result indicates that among the dimensions of social capital, structural dimension is found to have the strongest association with the three dependent variables. This indicates that firms which have created a favorable context in the relationship between organizational leverage are potentially to achieve better performance in the transfer of technology from firms that do not practice it. Therefore, firms need to focus on all dimensions of social capital and absorptive capacity as they relate significantly with technology transfer performances. It also found that social capital has significant influence on absorptive capacity. Consequently, to enhance the level of absorptive capacity of the firm, it is important for the firm to improve the internal social capital. The improvement of social capital can be done from the aspect of organizational context and managerial behavior and social competence. The following are recommendations of this study to firms.

i. Firms need to develop social capital and absorptive capacity by investing in a combination of skilled and general ideas. They should increase experiential training to enhance the confidence level among team members and to increase staffs' absorptive ability.

ii. Firms should construct a close social network to improve technology transfer in terms of technological knowledge and to promote informal technological knowledge transfer among units, divisions and individuals. They can increase and enhance relation among units and individuals by providing space and technical support for knowledge transfer.

iii. Firms should build trustful organizational culture to strengthen the communication and cooperation of individual to increase better understanding. They must align their planning and strategy to suit their own capabilities.

iv. Firms should cultivate an atmosphere to encourage knowledge sharing inside the company and knowledge transferring among all staffs.

v. Firm should encourage their staff to build professional associations in accordance with their interest to increase the stock of knowledge and to improve quality of transferring knowledge.

Additionally, the results also point out that technology park services have significant indirect contribution in enhancing the performance of technology transfer. Therefore, to increase the success of technology transfer within the firms operating in the technology park areas, the technology parks management should build interactions at the grass root levels by making regular meetings and gatherings amongst tenants of the technology park, government officials, and the community to open communication channels. The technology parks management should help the firms by creating a comprehensive and sustainable development on the long run.

5.4.3 Policy implications

To ensure that the transferred technology is able to bring great benefits in the long run, firms and government play important role. All parties involved need to work together to help firms (and people) to develop social capital and increase the capabilities needed to get the most out of the transferred technology. The establishment of technology parks by the government seeks to accelerate diffusion of technology and to enhance the competitive position of users. The findings show that technology park play a unique role in facilitating the success of technology transfer of the firms.

5.5 Limitation

This study has several limitations. First, it does not offer a rigorous examination on the relationship of technology park services on each of the variables studied. The study did not consider the influence of each dimension of technology parks services on the relationship between social capital and technology transfer performance. It also did not consider the influence of each dimension of technology parks services on the relationship between absorptive capacity and technology transfer performance. The other limitation is regarding the sample of this study. There are two aspects that need to be concerned, those are sample frame and sample size. The sample frame was the high technology industry operating in Malaysia technology parks. Technology park areas are provided with various and advance facilities and activities. Therefore, the result cannot be generalized to another industry due to the differences in the type of technology they used and special location which provided with high technology facilities. In terms of sample size, the response rate of this study is limited, this constrain rigorous test on the data. Thus, the result cannot be generalized to all industries.

5.6 Direction for Future Research

This study revealed the importance of some of social capital and absorptive capacity dimensions in affecting the technology transfer performance. Further studies could put attention on larger sample size to discover the other dimensions suggested in this study. Besides, the sample of this study was derived from high technology industry. It is suggested that using service industries will add more insight on the usefulness of social capital and absorptive capacity dimensions. The differences between high technology industries and service industries possibly occur in terms of the structural and condition of competition. Kato (2010) found that there are differences between manufacturing and services sectors that should not be ignored as the differences conceivably give significant bias to the policy inference. Therefore, examining the role of social capital and absorptive capacity in service industries will provide more knowledge in this area of analyses.

Probably, using focused group and comparative study will add richness to the area of interest. The implementation of focused group method together with other methods could generate discussion among participants. Group interaction process will generate collaborative interpretation of the findings and broaden the base of understanding. Besides that, using comparative approach may also provide the key to understanding, explaining and interpreting diverse outcomes of the previous findings. The comparison can be made across the location of the firms operating, in the technology parks or outside the technology parks; the countries; cultural; political and social systems etc.

This study also pointed the role of Technology Park services in moderating the transfer performance. Further study could test more on the role of the variables studied especially the technology park services as the impact of technology park services on the firms is still at infancy stage. This study provides an early result as foundation information for study on technology park services effect on technology transfer performance.

5.7 Conclusion

This study was designed to investigate the effect of social capital, absorptive capacity and technology park services on technology transfer performance. In this investigation, this study has achieved its four main objectives; the first main objective was seek to determine the direct influence of each dimension of social capital and absorptive capacity on the performance of technology transfer; the second was to determine the relationships between each dimension of social capital and absorptive capacity; thirdly, this study intended to determine the mediating role of absorptive capacity on the relationship of social capital and technology transfer performance; and the fourth main objective was to determine the moderating role of technology park services.

The first part of the investigation on the first main goal reveals that all dimensions of social capital and absorptive capacity have significantly positive influence on technology transfer performance. It was establish that among the three dimensions of social capital namely structural dimension, relational dimension and cognitive dimension; the structural dimension has the highest impact on technology transfer performance. As well, the influence of two dimension of absorptive capacity namely potential capacity and realize capacity are almost the same. Both of them have significantly influence the technology transfer performance in positive way.

In the second part of the investigation, the study confirmed that social capital dimensions have positive significant influence on absorptive capacity. In the third part of the investigation, the influence of absorptive capacity on technology transfer performance also show positive and significant results. The significant relationships in the first, second and third part of the investigation established the existing of zero-order relationships among the variables which show the possibility of the existing of mediating role. This study has explained the central importance of absorptive capacity in the relationship between social capital and technology transfer performance by confirming that realized and potential absorptive capacity mediate the relationship between social capital and technology transfer performance.

One of the more significant findings to emerge from this study is the moderating role of technology park services. The indirect effect of technology park services is also considered essential to enhance the effectiveness of technology transfer. Therefore, the technology parks management should put more effort to conduct more activities that will enhance the social capital and absorptive capacity of the firm operating in the technology park areas. The result of this study thus suggests that for firm to get the most out of the transferred technology, firms need to strategize its social capital and capacities to absorb the technology. Consequently, this would circumvent laboring on insufficient activities that will not improve firms' competitiveness. The internal competencies of the firms can become inimitable if the firms improve their social capital and keep on learning which eventually leads to an increase in their absorptive capacity.

PUBLICATIONS FROM THE STUDY

Journals

1. Abidin, R., Hasnan N. & Abdullah C. S. (2010), Technology Park Performance: The Effectiveness of Technology Transfer. *Journal of Technology and Operations Management*. Vol 5. No. 1, 8 pages.

2. Rahimi Abidin, Norlena Hasnan, Che Sobry Abdullah, Shahimi Mohtar and Faisal Zulhumadi (2013), "Relationship between Social Capital and Technology Transfer Performance: A study on Companies in Technology Park," *Journal of Southeast Asian Research,* Vol. 2013 (2013), Article ID 116724, DOI: 10.5171/2013.116724

3. Rahimi Abidin, Norlena Hasnan, Nor Hasni Osman, Che Sobry Abdullah and Shahimi Mohtar (2014), "Technology Park Services: The Impact on Incubating Companies," *Journal of Southeast Asian Research,* Vol. 2014 (2014), Article ID 674095, DOI: 10.5171/2014.674095

International conferences

1. Abidin R., Abdullah, C. S., & Hasnan, N. (2012). Review on the Relationship of Social Capital, Absorptive Capacity and Technology Transfer Performance: a Conceptual Framework. *Proc. 3rd Int. Conference on Technology and Operation Management, Bandung, pp 248-255.*

2. Abidin R., Abdullah C. S, Hasnan N. Mohtar S. & Zulhumadi F. (2013). Social Capital and Technology Transfer Performance in Technology Park Incubating Companies. *Proc. 20th IBIMA 2013 Conference, Entrepreneurship Vision 2020: Innovation, Development Sustainability, and Economic Growth*, Kuala Lumpur, Malaysia pp 1155-1162.

3. Abidin R., Abdullah C. S, Hasnan N. Mohtar S. & Osman N. H. (2013). The Impact of Technology Parks Services on the High Technology Industry: A Case Study on Kulim Hi-Tech Park. *Proc. 20th IBIMA 2013 Conference, Entrepreneurship Vision 2020: Innovation, Development Sustainability, and Economic Growth*, Kuala Lumpur, Malaysia pp 1147-1154.

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